

SOME RESPONSES OF RESIDENT ANIMALS TO THE EFFECTS OF FIRE IN A COASTAL CHAPARRAL ENVIRONMENT IN SOUTHERN CALIFORNIA

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ABSTRACT.

This is a preliminary report concerning the responses of wildlife to a chaparral fire in Ventura County, California, which occurred between Camarillo and Newbury Park on 28 October 1980, sweeping over 8,400 acres of mountains and valleys. A hundred acre area including Camarillo Oak Grove County Park had been under intensive study for four years at the time of the fire which destroyed all cover except 25 acres of the park itself.

Over a hundred species of birds made use of this environment during the year with an average daily tally of about 25 species and some 200 individuals. Mist nets were extended once each week and captured birds were banded, weighed, measured and examined for fat, evidence of disease and for external parasites. In the three months since this fire evidence of some of the ecological changes affecting the birds have been: A decrease to near total absence of birds in the burned area; crowding in the unburned park proper resulting in competition for food and cover; movement of towhees out from the park foraging for food in the ashes of the chaparral; apparently fairly good survival among the towhees and some other species with almost a total loss or emigration of Wrentits; California Quail concentrated at the park and then dispersed using burned cacti as over-night shelters; an increase in predation of the concentrated and exposed birds. There was also a rapid decrease in feather mite infestations among surviving birds.

Within the park itself the effects of the fire upon winter residents were less evident since they arrived after the fire and took up their normal winter territories. Those that over-wintered outside of the park had to move on.

This brief study indicates that each animal species tries to cope with its altered habitat in its own way. It suggests that any use of fire to control chaparral environments must be done with utmost care and understanding of the ecosystem elements involved.

INTRODUCTION

A chaparral or brush fire in the Mediterranean ecosystems of California is so spectacular and so destructive to natural and man-made structures that it has been the subject of investigation, probably since man first experienced it. Numerous scientific papers and reports have been published concerning the effects of these fires on both plant and animal ecosystems and how they recover from them. The "Symposium on the environmental consequences of fire and fuel management in Mediterranean ecosystems" held at Palo Alto in 1977 (USDA Forest Service General Technical Report WO-3, 1977) summarized and referred to many of these studies so I shall not attempt a summary here. The fire of 28 October 1980 which destroyed the ecosystems of some 8,400 acres of hills between Camarillo and Newbury Park consumed an area that I had had under observation for four years and led me to believe that I might be in a position to add some observations to its effect upon an environment under study and of known biotic rhythms.

STUDY AREA

The area of study lies in a small valley of Ventura County to the north of and beneath the Conejo Grade and east of Camarillo, including the Camarillo Oak Grove County Park. Nearly half of the twenty-five acres in this park supports less than fifty overaged Laurel Oaks (*Quercus agrifolia*). The remainder has been planted to exotics such as olives (*Olea europaea*) and *Eucalyptus* and is covered by lawns and a black surfaced parking area. It is surrounded on the north, east and south by *Opuntia basildris* dominated hillsides; *Opuntia* mixed with many native shrubs and annuals. To the west it is bounded by the extensive Hartman citrus orchard. The valleys and swales had a heavy cover of annuals, sage (*Ramona*), Lemonade-berry (*Rhus integrifolia*), Toyon (*Photina arbutifolia*), *Nicotiana glauca*, etc. The environment was typical, with slight variations, of coastal chaparral and riparian valleys of Southern California. Outside of the park, where moisture was great enough, and where oaks and sycamores (*Platanus racemosa*) had become established before grazing was heavy enough to prevent forest regeneration, there were residual trees.

METHODS

Beginning in December 1976, careful tallies were made from dawn to two hours after, using the park as a focal point and extending for at least a hundred acres eastward, up a valley to a permanent spring a kilometer away. This area was small enough that nearly every variable of the habitat, except the hill tops, could be contacted at each observation. All birds and mammal seen were recorded, as well as their activities and vocalization; prominent insects were listed, changes in vegetation were noted, plus temperature, humidity wind speed and stream flow. These records were kept twice each week, except when I was absent from the locality. In addition, beginning October 1978, birds were netted one day each week from dawn until noon. Seven to 10 black, nylon or silk Japanese mist nets, 36 mm mesh, 3 meter high and 6 to 12 meters long were set up at regularly used locations. For two years nets were placed only in the park, but in September 1980 additional net lanes were in use at the spring to determine how much exchange there was among birds using the hills, the valley and the park. Records were kept of the footage of nets used each day so as to compare netting success and population densities. Each captured bird was ringed with a U.S. Fish and Wildlife Service band, sex and age were recorded where evident; and in addition the birds were measured, weighed, examined for body fat or sexual activity, injuries or disease, and the feathers were examined for parasites. Hipposcoid flies, feather mites and chiggers collected were sent to taxonomists for identification. The semi-weekly ecological observations or tallies totaled 85 in 1977, 96 in 1978, 89 in 1979 and 77 in 1980 (before the fire); more than 1,000 hours in all.

RESULTS

1. Before Burn---It had been dry in 1976 and 1977, and livestock was removed from the area late in 1977. The vegetation of the hills and valley had made so little growth during 1977 that except for woody plants and shrubs and the clumps of cactus, there was very little ground or escape cover. A small intermittent stream drains this valley and, when flowing, passes through the park and Hartman orchards to empty into the Calleguas Creek. The drought of 1976-77 was broken by progressively wetter winters, as evidenced by the flow of this small creek through the park. There was no flow in 1977. In the winter of 1977-78, increased rainfall began to rebuild the aquifer supplying this stream, and it began to flow on 14 February, flowing each succeeding winter as follows:

<u>Year</u>	<u>Dates of Flow</u>	<u>Number of Days</u>
1977	No flow	
1978	14 Feb. to 28 March	42
1979	27 Feb. to 25 April	57
1980	20 Feb. to 31 May	100

This increase in soil moisture resulted in a dramatic increase in vegetation. By the winter of 1977-78, the valley and hillsides were so denuded of vegetation that coveys of quail could be seen feeding on hillsides at distances up to 400 meters. The damp winters

provided moisture for a heavy growth of annuals to a height of as much as 2 meters. During the normal rainless summers of 1978, 1979 and 1980 this heavy vegetation cover prevented the excessive evaporation that had occurred during the previous dry years. This permitted extensive growth of perennial shrubs (sumac, sage, toyon, wild nicotine) to heights of 3 to 4 meters forming dense woody thickets. At no time since 1977 did the soil become exposed as it had been and the cover was abundant to the extent that it was difficult to see foraging quail even from a few meters. The plant-animal ecosystems present responded to this moisture in like fashion.

The presence of abundant and succulent vegetation resulted in an increase in insect life as well. Fortunately, aerial insecticide spraying was confined mainly to the agricultural land outside of the valley, and there was not much that drifted into it. Butterflies, Mourning Cloak (*Nymphalis antiopa*), Red Admiral (*Vanessa atalanta*), Checker (*Euphydryas*), Cabbage (*Pieris rapae*), Thistle (*Vanessa cardui*), and several Little Blues (*Lycaenidae*) made their appearance as well as beetles, bugs (Hemiptera), Harlequin Bugs (*Murgantia histrionica*), aphids, bees and small flies, and their predators and parasites as well. This insured that all of the newly sprouted annuals, as well as the perennials, were pollinated, producing abundant seed. This additional food supply permitted a higher survival of nestling birds and weanling rodents.

The vertebrate wildlife responses to these conditions were equally as dramatic. A small herd of 6 mule deer (*Odocoileus hemionus*) moved into the area. The Cottontail Rabbit (*Sylvilagus auduboni*) population increased as follows:

<u>Year</u>	<u>Average Daily Tally</u>	<u>Percent Change</u>
1977	1.6	
1978	3.2	100 increase
1979	14.6	356 increase
1980	6.4	128 decrease

It reached a population in 1979 9 times more abundant than it had been in 1977 and then fell back to a level in 1980 which was about average for the four years.

Bird populations demonstrated a similar response:

<u>Year</u>	<u>Average Daily Tally</u>	<u>Percent Change</u>
1977	134	
1978	189	Plus 41
1979	223	Plus 18
1980	240	Plus 8

By the end of the study, the average number of birds counted in the area was 79% greater than it had been in 1977. The number of species in such an environment cannot change as radically as total numbers, because the total species in a geographical area that can compete in any one habitat or group of habitats is limited; therefore, the average for the four years went up only 8 species (72 species in 1977, 75 species in 1978, 75 species in 1979, 80 species in 1980). The number of individuals of each species seen, i.e., the population density per species did reflect this increase in food and cover availability. In 1978 the average number of birds seen per species per observation was 35% greater than it had been in 1977 and again increased by 5% in 1979. In other words, the number of birds counted per species increased by 2.7 birds by the end of 1979 (from 6.2 to 8.9). What this means is that not only did more species seek the area, but there were more individuals per species as well.

This was the situation when this phase of the study was suddenly brought to a close by the fire of 28 October 1980. How long such trends would have continued, and what other vertebrate population changes would have been made had the environment been allowed to progress toward a more woody habitat, can only be conjectured. Within the limits prescribed by their gene patterns and their physiology, each surviving species responded to the changed conditions brought on by the fire and responded in their own way, thereby producing a kaleidoscope of actions and events which I shall attempt to touch upon here.

2. After Burn---During the morning of Tuesday, October 28, strong east winds, whipping up to thirty miles or more per hour, stirred the embers of an improperly extinguished campfire north of Newbury Park and surrounding tinder-dry vegetation burst into flame. This quickly spread into a wall of flame more than a mile wide, moving southwest along the mountains, altering in intensity and speed with the available brush and woody cover. At times it developed convection winds of fifty or more miles per hour, throwing forth an advancing wave of heat and smoke that overwhelmed slow moving mammal and bird species. Heat was so great that it was felt in Camarillo, as much as five miles away, and humidity dropped to near zero.

The immediate effect was to crowd birds that had not succumbed to smoke, lack of oxygen, heat, or being burned in a flash of incandescent feathers, into the unburned park or other clumps of cover that had been spared by the flames. By the following morning, the low humidity had created a great need for water. Birds crowded around dripping water faucets in the park or drank at the still flowing and ash covered spring up the valley.

Santa Ana (east) wind continued to blow daily for many days following the fire, holding the humidity low and extending the need for water among the survivors. Several mornings of coastal fog relieved this situation at times, but rain did not occur to break the low humidity syndrome until December 3, 35 days after the fire.

Compared to the bewildering responses of the birds, the responses of the plants were straight forward. They had three choices: (1) Regenerate, (2) Germinate or (3) Die. All three choices were evident. Most of the annuals were killed outright and began germinating from seeds. Germination was quickest among those seeds in disturbed or in low areas after a 20 mm rain on December 3 and after two months exposure to sun and warmth. Such germination was most evident by mid January, giving a green cast to much of the exposed soil. Shrubs and perennials had energy and moisture enough in their roots to send new shoots up from the bases of the charred plants. Oaks responded by sending out new leaves and flowers from adventitious buds on limbs and shoots at the top of trees or on the dorsal surface of limbs where the heat had not been intense enough to kill the tissue. These flowers were present by 29 November and were being pollinated by a large population of Honey Bees (Apis mellifera) that had moved in, probably from the unburned valleys to the west. Wild Nicotiana immediately produced new shoots and flowered, providing food for returning hummingbirds. Yucca (Yucca whipplei) sent up flower stalks from unburned corms and bloomed by the first of January. These and similar plant responses were evident over the whole ecosystem.

All of the insects on or in plant tissue exposed to the direct flames were killed. This included their eggs, larvae, pupae and adult forms. Where plants were not exposed to the full force of the flames, enough insects escaped to provide food for gleaners. Each morning, Audubon Warblers (Dendroica auduboni) and Ruby-crowned Kinglets (Regulus calendula) left the park and foraged out over the valley and up the canyon, first seeking insects left on unburned plants and later checking the new growth.

Subterranean species fared better. The morning following the fire, many net and tube spinning spiders had spread their snares in a sheen over the soil adjacent to cracks and crannies where they had escaped. This was a daily phenomenon until germinating plants began obscuring the nets. Continued warm weather caused hidden spider eggs to hatch and young were ballooning on December 5.

As quickly as the damaged oaks began producing flowers, bees moved in by the thousands to pollinate them, and for several days, from 29 November through 3 December, their hum could be heard among the oaks. This phenomenon did not take place within the park, where the undamaged trees would not flower until this coming March.

Butterflies, Monarch (Danaus plexippus), Checker, Thistle and an occasional dragonfly, moved into the burned areas from the park or orchard. And another aeroplankton became airborne about the park, enough that a Black Phoebe (Sayornis nigricans) and a Say's Phoebe (Sayornis saya) could be sustained on them.

Ectoparasites: During two years, over 2,000 birds were examined for ectoparasites while being banded and recorded. Among these were three birds with chiggers attached to their abdomens; walking and scratching species, Golden-crowned Sparrow (*Zonotrichia atricapilla*), Hermit Thrush (*Hylocichla guttata*) and a California Thrasher (*Toxostoma redivivum*). In the three months following the fire, there was a burst of infestation, 15 birds, including White-crowned Sparrows (*Zonotrichia leucophrys*), Golden-crowned Sparrows, Hermit Thrushes and one Audubon Warbler (the last fills many niches, even to that of a ground forager). This indicates an infestation rate many hundreds of times greater than normal. I attribute this to the fact that these chiggers, *Neoschoengastia americana*, which normally seeks hosts by crawling upon the plants, had survived the fire, and having no plants upon which to crawl, walked over the surface of the soil, and thereby came into contact with these foraging terrestrial birds.

In addition, each captured bird has been examined for feather mites (probably *Proctophylodidae* as well as other families; as yet unidentified) among the primary and secondary wing feathers. Their abundance was rated as: many, medium, few and none seen, in an attempt to learn if they were seasonal in their appearance on the birds. Figure 1 illustrates the prevalence of infestation unrelated to the numbers of mites (i.e., the number of birds infested). The prevalence of feathermite infestations among House Finches at the park is compared with that in town, at my feeding station, for the period August 1980 into January 1981. A three year study indicated that the mites normally declined from August into December and began increasing in January. The prevalence of infestation at the park among House Finches was much less than that in town, but the 1979 pattern was somewhat similar to the three year average for town.

Following the fire, prevalence of infestation dropped precipitously both in the town and in the park populations, that of the park approaching zero by December, Figure 1. Finches

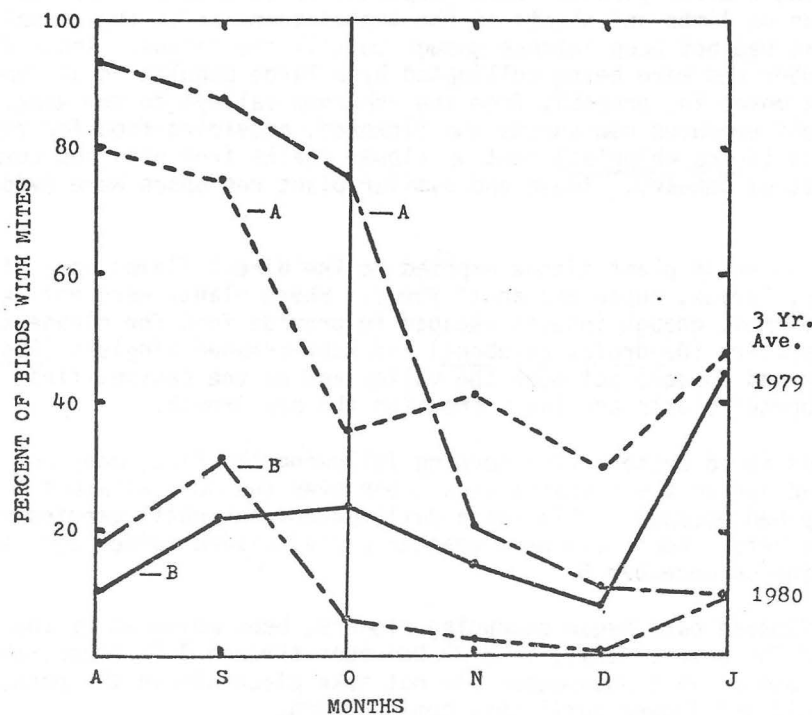


Figure 1. The percentage of captured House Finches infested with feather mites at Camarillo as compared with the percentage infested at the county park. A -- shows the prevalence in 1980 in Camarillo compared with the three year average; B -- shows the prevalence in the park 1979 compared with 1980.

In this and in the following figures the vertical line indicates the month when the fire occurred.

and other birds commonly control their mite populations by dust bathing in fine silicon dust where it is available. As previously stated, the firestorm was accompanied by high eastern winds which continued for most of November, and the humidity was very low. It was noted that all of the captured birds, both in town and in the park, had a fine coating of ash distributed through their feathers. This coating remained until the rain of December 3, which washed ash from the air and from the plants, and probably from the birds as well. I suspect that the ash acted upon the feather mites as silicon-dioxide (like Dri-Die insecticide) bringing about this almost total absence in the burned area and low levels of infestation away from the actual burn.

The black ant, which carries plant fibers into the chambers, had several known colonies within the burned area. These were still active following the fire, but with the almost complete consumption of plant fiber in the vicinity of these nests, the ants may have been in trouble. The alkaline ash may have been of some detriment to them as well. Several of these colonies ceased to be active, but I did not determine whether it was a result of the fire or of a normal reduction in activity because of the season.

I did not attempt a systematic survey for the remains of vertebrates following the fire, but in walking through the burned area over a period of two weeks, I found animals killed by heat, smoke or a combination of these, which included 18 Cottontail Rabbits, 15 rats, probably mostly *Neotoma* and *Rattus*, two Pocket Gophers (*Thomomys bottae*), 1 Opossum (*Didelphis virginiana*), 8 California Quail (*Lophortyx californicus*), and 1 each of Acorn Woodpecker (*Melanerpes formicivorus*), Spotted Towhee (*Pipilo erythrophthalmus*), Golden-crowned Sparrow and Hermit Thrush. These totaled 48 animals on as many acres. It is my estimate that the vertebrate loss, other than birds, was at least one per acre over the entire burn.

One living Mule Deer was seen in the valley following the fire, and it undoubtedly moved out of the burn to areas where fodder still remained. However, fresh droppings along the creek bed near the spring indicated that deer were coming to it for both food and water.

In the first weeks following the fire, coyotes (*Canis latrans*), at least two, for a pair was seen hunting, gleaned the area for fire kills that were still palatable, and they may have continued to hunt in the burn for survivors. Other gleaners, including a pair of Ravens (*Corvus corax*), also searched the burn regularly until edible victims were depleted. Ground Squirrels (*Otospermophilus grammurus*) and Pocket Gophers that remained underground during the fire continued active afterwards, for fresh burrows were seen regularly in following months. I do not know what effect reduced forage had on these animals.

As Figure 2 indicates, the rabbits suffered almost total annihilation in the vicinity of the park. The year 1979 had been a banner one for rabbits, with peak abundance in late summer. The population of 1980 appeared to be about half that of 1979. Each year the numbers greatly reduced during winter months, replaced by spring and summer breeding. The numbers seen following the fire continued to decline, since both Great-horned Owls (*Bubo virginianus*) and Red-tailed Hawks (*Buteo jamaicensis*) foraged the area, bringing the observable population to near zero.

The average number of birds tallied in fall months in the area in 1980 is compared with the four year average in Figure 3. Normally the visible population had been increasing during the summer and fall months as juveniles are absorbed into the population, and secretive adults become evident as they cease to breed. These numbers are further augmented by winter residents, to a peak in January. In 1980, the number of birds accumulating in the park area in November included those escaping the fire and migrants, after which there was a rapid reduction in numbers seen, which included both surviving permanent residents plus winter residents. In Figure 4, the density of 12 species of permanent residents in 1980 is compared with the four year average. There was the same decline in individuals in 1980 as average, except that it continued into January because of intra-specific as well as inter-specific pressures, and because of movement out of the area as food became available.

The California Quail is a species resident of both the park and the chaparral. It is abundant in this valley, and the population responded to the increased abundance of food and cover from 1977 to 1980. This increase was evident in spite of the fact that the accumulation of vegetation made it increasingly difficult to see quail. Figure 5 compares those

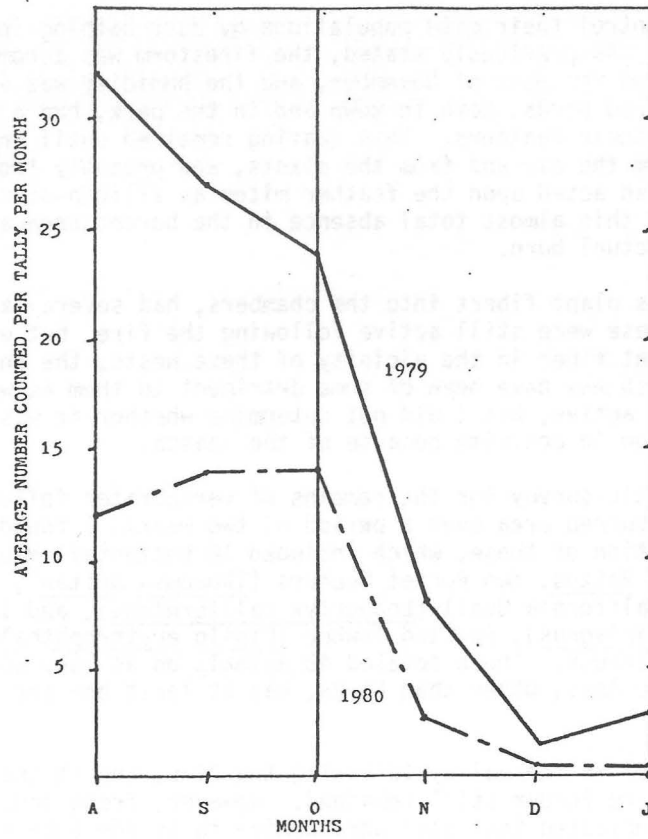


Figure 2. The abundance of western cottontail rabbits at and in the vicinity of Camarillo Oak Grove Park as indicated by the average numbers tallied.

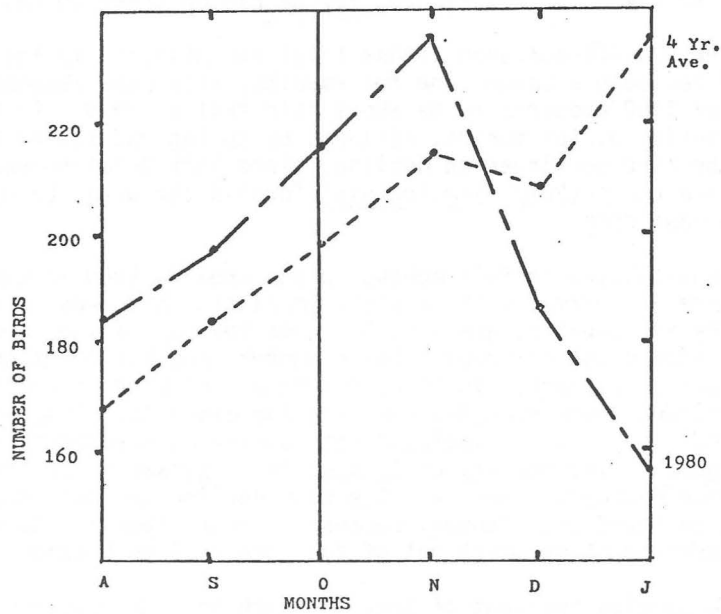


Figure 3. The total birds per tally per month in Camarillo Oak Grove County Park; comparing the abundance in 1980 with the four-year average.

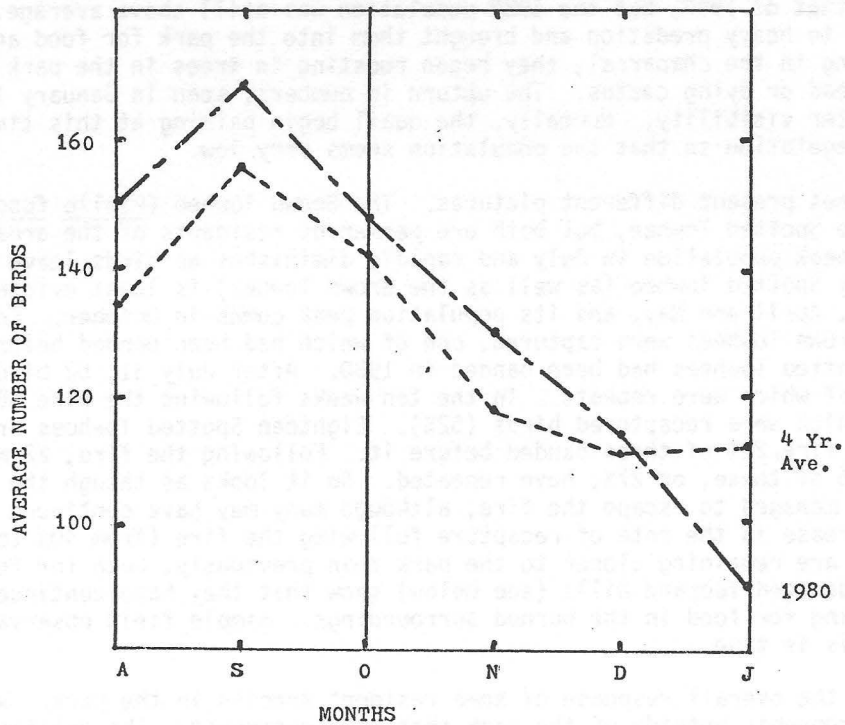


Figure 4. The abundance of twelve species of resident birds as indicated by the average number tallied per month; 1980 compared with the four-year average in Camarillo Oak Grove Park.

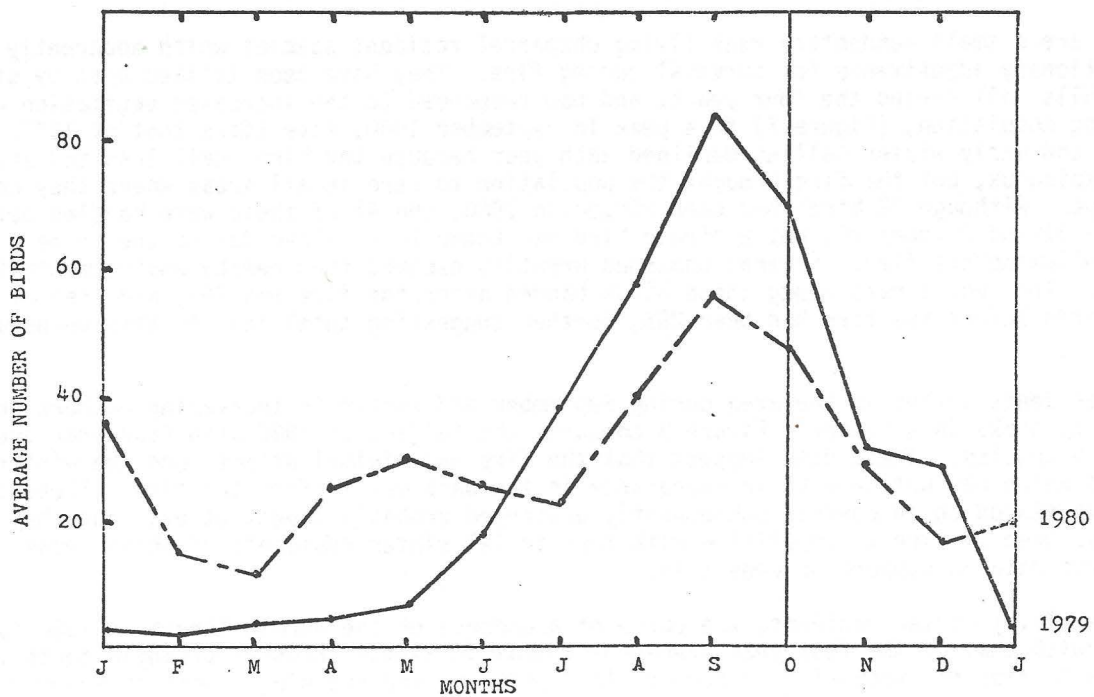


Figure 5. The abundance of California Quail at and in the vicinity of the Camarillo Oak Grove Park; comparing the average number of birds per tally per month in 1979 and 1980.

tallied in 1979 with the 1980 tallies. The 1979 population increased to greater covey size in the fall than that of 1980, but the 1980 population was still above average. The fire exposed the quail to heavy predation and brought them into the park for food and water. Instead of roosting in the chaparral, they began roosting in trees in the park or beneath dense clumps of dead or dying cactus. The upturn in numbers, seen in January 1981, resulted from the greater visibility. Normally, the quail begin pairing at this time and disappear into the vegetation so that the population seems very low.

Two resident towhees present different pictures. The Brown Towhee (*Pipilo fuscus*) is more migratory than the Spotted Towhee, but both are permanent residents of the area. The Brown Towhee reaches a peak population in July and rapidly diminishes as birds leave the area. The more sedentary Spotted Towhee (as well as the Brown Towhee) is least evident while breeding in March, April and May, and its population peak comes in October. Following the fire, only five Brown Towhees were captured, one of which had been banded before the fire. A total of 101 Spotted Towhees had been banded in 1980. After July 31, 52 birds were captured, 20, or 40% of which were repeats. In the ten weeks following the fire 46 birds were captured, 24 of which were recaptured birds (52%). Eighteen Spotted Towhees are known to have survived the fire, 22% of those banded before it. Following the fire, 22 more have been ringed, and 6 of these, or 27%, have repeated. So it looks as though the Spotted Towhee population managed to escape the fire, although many may have continued to suffer from it. The increase in the rate of recapture following the fire (from 40% to 52%) would suggest that they are remaining closer to the park than previously, both for food and water, but their damaged feet and bills (see below) show that they have continued to try and survive by searching for food in the burned surroundings. Simple field observations have indicated that this is true.

We have looked at the overall response of some resident species in the park. What of those found in the environments outside of the park that were destroyed? The tallies totaled for 15 species of residents in the fall of 1980 are compared with the four year average for these species in Figure 6. There is normally some reduction in numbers during this period, but following the fire the population dropped to near zero by December. Recuperation of plants in the valleys and along streambeds, as well as greater visibility, brought the increase of January as the birds moved out from surviving coverts in search of food and could be counted.

Wrentits are a small sedentary weak flying chaparral resident species which apparently has no evolutionary adjustments for survival during fire. They have been tallied both by sight and by calls all during the four years, and had responded to the increased vegetation with increasing population, (Figure 7) to a peak in September 1980, five times that of 1977. The fall and early winter tallies declined each year because the birds call less and are less conspicuous, but the fire brought the population to zero in all areas where they could not escape. Although 72 birds had been ringed in 1980, and 47 of these were handled between July 31 and October 28, not a single bird was known to be alive during the three months following the fire. Several unbanded Wrentits escaped from nearby environments into the park. The repeat rate among these birds banded after the fire was 26%, and that of banded birds before the fire had been 28%, further suggesting total loss to this vulnerable species.

Winter residents arrive in the area during September and appear in increasing numbers until the density peaks in November. Figure 8 compares the tallies of 1980 with four year averages for 5 species. These data suggest that the fire had minimal affect upon the winter residents which had not made their appearance in the park until after the fire. Those that would have stayed on in coverts subsequently destroyed probably sought others, but they would have been in direct competition with territorial winter residents of those areas. I do not have data to support or deny this.

As an example of winter resident, the curve of abundance of the Hermit Thrush in 1980 is compared with that of the four year average in Figure 9. Hermit Thrushes straggle south in August, with migrants appearing in numbers in September, and reaching a peak in November. This is followed by a rapid reduction in numbers seen as migrants move on south, leaving remnants that spend the winter here, augmented by migrants moving north in March and April. Although more abundant than usual, the birds of 1980 followed the same pattern as those of

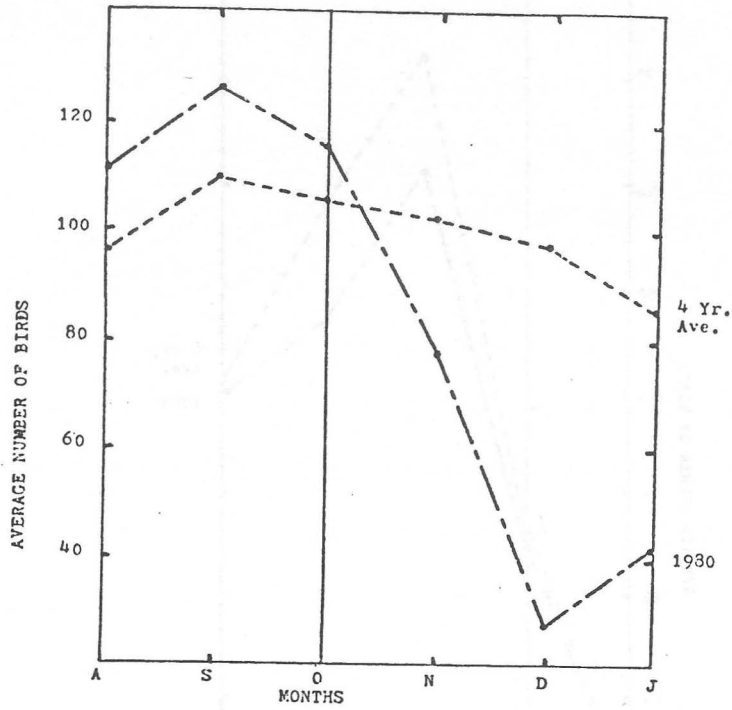


Figure 6. The abundance of fifteen resident species of chaparral birds; comparing the average number per tally per month in 1980 with the four-year average.

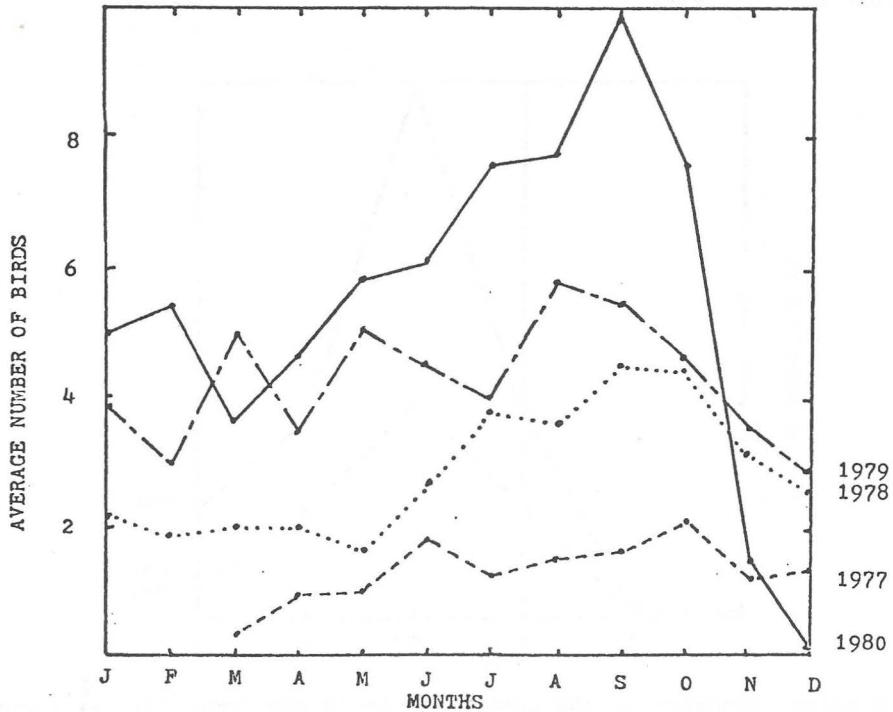


Figure 7. Comparison of the abundance of Wrentits in the Camarillo Oak Grove Park and its vicinity as indicated by counts made twice a week over a four-year period.

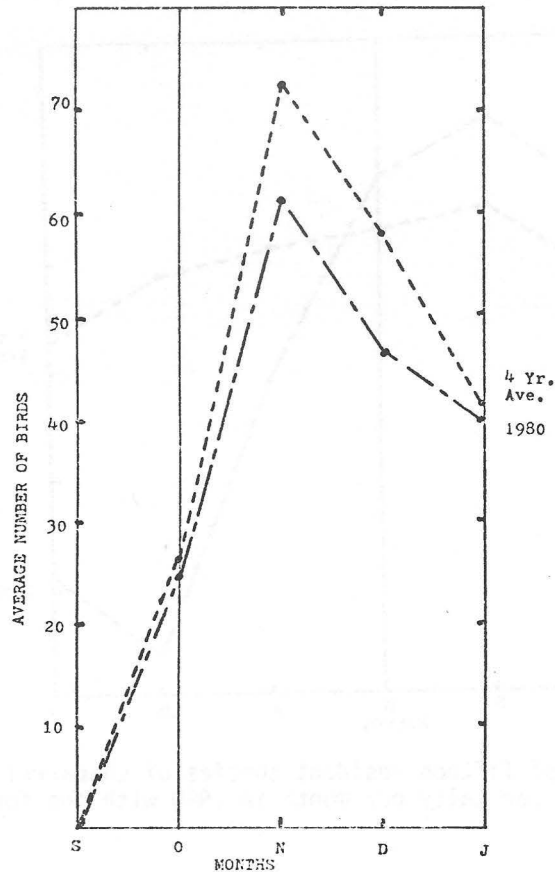


Figure 8. The abundance of five species of winter resident birds in the Camarillo Oak Grove Park; comparison of the average numbers tallied each month in 1980 with the four-year average.

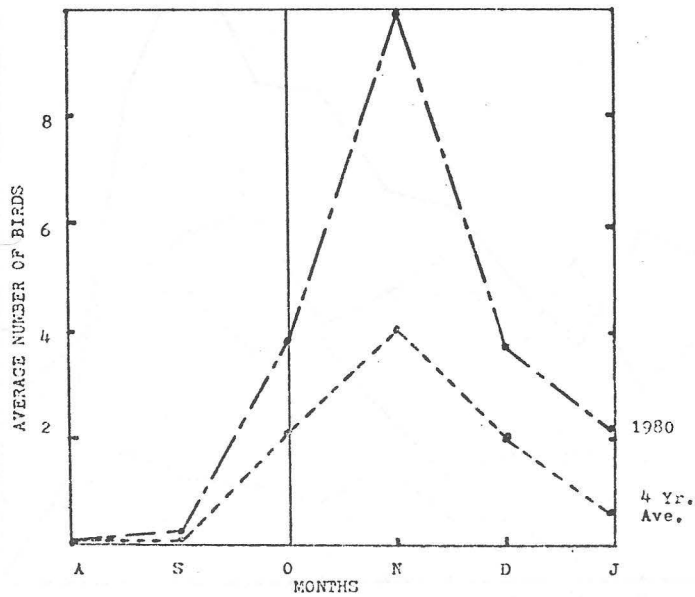


Figure 9. The relative abundance of the Hermit Thrush in the Camarillo Oak Grove Park area in 1980 as compared with the four-year average, based upon counts made twice each week.

previous years. This is explained by the fact that they are highly mobile, could escape the fire, and did not enter the habitat in numbers until after the fire. The migrants were not affected by the fire and moved on south, while the winter residents sought cover and food as it was available.

The density of birds per species has already been mentioned, and the tallies during 1980 (Figure 10) suggest no conspicuous differences from the four year averages. The number of birds seen per species, per tally, per month, followed normal trends until the fire. Following the fire, there was a reduction of 3.1 birds per species, a 34% loss during November. This could be explained by an actual loss in population from the fire or by exodus from the area. Even though there was some recruitment during December and January, the three month population density remained at 26% below average. This suggests many things: the birds were killed outright, the birds left the area, the damaged environment could support only three-quarters as many birds as normally, intra-specific and inter-specific strife prevented normal population densities, etc.

The percentage of marked birds in the population that were recaptured is compared in Figure 11 for 1979 and 1980. Normally, the population is diluted by migrants during September, October and November. This reduces the repeat rate until the new winter residents are banded, and then the percentage of marked birds recaptured goes up. Following the fire, the residual population was diluted by migrants, but after November, the number of birds remaining was fewer, and the recapture rate rose rapidly.

In another attempt to evaluate what has happened here, I have compared netting success during the five months of September through January, in the park with that in the canyon at the spring. In Figure 12, the number of birds per 100 meters of nets in both the park and the canyon, during September and October, remained nearly unchanged. Following the fire, the birds crowded into the park, were milling around, searching out food and water, and the take per 100 meters went up by 83%. Even though there were still birds about the spring, the take dropped by 17% during November, and from there went on down to zero in January. The success in the park dropped to near normal levels in December and stayed there as pressures on the birds and the population density leveled and became more stable.

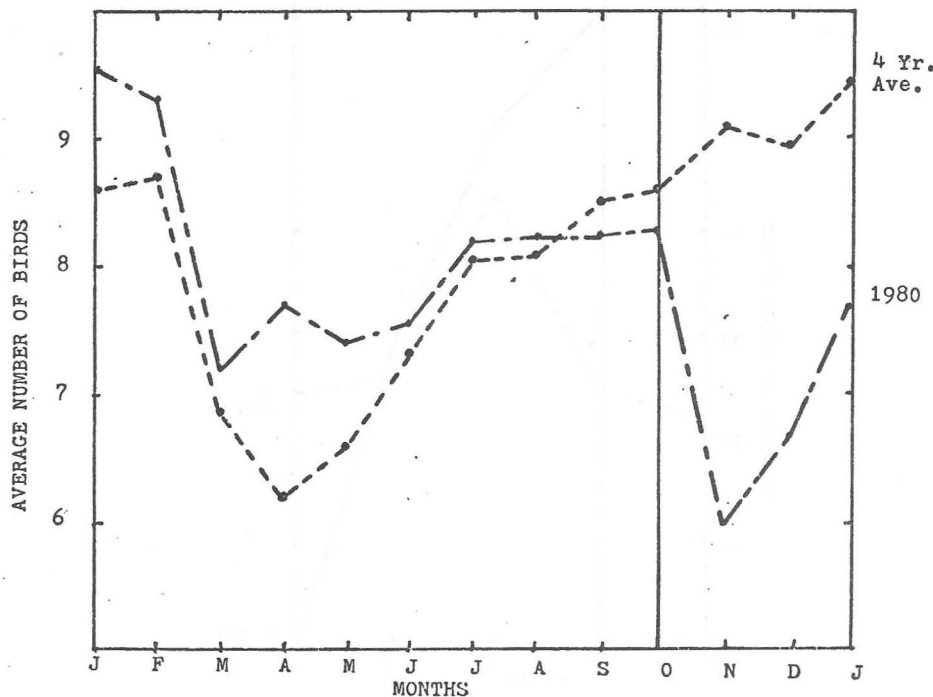


Figure 10. The average number of birds per species per tally per month in the Camarillo Oak Grove Park area; comparing those of 1980 with the 4-year average.

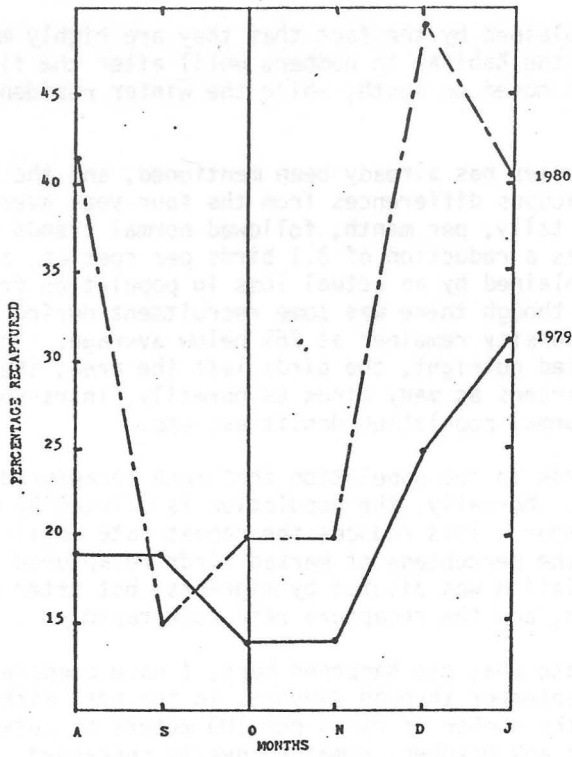


Figure 11. The monthly rate at which banded birds were recaptured in the Camarillo Oak Grove Park area in 1979 and 1980.

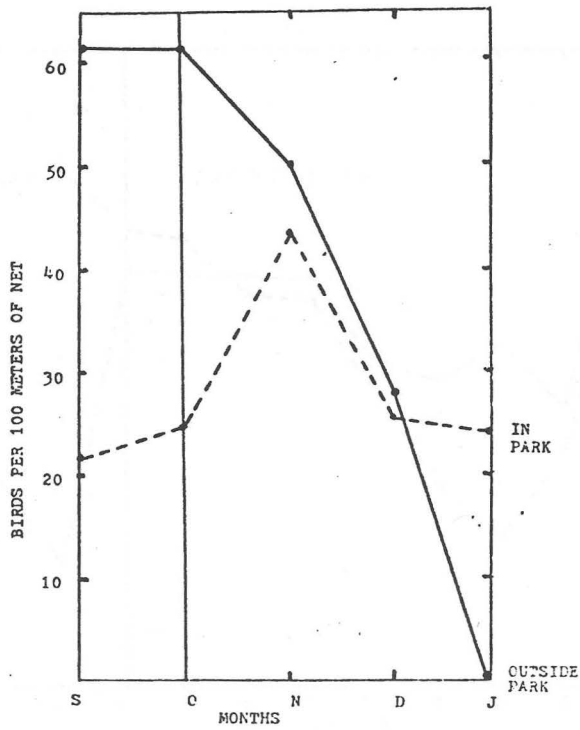


Figure 12. Comparison of netting success in the Camarillo Oak Grove Park with that in a partially wooded valley a kilometer east of it following a chaparral fire in October 1980.

During ten weeks following the fire, 42 survivors of 13 species were recaptured in the area. Interpreting the meaning of these figures is difficult. Only one Acorn Woodpecker was captured, and it was one that had been taken in August. The one found dead had also been banded. These two birds made up a third of the woodpeckers known to be in the park. Three Red-shafted Flickers (Colaptes cafer) were captured, one a survivor banded in 1979. Flickers are wanderers, so I do not know what part of the population this indicates. Two of four Mockingbirds (Mimus polyglottos) were survivors, one banded in 1978 and the other in 1979. This is a sedentary species with a permanent population of about seven birds; therefore, survival appeared to have been good. Two of five California Thrashers captured after the fire were banded, one in 1979 and one in 1980. This is another low level population species, so this figure represents good survival. Ruby-crowned Kinglets search trees and shrubbery and are easily recaptured. Ten of twelve taken after the fire repeated, in addition to one survivor from October 1980. Three birds had been banded before the fire, and this suggests that at least a third of the pre-fire population survived. Four Hermit Thrushes, of 47 captured (43 new, plus these four old ones), had been ringed in 1979 and early 1980. Since these are migrants and winter residents, nothing about survival can be drawn from this. The Audubon (Yellow-rumped) Warbler is in the same position. Four of 40 birds taken after the fire were banded in 1979 and early 1980. Like the Hermit Thrush, this is both a transient migrant and a winter resident, so we cannot estimate survival. Of another migrant, the Orange-crowned Warbler (Vermivora celata), three were taken before the fire, and a September captured bird was recaptured in January 1981. Since this is a transient, I wonder if it wandered away and returned. The Oregon (Dark-eyed) Junco (Junco oreganus) is a late arrival, and they were not seen until after the fire. One of seven birds was a return from early 1980. House Finches (Carpodacus mexicanus) are both resident and wanderers in this area. Their repeat rate before the fire had been 15% and following it was 23%; and five of the 22 birds were those that had been ringed during 1980. White-crowned Sparrows, another winter resident, had just begun to arrive in the habitat before the fire. Following the fire, 29 birds were captured, one of which was one of six that had been ringed just before the fire, so some of the early arrivals had survived. There was one survivor of Brown Towhees and 18 of Spotted Towhees, and these have been discussed.

On the morning following the fire, a Spotted Towhee was found that had its wings singed so badly that it could not fly, and it died soon after discovered. On November 11, 14 days after the fire, a Golden-crowned Sparrow was captured. This bird had its upper and lower mandibles damaged, and both feet were badly swollen. This bird survived until 9 December, when it was recaptured. Its right foot was only bone below the hallus, but no toes, and its mandibles were distorted. Later, several Spotted Towhees were captured, showing similar foot damage. In these, the mandibles, usually lower, and the forward toes were damaged or missing. These birds were banded and released, and somehow survived to be recaptured. It would not be suggested that these scratching species would forage in the smouldering ashes following the fire, ashes hot enough to burn the tissue. Something else happened. Moisture from the rain or dew, reacting with wood ash or some other soil elements, may have produced conditions caustic to the feet and bills of these birds. It is only a suggestion, but certainly what ever caused it was another hazard that the survivors of this fire had to face, beside exposure to feral cats, raptors, other predators, intra-specific strife, starvation, exposure to weather, inter-specific competition for food and sleeping places, depleted food supplies, plus being displaced from their normal and established territories.

This is a brief account of what appeared to have happened, or to be happening, to a population of more than thirty species of birds, in a man disturbed chaparral and riparian habitat of Southern California overwhelmed by fire at the end of summer, and in the midst of fall migration. It suggests that each species attempted to cope with its altered habitat in its own way, thereby allowing for few generalizations concerning the effects of fire upon the occupants in such an environment. And, by inference, it suggests that any use of fire to control chaparral environments must be done with utmost care and understanding of the ecosystem elements involved.