BIRD RESPONSE TO FIRE SEVERITY AND REPEATED BURNING IN AN UPLAND HARDWOOD FOREST

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Prescribed burning is a common management tool for upland hardwood forests, with wildlife habitat improvement an often cited goal. Fire management for wildlife conservation requires understanding how species respond to burning at different frequencies, severities, and over time. In upland hardwood forests of the Eastern United States, high-severity fires are rare, and effects on breeding bird communities are not well known. Research indicates that single or multiple low-intensity burns with little tree mortality may have a negligible effect on most bird species, or short-term effect on some species associated with shrub or leaf litter cover (Aquilani and others 2000; Artman and others 2001; Greenberg and others 2007, 2013). In contrast, high-severity fires with heavy tree mortality may create habitat for species requiring open, early successional conditions (Greenberg and others 2011) or snags for nest cavities, while retaining many species associated with closed canopy forests (Greenberg and others 2007, 2013). In this study, we experimentally assessed how breeding bird communities and species responded to fuel reduction treatments, including prescribed fire and a fire surrogate.

Our study was conducted on the 14,400-acre Green River Game Land in Polk County, North Carolina, in the mountainous Blue Ridge Physiographic Province of Western North Carolina. Our experimental design was a randomized block design with repeated measures over years. We selected three study areas (blocks) within the Game Land. We selected blocks to ensure consistency in baseline forest age, type, and management history among the treatments. Minimum size of experimental units (4 within each block; 12 total units) was 35 acres to accommodate 25-acre "core" areas, with 66-foot buffers around each. Treatments were: mechanical understory reduction in 2002 (M); prescribed fire in March 2003 and a second burn in March 2006 (B); mechanical understory reduction (2002) followed a year later (2003) by prescribed fire, and a second burn in 2006 (MB); and compared to controls (C).

We measured density of live trees and snags in each experimental unit before treatments (2001), twice after initial treatments (2003, 2005), and again twice after the second prescribed burns in both burn treatments (2006, 2011). We surveyed breeding bird communities using three, 164-foot radius point counts spaced 656 feet apart in each experimental unit. Each point was surveyed for 10 minutes during three separate visits between 15 May and 30 June during 2001–2005 (after initial fuel reduction treatments) (Greenberg and others 2007), and in 2006, 2007, 2009, and 2011 (Greenberg and others 2013) to study the longer-term effects of fuel reduction treatments that included a second prescribed fire in both B and MB.

During the first prescribed burns (March 2003), flame heights of 3 to 6 feet occurred throughout all burn units, but reached up to 15 feet in localized spots within blocks, where topography or intersecting flame fronts contributed to erratic fire behavior. In the 2003 burns, temperature at 12 inches aboveground averaged 594 ^{o}F in B, but patches (6–22 percent of each burn unit) burned at temperatures >1100 ^{o}F. In MB, where loading of dead fine woody fuels was approximately double that of C and M, temperatures at 30 cm aboveground averaged 517 ^{o}F, and 22–49 percent of each unit burned at temperatures >1100 ^{o}F. The second burn (March 2006) was less intense, with flame heights generally < 5 feet. In 2006, measured temperatures 12 inches aboveground were generally < 316 ^{o}F on B sites and 433 ^{o}F in MB sites, with <3 percent of any burn unit exceeding 1100 ^{o}F. A detailed description of fire behavior in this study is given by Waldrop and others (2010).

Initial (2003) higher dead fuel loadings and consequently high-severity fires in MB killed trees (fig. 1a) and created open canopy structure with abundant snags (fig. 1b). These changes to forest structure resulted in much higher species density (fig. 2a) and richness (fig. 2b) of breeding birds in MB compared to other treatments due to a higher occurrence and (or) abundance of species associated with young, open forest and edge conditions such as eastern bluebirds (*Sialia sialis*), indigo buntings (*Passerina cyanea*), eastern towhees (*Pipilo erythrophthalmus*), brown thrashers (*Toxostoma rufum*), chipping sparrows (*Spizella passerina*), American goldfinches (*Carduelis tristis*), mourning doves (*Zenaida macroura*), and pine

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warblers (*Setophaga pinus*), in addition to most other species that also occurred in the other treatments and control. Abundance of most other species was not affected by the three fuel reduction treatments, even after the second burn.

Although we could not assess whether a second burn contributed additionally to the delayed tree mortality initiated by a single burn, our results indicate that repeated, relatively low-intensity burning with patches of higher intensity fire can affect a gradual, subtle change in forest structure that may, over time, attract breeding bird species associated with young forest conditions. In contrast, a single high-intensity, high-severity fire can create young forest conditions and a heterogeneous canopy structure that can be maintained by repeated burning and increase breeding bird relative abundance and richness by attracting disturbance-adapted species while retaining most other forest species.

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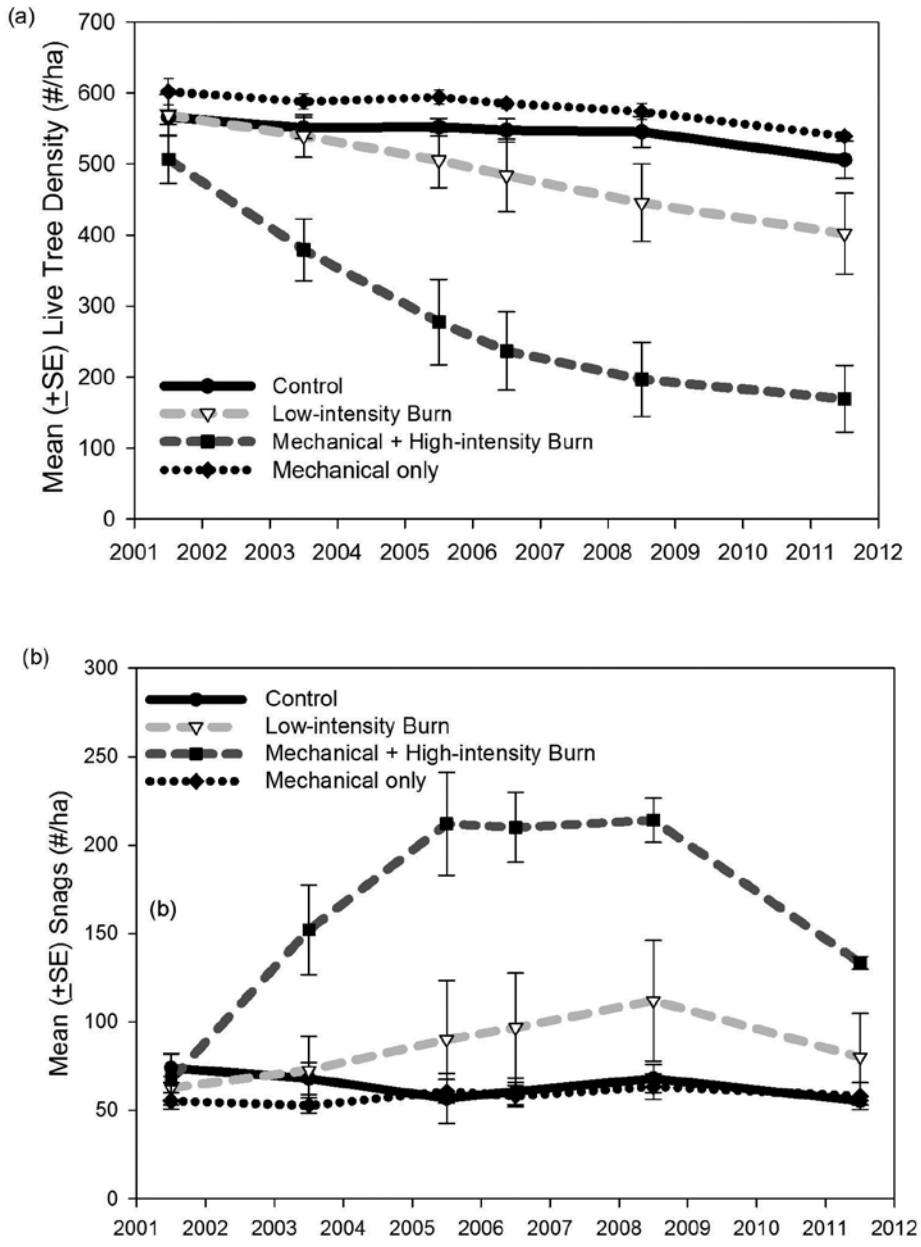

Figure 1—Mean (±SE) total density of (a) live trees and (b) standing snags in 3 fuel reduction treatments: burned (2003 and 2006); mechanical understory reduction (2002); mechanical understory reduction (2002) then burned (2003 and 2006); and untreated controls (n = 3 each), Green River Game Land, Polk County, NC.

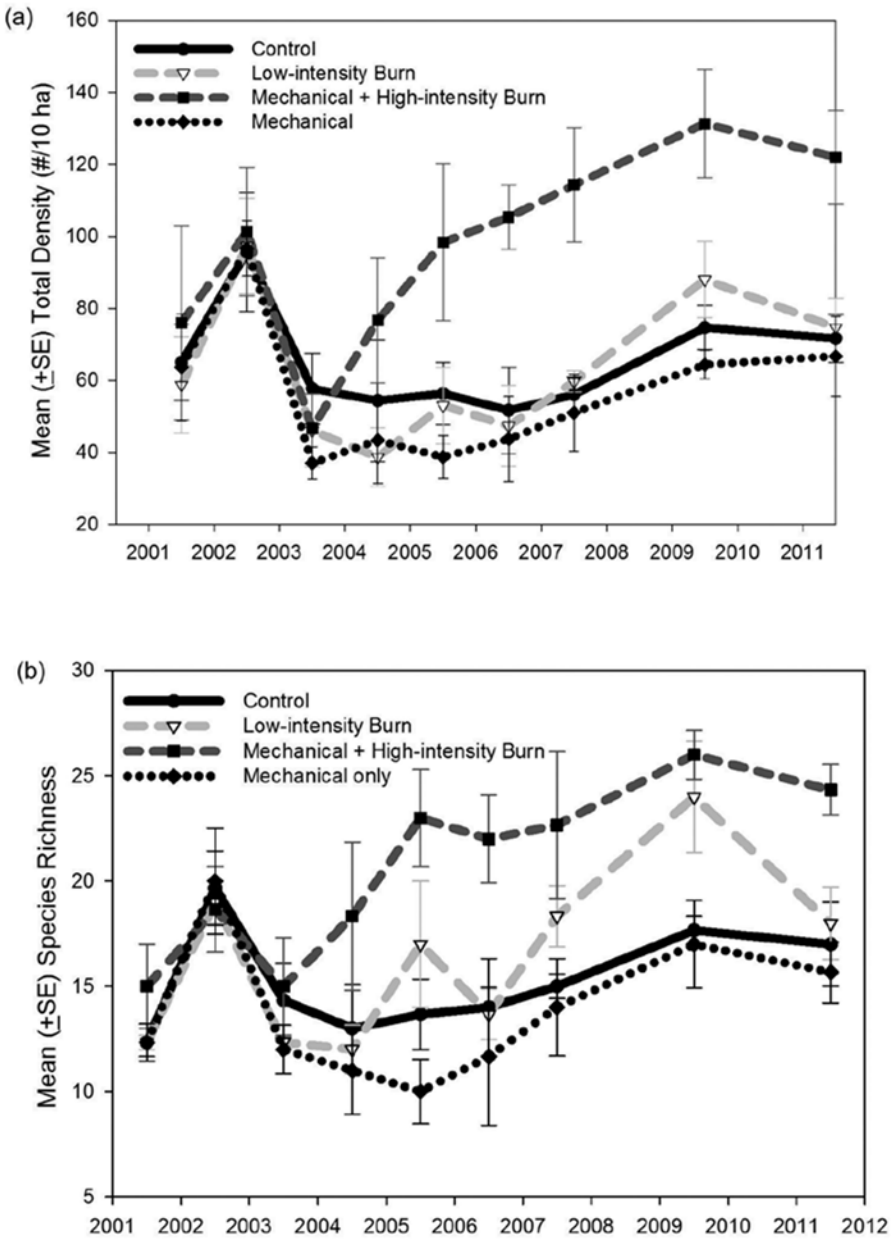

Figure 2—Mean (±SE) (a) total density and (b) species richness of breeding birds in 3 fuel reduction treatments: burned (2003 and 2006); mechanical understory reduction (2002); mechanical understory reduction (2002) then burned (2003 and 2006); and untreated controls (n = 3 each), Green River Game Land, Polk County, NC.