HERPETOFAUNAL RESPONSES TO FOREST MANAGEMENT: A SYNOPSIS OF FINDINGS IN OAK-HARDWOOD RESTORATION FOREST STANDS

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Extended abstract—Globally, biodiversity declines have occurred at alarming rates across a wide array of taxa. Amphibians and reptiles (known collectively as herpetofauna), represent two taxa that have declined considerably over the past three decades. A variety of stressors, including landscape change, habitat destruction, emerging pathogens, illegal collection, and climate change all contribute synergistically to impact herpetofaunal populations. Of these threats, habitat alteration and destruction represent acute stressors that have increased concomitantly with the rise in global human population. Habitat alteration includes a variety of natural and anthropogenic sources of disturbance. Forest management represents a significant form of habitat disturbance that often impacts large portions of the landscape; however, forest management practices involve a variety of vegetation management techniques that can be tailored to mimic regional disturbance regimes. In addition, forest management can be used in a restoration context to restore ecosystem function and forest structure. Our current study evaluated the ecological impacts of forest restoration in pine-dominated forests in the William B. Bankhead National Forest (BNF) located in Lawrence, Winston, and Franklin counties of northwest Alabama. The over-arching goal of the larger project was to evaluate the efficacy of forest management (thinning and prescribed burning) to restore upland loblolly pine (*Pinus taeda*) dominated stands to historical hardwood (*Quercus* and *Carya*) conditions.

Experimental design consisted of a randomized block design and included six total treatments consisting of control (no thin and no burn), burn, light thin (17 m^2/ha residual basal area [BA]), heavy thin (11 m^2/ha residual BA), light thin and burn, and heavy thin and burn. Each treatment was replicated three times across the landscape for a total of 18 treatments with each stand approximately 9 ha in size. Herein, we report the impacts of the thinning and prescribed burning on herpetofaunal populations. We used a variety of techniques to evaluate herpetofaunal response to forest management, including drift fences equipped with box traps and pitfall traps (detailed in Sutton and others 2010) and artificial cover objects (Sutton 2010). In addition, we used radiotelemetry to monitor the spatial ecology and habitat use of the copperhead (*Agkistrodon contortrix*) in a subsample of stands. We employed radiotelemetry as a means to evaluate the impacts of forest management at a larger spatial scale than what would be revealed by drift fences alone. We monitored each forest stand for 1 year prior to management implementation and for 2 years post-management.

Over the 4-year study period, we captured a total of 2,643 individuals of 47 species (27 reptiles and 20 amphibians) over 3,132 trap nights. Collectively, we found that reptiles (specifically lizards and large-bodied snakes) were impacted by forest management compared to other reptile species (Sutton and others 2013, 2014). Specifically, the Green Anole (*Anolis carolinensis*), which was the most abundant lizard captured during the study (n = 261), increased up to two seasons post-treatment with abundance correlated with increased temperatures in thinned stands (fig. 1A). Eastern Fence Lizard (*Sceloporus undulatus*) counts increased primarily during the second season post-treatment primarily in thin and burn stands. Conversely, Little Brown Skink (*Scincella lateralis*) counts decreased post-treatment in all treated stands; we found that stands with greatest counts also had relatively greater litter depths (fig. 1A). Two other species, the Five-lined Skink (*Plestiodon fasciatus*) and Broad-headed Skink (*Plestiodon lateralis*), did not directly respond to forest management; however, *P. fasciatus* relative abundance was greater in forest stands with greater coarse woody debris cover (fig. 1A). In reference to snake responses to forest management, *A. contortrix* was the most abundant snake captured during the study (n = 178); however, we documented no clear impact of management on counts of this species (fig. 1B). The Black Racer (*Coluber constrictor*) and Black Kingsnake (*Lampropeltis nigra*) tended to increase in thin-only stands during the second year post-treatment (fig. 1B). Amphibians did not show a clear response to forest management, but pond-breeding species, such as the Marbled Salamander (*Ambystoma opacum*), Eastern

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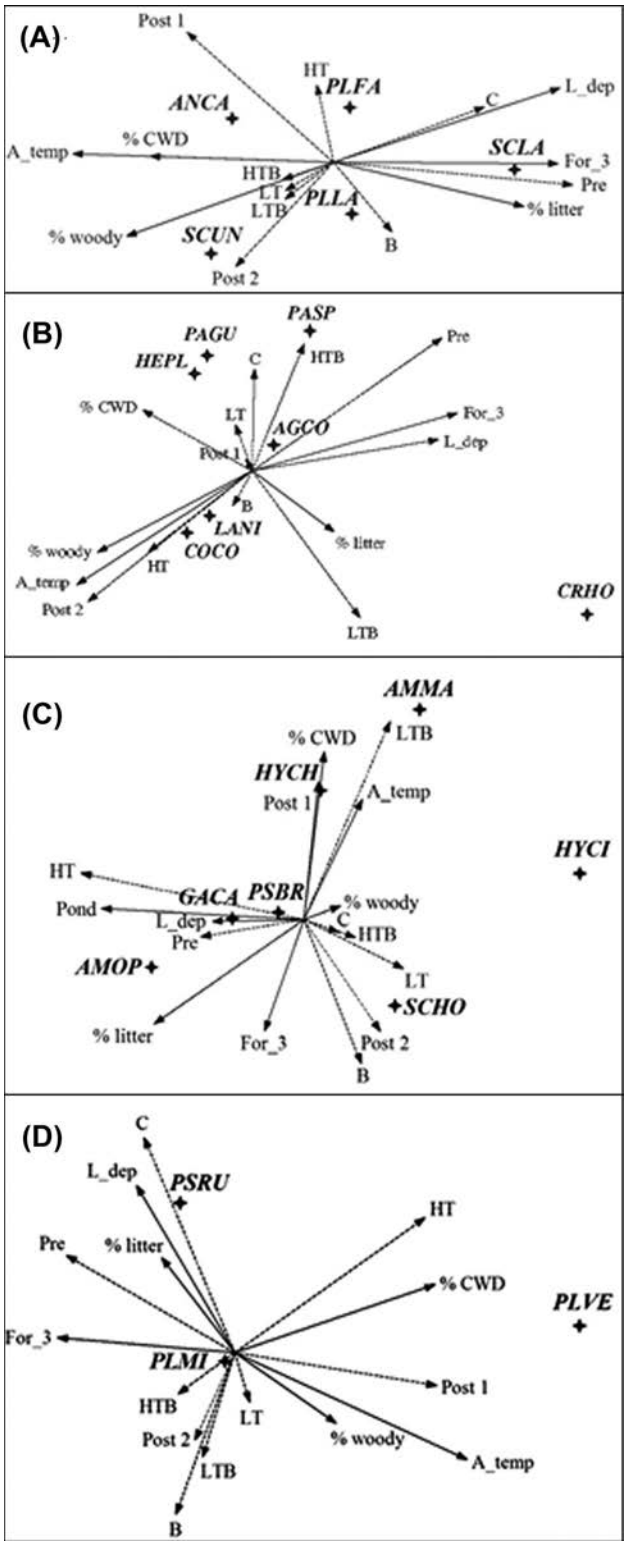

Figure 1—Ordination results displaying microhabitat, management, and yearly effects on lizards (A), medium- and large-bodied snakes (B), pond-breeding amphibians (C), and terrestrial salamanders (D) to forest management. Please refer to Sutton and others (2013) for further details related to these figures.

Narrow-mouthed Toad (*Gastrophryne carolinensis*), and Mountain Chorus Frog (*Pseudacris brachyphona*), tended to occur in forest stands that occurred in close proximity to temporary ponds (fig. 1C). The Eastern Spadefoot (*Scaphiopus holbrookii*) increased in abundance in thin-only stands primarily during the second year post-treatment (fig. 1C). We did not detect impacts of forest management on terrestrial salamanders, but found that the Red Salamander (*Pseudotriton ruber*) was primarily associated with unmanaged (control) stands (fig. 1D).

Results from our radiotelemetry work revealed that *A. contortrix* selected microhabitats with relatively greater litter depth and coarse woody debris cover compared to randomly available microhabitats (Sutton and others 2017). Although home range estimates were nearly three times larger for male *A. contortrix* compared to gravid female snakes, we did not observe differences in home range size between snakes in thin and unthinned stands (Sutton and others. 2017). At the landscape spatial scale, male snakes selected hard edge (e.g., road edges and field edges) habitats at a greater frequency than what was available and avoided pine forest and soft edge habitats; gravid female snakes did not select macrohabitats differently from what was available, but occurred most commonly in thinned stands (Sutton and others 2017). Overall, we found that forest management had negligible impacts on amphibians and had a more pronounced impact on reptiles. Lizards and large-bodied colubrid snakes generally increased in relative abundance after management, but considerable species-specific responses were observed, and these nuances should be considered prior to implementation of forest management operations in similar systems. As our study reports short-term responses of herpetofauna to prescribed burning and thinning, monitoring should be continued to understand longer term impacts of management on herpetofauna in pine-hardwood forests of the Southeastern United States.

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