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Short-term changes in summer and winter resident bird communities following a high severity wildfire in a southern USA mixed pine/hardwood forest

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ABSTRACT

High severity forest fires are increasing in large areas of the southern and western United States as the climate becomes warmer and drier. Given their strong roles in ecosystem dynamics, documenting the response of bird communities to wildfires is important for improving our understanding and management of post-wildfire ecosystems. However, because wildfires are unplanned events, relatively few studies have been conducted to assess local-scale impacts on forest bird communities. In this study, we had the opportunity to use a before-after, control-impact (BACI) approach to assess the response of resident birds to high severity wildfires that occurred in the Lost Pines ecoregion of Texas in September and October 2011. We replicated a previous study using point count surveys to assess summer and winter bird community changes ca. 1 year after the wildfires. We found that total number of detected individuals did not change following the wildfires, but winter bird species richness increased in burned habitat. Changes were apparent at the foraging guild-level for the winter bird community, with an increase in aerial insectivores and decrease in bark insectivores. Summer and winter bird community composition changes were apparent at the species-level and generally agreed with species-specific habitat preferences. For example, species such as eastern bluebirds and chipping sparrows that prefer open woodlands were positively associated with burned habitat. Our results provide quantitative evidence that high severity forest fires increased habitat suitability for many resident bird species. At the landscape-scale, fire-induced increases in habitat heterogeneity could result in higher bird diversity in the Lost Pines ecoregion. We expect bird community composition will be dynamic in the Lost Pines ecoregion over the next few decades as the burned habitat continues to change through successional processes and post-fire management actions.

1. Introduction

The climatic pattern towards warmer and drier conditions in much of the southern and western United States, coupled with longstanding broad-scale fire suppression, have resulted in an increase in high severity forest fires (Litschert et al., 2012; Crotteau et al., 2013; Hurteau et al., 2014), particularly in pine-dominated and mixed-pine forests (Miller et al., 2009; Miller and Safford, 2012). Previous research has shown that fire severity is a primary driver of fire influences on many ecosystem components (Knapp et al., 2009; Brown et al., 2014a), including influences on bird responses (Smucker et al., 2005; Fontaine and Kennedy, 2012; Lindenmayer et al., 2014). Thus, improving our understanding of community responses to high severity forest fires (i.e., wildfires that kill or top-kill the majority of live vegetation and consume the majority of dead organic matter) is currently of high interest to assist land managers with post-fire management decisions (Bisson et al., 2003; Beschta et al., 2004). These decisions range from allowing natural recovery and regeneration regimes

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with minimal human intervention up through to high levels of manipulation, such as salvage logging and active revegetation (Driscoll et al., 2010; Powers et al., 2013).

Understanding the response of bird communities to wildfires is important given their strong roles in ecosystem dynamics (Sekercioglu et al., 2004; Anderson et al., 2011; Cavallero et al., 2013), potential use as ecological indicators (Niemi and McDonald, 2004; Howe et al., 2007), and aesthetic, cultural, and intrinsic value (Burger et al., 1995; Bowen-Jones and Entwistle, 2002). Given the vagility of birds, fire-induced changes in abundance and occupancy are likely driven by spatial responses to changes in habitat suitability (i.e., food resource and nesting site availability and structural habitat preferences; Hutto, 1995; Saab and Powell, 2005; Fontaine and Kennedy, 2012). At the extreme end, species such as Kirtland's warbler (*Setophaga kirtlandii*), red-cockaded woodpecker (*Picoides borealis*), and black-backed woodpecker (*Picoides arcticus*) are fire specialists, relying on wildfires to generate high suitability habitat under natural conditions (Probst, 1986; Saenz et al., 2001; Hutto et al., 2008). Wildfires can also result in reduced habitat suitability, particularly for species that are primarily foliage insectivores (Saab and Powell, 2005) and species that prefer mature forests (Ager et al., 2007). Given the diversity and complexity of ecological requirements and preferences of bird species, studies that investigate local-scale responses to habitat changes are useful both for informing post-wildfire management decisions and for understanding landscape-scale species and community patterns and trends (Dickson et al., 2009; Pons and Clavero, 2010; Fontaine and Kennedy, 2012).

In this study, we had the opportunity to assess the short-term outcomes on the bird community following a high severity wildfire in the Lost Pines ecoregion of central Texas. To our knowledge, this represents the first published study to assess wildfire impacts on birds in this mixed pine/hardwood ecoregion. Further, although several studies have investigated fire impacts on grassland and shrubland bird communities in Texas (e.g., Reynolds and Krausman, 1998; Marx et al., 2008; Roberts et al., 2012), to our knowledge this is the first published study to assess wildfire impacts on bird community composition in forested regions of Texas. We hypothesized that the substantial changes in forest structure would result in local-scale species composition changes through indirect impacts on food resource and nesting site availability, and species-specific habitat preferences. Specifically, we predicted that insectivorous species that primarily forage on tree bark and foliage would decrease in the short-term, whereas other insectivorous guilds and omnivores would increase due to greater understory vegetation diversity (Brown et al., 2014a) potentially producing greater insect diversity and abundance (Swengel, 2001; Buddle et al., 2006). We also predicted that species associated with open forest habitats would increase in burned areas due to substantial tree mortality, whereas species associated with mature closed-canopy forests would decrease in burned areas.

2. Methods

2.1. Study area

This study was conducted in the 34,400-ha Lost Pines ecoregion in Bastrop County, Texas, USA (Fig. 1). The Lost Pines is a remnant patch of loblolly pine (*Pinus taeda*)-dominated forest that was likely isolated from the East Texas Piney Woods ecoregion between 10,000 and 14,000 years ago, when east-central Texas transitioned from primarily forest to primarily open savanna and grassland (Bryant, 1977). Genetic data indicate the loblolly pines of the area began to differentiate genetically up to 30,000 years ago

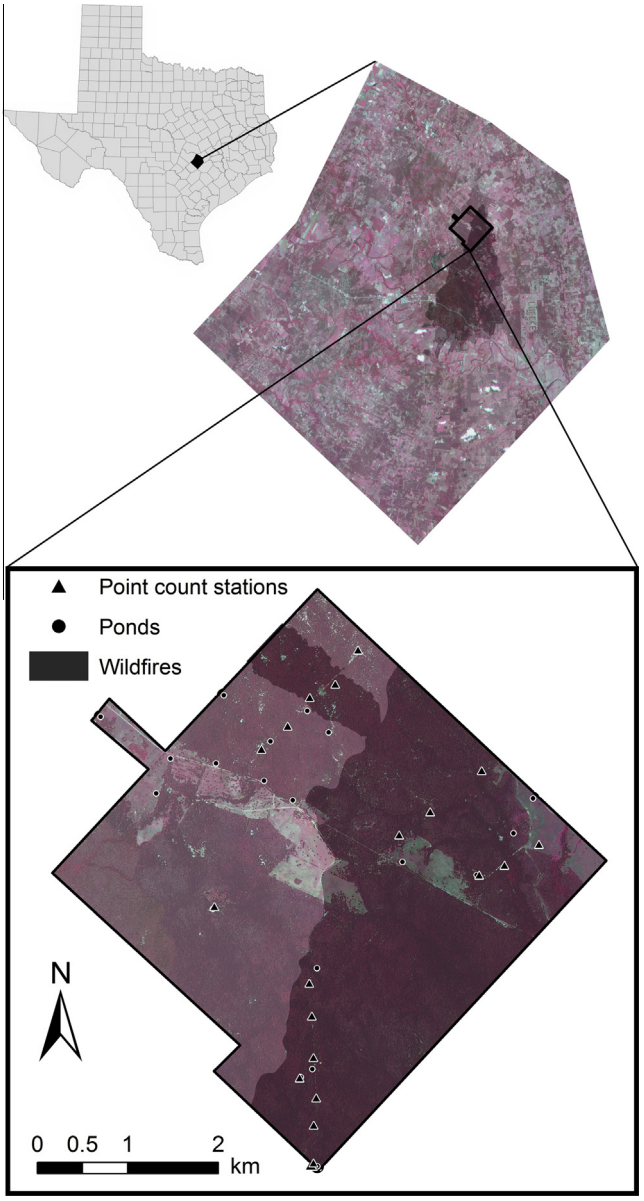

Fig. 1. Aerial image of the Griffith League Ranch (GLR), Bastrop County, Texas, USA, and its location with respect to high severity wildfires that burned 13,531 ha in the Lost Pines ecoregion in September and October 2011. Overlain on the image are the locations of the point count stations used to investigate changes in the summer and winter resident bird communities following the wildfires.

(Al-Rabah'ah and Williams, 2004). The Lost Pines was extensively logged in the 1800s and early 1900s (Moore, 1977). Since the early to mid-1900s, landscape-scale fire suppression has been implemented throughout the ecoregion, resulting in the accumulation of heavy fuel loads.

The study area for this project was the 1948-ha Griffith League Ranch (GLR). The GLR was primarily a forested ranch, with a pre-fire overstory dominated by loblolly pine, post oak (*Quercus stellata*), and eastern red cedar (*Juniperus virginiana*), and a pre-fire understory dominated by yaupon holly (*Ilex vomitoria*), American beautyberry (*Callicarpa americana*), and farkleberry (*Vaccinium arboreum*). The GLR contains 3 permanent ponds (i.e., ponds have not dried in at least 14 years), 10 semi-permanent ponds (i.e., ponds typically dry several times per decade), and 10 or more ephemeral pools that hold water for days to months annually depending on rainfall.