

Final Report

Initial Post-Fire Avian Response to High Fire Severity

Joint Fire Science Program project number: **03-2-3-15**

Principal Investigators:

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Project Rationale

Resource managers in southern California consider fire management and fire hazard reduction to be important components of their land management decisions. While wildland fire is a fundamental component in southern California ecosystem dynamics, inadvertent ignitions at the urban-wildland interface have led to multiple stand-replacing fires involving large tracts of land. Large wildfires are costly in terms of suppression resources, property loss, resource damage, and lives. Prescribed fire and other fuels treatments are used at the wildland-urban interface to reduce wildfire threat. However, prescribed fire frequently differs from wildfire in intensity, severity of effects, and particularly season of burn. Limited safe burning windows and air quality constraints work to restrict the size of fires and amount of prescribed burning that can be done. Nonetheless, prescribed fire is commonly used to improve wildlife habitat by burning vegetation in a mosaic of age classes. Relatively little research has been done on wildlife use of large tracts of burned habitat, particularly in chaparral.

At present, species that tolerate specific fire regimes have limited alternate habitat options due to massive urbanization of southern California. Thus fire and resource professionals need additional information on fire effects for local species and habitats to facilitate planning fuels management projects. Fire effects research on ecosystems requires landscape level studies that incorporate species dynamics. Most southern California prescribed burns are conducted during winter and spring, seasons when wildfires are uncommon. Ideally, research should study fire effects in ecosystems during fire season and on populations with viable population levels. This will reduce contingency plans redirecting exorbitant amounts of resources to endangered species or habitat.

Little attention has been given to fire effects on birds, particularly on a landscape scale. The July 2002 Pines Fire in eastern San Diego County presented an opportunity to study bird response to a large scale fire in southern California. At the time of the fire in July and August 2002, the San Diego Natural History Museum had just completed data recording for its San Diego County bird atlas. This project resembled other bird atlases in that it was based on a sampling grid of squares 3 miles on a side, was conducted over a 5-year period (March 1997-February 2002), and achieved a thorough inventory of breeding birds in each cell of the grid. All of the 28 squares of the grid touched by the Pines Fire were covered thoroughly. Research projects on large mammals and sensitive riparian species had also been established prior to the Pines Fire; large sections of the study areas were burned in the 61,645 acre fire. These circumstances offered a unique opportunity to study environmental effects of fire on southern California habitats and wildlife.

This JFSP project tracked post-fire changes in bird density and diversity to determine how avifauna responds to large, high-severity fire. The Pines Fire burned during the natural fire season, so the information gathered is relevant as baseline data for comparing to prescribed fire effects. Study results provide quantified post-fire data for numerous bird species. Responses of each species can be linked with various life-history attributes and habitat preferences. Data collected over the expanse of the Pines Fire may show a range of post-fire effects. Cumulative information can be compared to “unseasonable” prescribed burns to ascertain if fire effects fit within the variability of a “natural” fire. Additionally, habitat and species-specific bird population trends can then be joined with other San Diego faunal research programs to improve overall fire and habitat management. This information will be valuable for developing future perimeter size and intensity levels for fire prescriptions to reduce fuel loading while supporting wildlife resources.

Objectives of this Project

- 1) Evaluate the effects of a stand-replacing fire on southern California bird diversity and numbers for use in developing future perimeter size and intensity levels for fire prescriptions used to reduce fuel loading and support wildlife resources, particularly in chaparral.
- 2) Determine how avifaunas respond to a large, high severity fire to complement faunal post-fire research programs in the same area or similar habitat.
- 3) Disseminate results through electronic reports, journal articles, and public presentations.

Success in Meeting Objectives

- 1) Response to the high intensity, stand-replacing Pines Fire varied for the 97 bird species observed during this study for which data were sufficient for analysis. Abundance of 38 bird species increased in burned areas, suggesting that these species benefit from the burned environment much like vegetative fire followers. Abundance of 25 bird species declined, implying their habitat quality was degraded by fire. No preferences were observed for 26 bird species, while preferences for another 15 bird species need further study. To complicate matters, some species preferences were seasonal, preferring burned habitat during winter compared to avoidance of burned areas during the breeding season. Two-thirds of the bird species responded either positively or were unaffected by fire, indicating that fire could be used on a large scale to reduce fuels in their habitats or territories. Resource professionals may use this information to expand or shrink the prescribed fire size and shape based on the immediate post-fire habitat preferences observed for the various bird species living within the proposed burn perimeter.
- 2) Diversity and abundance changes from pre-fire populations have been documented for 97 bird species. Future collaboration on post-fire population dynamics with herpetologists and mammalogists will help determine how species’ abundances vary or coincide across taxa through time.
- 3) Preliminary electronic reports were distributed to interested parties at the end of each semi-annual field season (see Table 1). Presentations on the study have been given on five occasions to date, and another presentation will be made at the upcoming 3rd International Fire Ecology and Management Congress (November 2006). Data and summaries from this project will be made

available on the San Diego Natural History Museum website once all analysis is complete. A comprehensive journal article will be submitted by June 2007.

Table 1. Deliverables

Proposed	Delivered
Progress reports and presentations will be provided for year 1 and 2 to the Joint Fire Science Program, four southern California National Forests, and local fire and land management staffs, particularly those involved in ownership/management of the Pines Fire lands and surrounding vicinity.	Annual JFSP summaries were produced and 2 year post-fire results were presented. Bi-annual progress reports about bird population trends were sent electronically to user organizations and people as they became available. Five oral presentations of preliminary results were made at focus group meetings and conferences. Comprehensive results will be presented at the 3 rd International Fire Ecology and Management Congress in November 2006.
At completion of the study, results will be submitted to a peer-reviewed journal. Upon publication, copies will be delivered to fire and land managers and professionals plus others that have shown interest in this Pines Fire research.	Final data have been collected and entered. Analysis is underway. Results will be disseminated to appropriate user groups, and a journal article encompassing the comprehensive study results will be submitted by June 2007.
Results and interpretation, including GIS-generated maps of the results, will be available to the public through the San Diego Natural History Museum’s website, www.sdnhm.org .	Upon completion of analyses, the final report and all pertinent information from this study will be added to the San Diego Natural History Museum web page.
Additional deliverables	A second massive wildfire occurred in 2003 in adjacent bird survey sites. Data from both fires can now be compared to determine if similar trends occur in bird populations after large fires. Additionally, post-fire data collection has continued without interruption. New funds have been secured so that long-term pre- and post-fire bird survey datasets may continue uninterrupted for 2 more years.

Presentations

Unitt, Philip. Effects on birds of San Diego County's Wildfires of 2002-2003. San Diego Audubon Society annual banquet, May 2005, San Diego, CA.

Unitt, Philip. Effects on birds of San Diego County's Wildfires of 2002-2003. San Diego Partners for Biodiversity meeting, 23 August 2005, San Diego, CA.

Unitt, Philip. Effects on birds of San Diego County's Wildfires of 2002-2003. San Diego Natural History Museum presentation, October 2005, San Diego, CA.

Unitt, Philip. Effects on birds of 2002-2003 wildfires in San Diego County. Western Field Ornithologists' 30th Annual Meeting, September 29-October 1, 2005, Santa Maria, CA.

Unitt, Philip. Initial post-fire avian response to high fire severity. Joint Fire Science Program annual meeting, 2 November 2005, San Diego, CA.

Summary of Research Findings

Most possible patterns of avian population response to wildfire are exemplified by one species or another observed after the Pines Fire (Table 2). Notably, the number of species preferring burned habitat is roughly similar to the number preferring unburned. Some species, such as the Mountain Bluebird and Mourning Dove, prefer to forage on bare ground. These species were attracted to the burned area and have decreased since, as the vegetation has recovered. The Mourning Dove was the most abundant bird in the Pines Fire area for the first two breeding seasons after the fire.

Even though some species, such as the Rock Wren, prefer bare ground, they may not have been able to find sufficient food in the area the first winter after the fire. The Pines Fire burned in July and August, so there was no growing season between it and the following winter. The response of some species that exploit early successional vegetation, such as the Mountain Quail and Black-chinned Sparrow, was not expressed in the first year after the fire, whereas for others, such as the Lazuli Bunting, it was. The response of some species was gradual; for others, it was abrupt. For example, the Fox Sparrow was virtually absent for the first three winters following the fire, then appeared in substantial numbers in the fourth winter.

Winter visitors especially responded negatively to the lack of food and cover that first winter after the fire. Such species included both insectivores like Say's Phoebe and granivores like the White-crowned Sparrow.

Birds' responses to the fire were modulated in many cases by variations in rainfall. Species taking advantage of the burned area appear more opportunistic in their response to rainfall as well. A dry winter in 2003–04 was followed by a wet winter in 2004–05 then a dry winter in 2005–06. These variations are likely responsible for the zigzag patterns of abundance seen in the Lazuli Bunting, a major fire-follower, and several winter visitors, primarily granivores.

Many of the resident chaparral birds followed the pattern of steady increase, paralleling the recovery of the vegetation. Examples of these include the Spotted Towhee and Bewick's Wren.

The Bushtit and Oak Titmouse exemplify the dipping pattern. Both of these are sedentary species. In the first year after the fire the survivors may have found themselves in an environment inadequate to sustain them, and a portion died or left the area before the population started to recover. The Bushtit was the most severely affected year-round resident bird over most of the Pines Fire area.

Some species preferring unburned habitat continued to use the burned area but have not increased there. Evidently the burned area is still inferior habitat from the point of view of species like Steller's Jay and Scott's Oriole.

Vegetation increased both vertically and horizontally (height and cover) across all habitats sampled, but has not yet returned to pre-fire status. Overlays of bird species occurrences with averaged habitat components will identify any gross features that may result in refinement of suitability factors required after large scale fire for each bird species or guild.

These data are being made available to other professionals to complement their post-fire research. Results and information gathered from this research will be available electronically

on the San Diego Natural History Museum website. Forest supervisors, fire managers, and resource professionals in southern California including National Forests, local U.S. Fish and Wildlife Service, and Bureau of Land Management will personally receive copies of all final information. Copies will be offered to non-federal resource, fire, and fuels managers (belonging to organizations such as private biological consulting firms, The Nature Conservancy, and State and County Departments in charge of fire on southern California lands). Upon completion of analysis, we will report our results at a major fire conference (November 2006) and publish a comprehensive paper in a journal.

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Explanation for Table 2

Table 2 lists the species by both response to the fire and change since the fire. In the columns, the species are categorized as preferring unburned habitat, preferring burned habitat, or having no preference, as specified by the chi-squared test. For some uncommon or localized species, the preference could not be established, especially in the case of some riparian species (two burned routes cover riparian habitat, but no control route does). In the rows, the species are categorized by pattern of change over the 4 years of the study so far. Because the study covers 4 years, the pattern can be a decrease, an increase, peaking (increase followed by a decrease), dipping (decrease followed by an increase), a zigzag pattern of increase–decrease–increase, a zigzag pattern of decrease–increase–decrease, no change, or absent from the burned routes entirely. The categorizations are the simplest possible interpretation supported by the chi-squared test.

The table specifies whether the pattern observed applies to the breeding season (b) or winter (w). Thus species occurring year round can appear in the table twice, if their response in winter differed from their response in the breeding season. In some cases this is due to a seasonal difference in the species' biology; in others it is due to a difference in phase -- that is, a pattern reflected at one season may not yet have played out fully at the other season. If the species' response was the same at both seasons, the species appears only once, noted with "b&w."

If the species' pattern of change along the burned routes differed significantly from its pattern of change (if any) along the unburned routes, as specified by the chi-squared test, the species name is in **boldface**. If the species was absent or rare along the control routes, the comparison could not be made.

Table 2. Responses of birds to the Pines Fire, December 2002–July 2006.

Trend within burn area	No preference for burned or unburned	Prefers burned	Prefers unburned	Preference unclear
Decreasing		Mourning Dove (b) N. Mockingbird (b) Black-headed Grosbeak (b)		Horned Lark (b)
Peaking	White-throated Swift (w) Flicker (w) Say's Phoebe (b)	Band-tailed Pigeon (b&w) Costa's Hummingbird (b) Anna's Hummingbird (b) Black Phoebe (b) Loggerhead Shrike (b) Western Scrub Jay (w) American Crow (w) European Starling (b) Rock Wren (b) House Wren (b) Lawrence's Goldfinch (w) Dark-eyed Junco (w) Rufous-crowned Sparrow (b)	Acorn Woodpecker (w) Hairy Woodpecker (b) White-breasted Nuthatch (b) Cactus Wren (b) Black-throated Sparrow (w) Brewer's Blackbird (b)	Northern Harrier (w) Sharp-shinned Hawk (w) Horned Lark (w) Western Meadowlark (w)
Zigzag (down-up-down)		Lazuli Bunting (b)		
Zigzag (up-down-up)	Savannah Sparrow (w) Brewer's Sparrow (w) Yellow-rumped Warbler (w)	Mourning Dove (w) House Wren (w) American Pipit (w) Lesser Goldfinch (w) House Finch (w) Golden-crowned Sparrow (w) Chipping Sparrow (w) Lark Sparrow (w)		
Dipping	Common Raven (b&w) House Finch (b)	Nuttall's Woodpecker (w) Western Kingbird (b) Mountain Bluebird (w) Lawrence's Goldfinch (b)	Oak Titmouse (b) Bushtit (w)	Red-winged Blackbird (b)
Increasing	Cooper's Hawk (b) American Kestrel (b&w) Mountain Quail (w) Say's Phoebe (w) Loggerhead Shrike (w) Western Scrub Jay (b) Phainopepla (b) Western Bluebird (w) N. Mockingbird (w) Blue-gray Gnatcatcher (b&w) Ruby-crowned Kinglet (w) Dark-eyed Junco (b) Vesper Sparrow (w) Sage Sparrow (b&w) Spotted Towhee (b) California Towhee (b&w) Brown-headed Cowbird (b)	White-tailed Kite (b) Red-tailed Hawk (b&w) Mountain Quail (b) California Quail (b) Wild Turkey (b) White-throated Swift (b) Black Phoebe (w) European Starling (w) Rock Wren (w) Lesser Goldfinch (b) Lincoln's Sparrow (w) Black-chinned Sparrow (b) Rufous-crowned Sparrow (w) Spotted Towhee (w) Bullock's Oriole (b) Brewer's Blackbird (w)	California Quail (w) Wild Turkey (w) Greater Roadrunner (b&w) Acorn Woodpecker (b) Hairy Woodpecker (w) Steller's Jay (w) Phainopepla (w) Western Bluebird (b) California Thrasher (b&w) White-breasted Nuthatch (w) Cactus Wren (w) Bewick's Wren (b&w) Mountain Chickadee (b) Oak Titmouse (w) Bushtit (b) Violet-green Swallow (b) Wrentit (b&w) White-crowned Sparrow (w) Black-throated Sparrow (b)	Red-shouldered Hawk (b&w) Bell's Vireo (b) Hermit Thrush (w) Verdin (b) Fox Sparrow (w) Song Sparrow (b&w) Common Yellowthroat (b&w) Yellow-breasted Chat (b) Red-winged Blackbird (w) Western Meadowlark (b)
Flat	Anna's Hummingbird (w) Flicker (b) Western Wood Pewee (b)	Nuttall's Woodpecker (b) American Crow (b) Ash-throated Flycatcher (b) Lark Sparrow (b)	Ladder-backed Woodpecker (b&w) Hutton's Vireo (b) Steller's Jay (b) American Robin (b) Mountain Chickadee (w) Scott's Oriole (b)	Verdin (w) Summer Tanager (b) Blue Grosbeak (b)
Absent			Pygmy Nuthatch (b&w) Scott's Oriole (w)	