

Effects of Fire on the Ecology of the California Gnatcatcher, *Polioptila californica*, in California Sage Scrub Communities

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Abstract. The California gnatcatcher occurs in the disappearing sage scrub communities of southern California and Baja California, Mexico. Fire is an integral part of this community, but its effects on the gnatcatcher are unknown. By determining density and productivity of gnatcatchers on burned and unburned coastal and inland sites, we can evaluate the relationship between bird utilization of coastal sage scrub and fire history in southern California. Coastal and inland sites which burned in 1990 have been monitored since 1992; there are unburned control areas near each site. About 20 pairs of gnatcatchers use one coastal control, and 14 pairs another, or about 2 pairs per ha. Burned coastal sites supported 4 pairs and 2 pairs respectively in 1994 and 1995, or about 0.2 pair per ha. The mean percent of successfully reproducing pairs on burned coastal sites over four years was 42.9, the mean on unburned sites was 50.4. On three unburned coastal sites, successful pairs produced an average of 1.83 young per territory over four years. On two burned coastal sites, the young produced increased from 1.3 in 1992 to 2.25 in 1994, but dropped to 1.0 in 1995. Approximately 15 pairs have territories near a burned inland site, and immatures and adults forage from three of these territories into the burn, but no territories are restricted to the burned area. These 15 pairs have a mean success rate of 37.7 percent and an average of 1.35 young per territory for four years. We believe that the extent of vegetative recovery determines habitat suitability for breeding pairs, and several parameters are being examined. Gnatcatcher pairs that are able to establish territories on burned areas breed at rates similar to those breeding on unburned sites.

Introduction

“One of the most restricted in distribution of all the birds in the United States is the Black-tailed Gnatcatcher (*Polioptila californica*), which is found in certain arid, brushy sections of the Pacific slope of southern and Lower California” (Woods 1921). Lumped for much of its sci-

entific history with the Black-tailed gnatcatcher, *P. melanura*, of the southwestern deserts, the California gnatcatcher is now recognized as a valid species (Atwood 1988, American Ornithologists' Union 1989). The species is presently distributed from Ventura County, California south to the tip of Baja California, Mexico, with the subspecies *P. c. californica* occurring along the coast from Ventura and Los Angeles counties south to approximately 30° N latitude in Mexico (Atwood 1991). It is rare to nonexistent in the northern part of its range due to extensive habitat loss in recent years (Atwood 1991) and current population studies estimate that there are less than 2,000 pairs left in California (Sahta 1991). Several studies have indicated that the California gnatcatcher has an extremely low reproductive rate, due to high nest failure and significant nest and hatchling predation (Atwood 1990). Nest parasitism by the brown-headed cowbird (*Molothrus ater*) may also decrease reproductive success (Atwood 1990). However, the leading cause of gnatcatcher decline may be a direct result of the significant loss of suitable habitat in the last 70 years (Atwood 1980, 1992; Rea and Weaver 1990), and the California gnatcatcher was Federally listed as a threatened species in March 1993.

In addition to the fragmentation suffered at human hands in the last 50 years, the sage scrub community in southern California has also been subjected to frequent fires of both natural and anthropogenic origin. While fire is an integral part of this community, its effects on vertebrate populations have not been well-documented. We have been studying the effects of fire on the avian community in sage scrub habitats since 1992. This paper considers only effects of fire on California gnatcatchers. By determining the density and reproductive success of gnatcatchers on burned sites of known age postfire, and on unburned controls, we can examine the relationship between gnatcatcher utilization of sage scrub communities and fire history in southern California.

Relatively little is known about the effects of fire on the sage scrub plant community, especially within the range of the California gnatcatcher. All sage scrub shrubs can

resprout to some degree. Some genera, like *Malosma*, *Rhus*, and *Salvia*, exhibit the ability to resprout vigorously after fire, some are less vigorous, like *Artemisia* and *Eriogonum*, while others reproduce primarily from seed. The fire history of an area is likely to affect succession after fire, due to differences in fuel loads which in turn affect the intensity of the fire (Malanson and Westman 1991). Intense fires may be more destructive, and leave less standing vegetation to be a source of shelter or new seed, or leave fewer refugia for animals after the fire.

Methods

There are ecological differences between coastal and inland gnatcatcher populations, and between different sage scrub subassociations (Kirkpatrick and Hutchinson 1980). The plant community along the southern California coast is San Diegan, while that inland in western Riverside County is Riversidean (Kirkpatrick and Hutchinson 1977). Since 1992, we have been studying a coastal population at Camp Pendleton, San Diego County, where gnatcatcher surveys conducted in 1989 by the U.S. Fish and Wildlife Service located 175-200 pairs of gnatcatchers. In November 1990, two fires burned over 2,600 ha of coastal sage scrub at Camp Pendleton. Our two study areas, Basilone-San Onofre and Uniform, contain unburned controls adjacent to habitat that burned in 1990. And we have also been studying an inland population at Lake Mathews in Riverside County, where fire burned portions of the habitat in 1990.

All sites were surveyed regularly for gnatcatchers and associated bird species. Reproductive success was quan-

tified by monitoring territories to determine clutch size (if nests could be found), fledging success, and fledgling survival. We used inconspicuous markers to indicate the limits of the resident pairs activity. Then, after the breeding season, we carefully mapped and measured the area delineated by these markers.

Reproductive success was defined for each pair, for each season, as no attempt (NA), unsuccessful attempt (UA), or successful attempt (SA), and the number of fledglings produced per pair each season was also determined. No attempt is defined as no breeding behavior observed; unsuccessful attempt is defined as breeding behavior observed but no surviving fledglings; and successful attempt is defined as fledglings produced which survived to disperse.

Vegetation at these sites was quantified via line point samples in a subsample of gnatcatcher territories (Beyers and Pena 1995; Beyers and Wirtz this volume).

Results and Discussion

At Camp Pendleton, approximately 20 pairs of gnatcatchers have utilized the unburned Basilone site, and approximately 14 pairs have utilized the unburned portion of the Uniform site, over four successive breeding seasons. These 34 pairs are distributed at about 2 pairs per ha in unburned habitat. Four pairs of gnatcatchers have utilized the burned San Onofre site and two pairs have established territories on the burned Uniform site during this period. Burned sites supported about 0.2 pair per ha.

The mean percent of successfully reproducing pairs on burned areas over four years was 42.9, the mean on unburned areas was 50.4 (Figures 1 and 2). These fig-

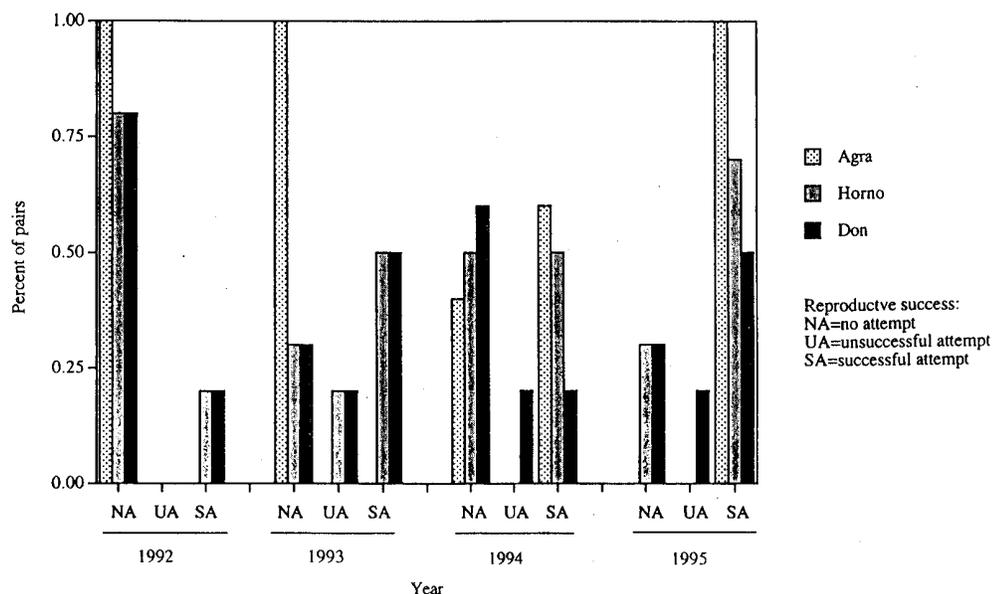


Figure 1. Gnatcatcher reproductive success at Camp Pendleton (Agra= burned, Horno and Don= unburned)

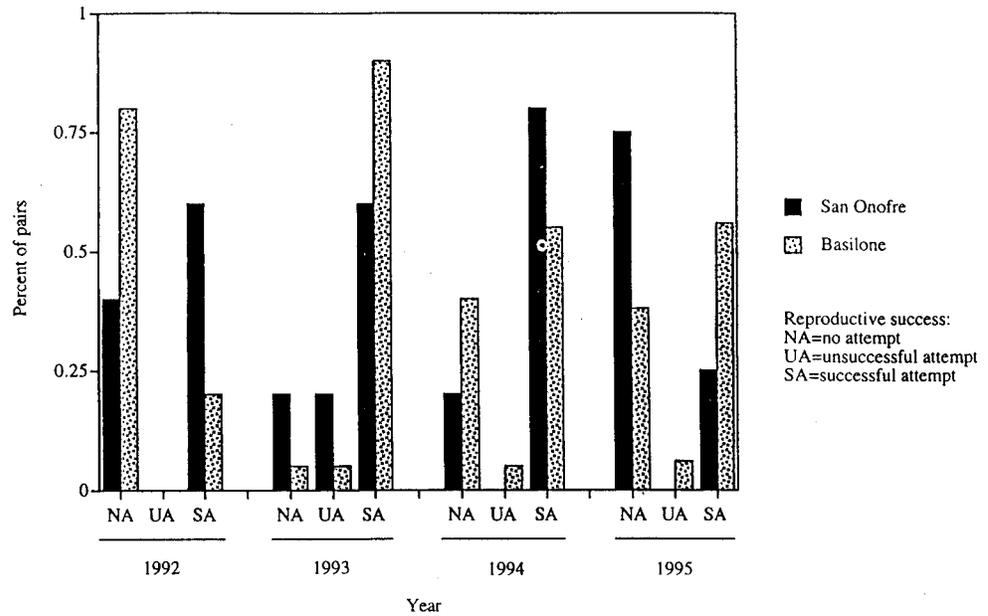


Figure 2. Gnatcatcher reproductive success at Camp Pendleton (San Onofre = burned, Basilone = unburned)

ures are greater than the 42% reported by Bontrager (1990) for pairs in Orange County. On three unburned areas successful pairs produced an average of 1.83 young per territory over four years (Figure 3). On two burned areas, the young produced increased from 1.3 in 1992 to 2.25 in 1994, but dropped to 1.0 in 1995 (Figure 3).

The plant community on the burned Pendleton sites is dominated by mixed introduced grasses, black mustard

(*Brassica nigra*), and resprouts of native laurel sumac (*Malosma laurina*), California sagebrush (*Artemisia californica*), coyotebush (*Buccharispilularis*), deer vetch (*Lotus scoparius*) and elderberry (*Sambucus mexicanus*). Unburned areas at Pendleton are dominated by a mixture of California sagebrush, coyotebush, laurel sumac, cacti (*Upuntia* sp.), deer vetch, elderberry, and seasonal herbaceous plants.

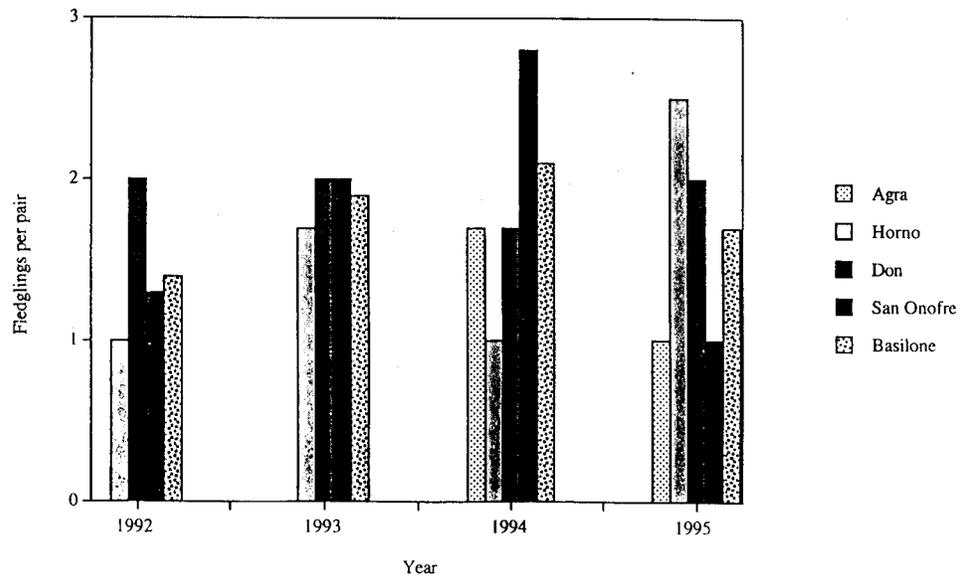


Figure 3. Gnatcatcher fledglings per pair at Camp Pendleton (Agra and San Onofre = burned; Horno, Don, and Basilone = unburned)

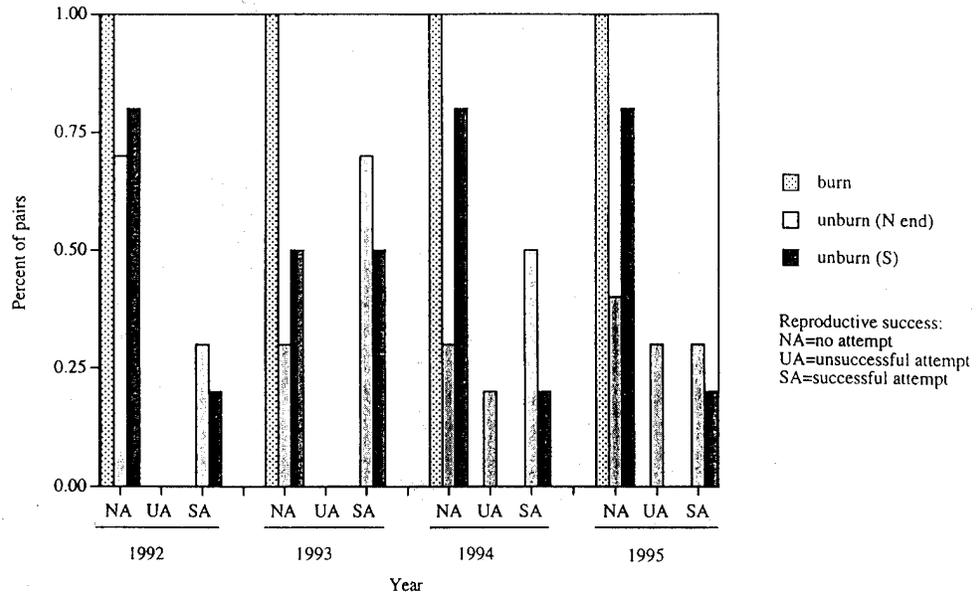


Figure 4. Gnatcatcher reproductive success at Lake Mathews

At Lake Mathews, 15 pairs utilize the unburned area and, while birds forage in burned riparian, no territories are located solely on the 5 year old burned area. These 15 pairs have a mean success rate of 37.7 percent (Figure 4) and an average of 1.35 young per territory (Figure 5), for four years. The mean success rate of birds at this site is less than the 42% reported by Bontrager (1990).

The plant community on more mesic sites at Mathews is dominated by California sagebrush and desert brittlebush (*Encelia farinosa*); this is the area typically occupied by gnatcatchers. More xeric stands at Lake Mathews are nearly pure brittlebush; these areas are never included in gnatcatcher territories, and seldom utilized for foraging. Plant succession on the burned area at Mathews

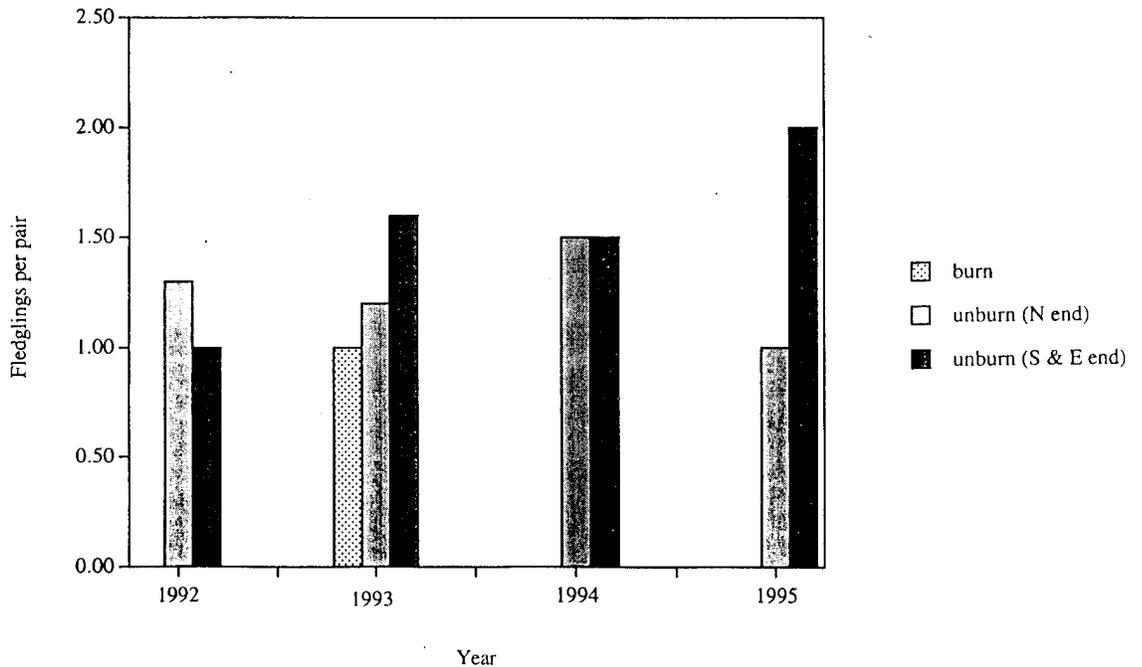


Figure 5. Gnatcatcher fledglings per pair at Lake Mathews

has been limited to introduced grasses, with sparse resprouts of sagebrush and brittlebush; burned areas have not been included in gnatcatcher territories, and are seldom utilized for foraging. Vegetative recovery in the burned riparian at Mathews has been rapid. Gnatcatchers frequently forage in recovering riparian at Mathews, and also at San Onofre at Camp Pendleton.

While gnatcatcher density may initially be reduced by fire, individuals forage in burned areas, and some pairs establish territories in burned areas, within three years postfire. The presence of gnatcatchers is probably dependent on suitable vegetation, whether left behind by the fire as refugia or as seedlings and resprouts respond to the fire. At Camp Pendleton, shrub regrowth has been rapid on the burned San Onofre site, which currently supports four breeding pairs. The San Onofre site is also adjacent to burned riparian, which has resprouted especially vigorously since 1992. The burned area at Uniform (Agra) was dominated by mustard in 1992, but by 1994 both crown sprouts and seedling shrubs were over one meter tall. Two breeding pairs of gnatcatchers were found in this area in both 1994 and 1995.

The gnatcatchers found on burned areas at Pendleton presumably represent dispersal from unburned areas, which are as close as one kilometer away. One of us (wow) has observed immature gnatcatchers flying across burned sites (both Agra and San Onofre) in July and August. The differences in reproductive success and fledglings per pair between the two burned areas is probably a function of differences in postfire plant succession. At San Onofre, riparian habitat supported much of the foraging activity of a pair that established itself between 1993 and 1994, but by 1995 this pair had moved largely into sage scrub regrowth. Unburned refugia from the 1990 fire initially provided foraging areas for the other three pairs; today (1995) regrowth in these areas reaches 2m. The number of fledglings produced per pair on the burned area is equivalent to those produced on the unburned area at Basilone. Although the burned area supports fewer pairs, there is little effect on the productivity of resident pairs after five years postfire. At Agra, where destruction of vegetation left no refugia after the 1990 fire, a few unburned bushes, plus rapidly resprouting species such as *Malosma laurina* and *Malacothamnus* now (1995) seem to provide critical foraging and nesting sites for the two pairs that have established themselves.

A census by Tutton (1991) at Camp Pendleton estimated that 80% of the gnatcatcher pairs on the base were located on areas that were at least 16 years postfire. Our data demonstrate an increased use of burned sites since 1992. Tutton suggests that the effects of human impact on gnatcatcher habitat cannot easily be separated from the effects of fire, and it is possible that areas with higher fire frequency experience other forms of disturbance as well.

At Lake Mathews, the burned area supports low grass and sparse shrub cover. There is generally little postfire

resprouting in Riversidean sage scrub because of the more intense fires which usually occur in this habitat (O'Leary 1989). Increased pollution and grazing pressure may hinder resprouting and regrowth of Riversidean sage scrub and facilitate invasion by non-native herbs (O'Leary and Westman 1988). Gnatcatchers rarely forage into this area, but occupied territories are present within 0.25 km on nearby slopes which are covered with *Artemisia* and *Encelia*. Beyers and Pena (1995) report a positive relationship between shrub cover and gnatcatcher utilization on our study areas at Mathews. They (1995) also note that, on unburned areas, gnatcatcher territories include much more shrub cover and taller shrubs, than adjacent areas not utilized.

Summary and Conclusions

We have observed 34 pairs of gnatcatchers in unburned San Diegan sage scrub and 6 pairs on burned San Diegan sites over five breeding seasons (Table 1). Unburned habitat supports approximately 2 pairs per ha, while burned sites support 0.2 pair per ha (Table 1). Mean reproductive success on unburned sites was 50.4 percent, that on burned sites was 42.9 percent (Table 1). The mean number fledged per territory, over five seasons, was 1.83 on unburned sites and 1.87 on burned sites (Table 1).

We have observed 15 pairs of gnatcatchers in unburned Riversidean sage scrub over five breeding seasons, and found no territories in burned habitat (Table 1). Unburned habitat supported about 0.10 pair per ha, their mean reproductive success was 37.7 percent, and the mean number of fledglings per territory was 1.35 (Table 1).

Although fire in San Diegan sage scrub initially decreases the number of gnatcatcher pairs and the reproductive success of surviving pairs, there may be a rapid postfire increase in both gnatcatcher density and productivity in only a few years IF there is adequate vegetation to support foraging and breeding activities. Either refugia left by fire, or riparian habitat which recovers quickly from fire, may increase the likelihood of gnatcatcher occupation and breeding on burned areas in San Diegan sage

Table 1. Density and reproductive success of gnatcatchers at coastal and inland sites.

	Unburned	Burned
Coastal		
Total pairs	34	6
Pairs/ha	2.0	0.2
Mean % repro. success	50.4	42.9
Mean no. fledged/territory	1.83	1.87
Inland		
Total pairs	15	0
Pairs/ha	0.1	0
Mean % repro. success	37.7	0
Mean no. fledged/territory	1.35	0

scrub. Riversidean sage scrub apparently recovers much more slowly from fire and is not suitable for gnatcatcher colonization for at least 5, and perhaps as much as 10 years.

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