

EFFECTS OF PRESCRIBED BURNING ON SMALL MAMMAL, REPTILE, AND TICK POPULATIONS ON THE TALLADEGA NATIONAL FOREST, ALABAMA

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Abstract—A study of the relationship between prescribed burning and tick populations was conducted in the Talladega National Forest, AL. The study area for mammal and tick sampling consisted of 12 plots ranging from the unburned control site to sites burned within the previous 5 years. The study area for reptile sampling consisted of four plots ranging from the unburned control site to sites burned within the previous 5 years. Small mammal trapping yielded a total of 66 individuals and 5 species captured over 2,160 trap nights. One-way analysis of variance (ANOVA) results showed significant difference between *Peromyscus leucopus* populations across burn treatments. A total of 107 reptiles were captured, representing 12 species. Both species richness and Shannon index of diversity were significantly lower in plot 1 (1 month postburn). Both values increased in plot 2 (1 year postburn). A total of 321 individual ticks were collected. Over 90 percent were lone star ticks (*Amblyomma americanum*), with the remaining ticks being American dog ticks (*Dermacentor variabilis*). ANOVA results showed statistically significant changes in tick populations between sites with different burn treatments.

INTRODUCTION

Prescribed burning removes accumulated fuels and, therefore, reduces the risk of intense fires. Many public agencies and some private landowners conduct prescribed burns to restore or improve natural forest conditions (Long 2002). Forests containing longleaf pine (*Pinus palustris*) are frequently burned to maintain habitat suitable for red-cockaded woodpeckers (*Picoides borealis*) and other species. Burning also promotes seed germination, flowering, and resprouting of fire-adapted native plants and generally improves wildlife habitat. Regular burning of rangelands and understory plants improves forage quality and quantity for wildlife and livestock. Fire can also change the physical conditions of a habitat, which select for the types of organisms that inhabit the area (Pilliod and others 2003).

Reptiles and small mammals are reservoirs for many tick-borne pathogens. The objective of this study was to determine how prescribed burning influences small mammal, reptile, and tick populations.

METHODS

Study Area

Talladega National Forest is at the southern terminus of the Appalachian Mountain chain. The Shoal Creek District is located in northeastern Alabama and lies in Calhoun and Cleburne Counties. The Shoal Creek District is comprised of hills and low mountains with steep slopes.

The study area is located near Coleman Lake in the Shoal Creek District. It was selected based on the availability of burn data. The study area consisted of 12 plots ranging from the unburned control sites to sites burned within the previous year.

Small Mammal Collection

Twelve sites were chosen based on length of time elapsed since a prescribed burn—1 month, 1 year, 5 years, and an unburned control. Three sites were selected for each time

period. Small mammals were collected on each site using Sherman live traps arranged in a 3 by 3 grid with trap spacing at 20 m apart. Traps were baited with sunflower seeds and checked each morning of the trapping period. Trapping was conducted for 5 nights for 4 months during the new-to-quarter moon phase to minimize the possible effect of moonlight on capture. Animals collected were identified to species then tagged and released at the site of capture. Animal collection data were separated by treatment type.

Due to small sample size, an index of population size was used instead of a statistical population estimator. The number of individuals captured per 100 trap nights (n individuals/ n trap nights * 100) was calculated for each species and for all species combined (Yates and others 1997). One-way ANOVA was used to compare the *Peromyscus leucopus* populations between treatments. Also the Shannon-Weiner diversity index was calculated and compared using a t-test.

Reptile Collection

Beginning in April 2008, two unbaited pitfall arrays with funnel traps were installed in each of four plots. These plots had varying burn histories—plot 1 was burned 1 month prior to study, plot 2 was burned 1 year prior to study, plot 3 was burned 5 years prior to study, and plot 4 was the unburned control site. Traps were opened beginning in May of 2008 and remained open throughout the duration of the study. The traps were checked approximately every 4 days from May to October. Any reptiles that were captured were identified, measured, and marked using toe-clipping method.

Plots were located along, or in the vicinity of, Forest Service Road 500 located in the Shoal Creek Ranger District in the Talladega National Forest. Plot 1 was a predominantly longleaf pine community with a 22-percent canopy cover. Plot 2 was also a longleaf community. Canopy cover in this plot was 33 percent. Plot 3 was a mixed hardwood-pine forest with a canopy cover of 88 percent. Plot 4 had a closed-canopy mixed hardwood-pine forest.

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Raw data was analyzed using species richness, Kruskal-Wallis one-way ANOVA, and Shannon index of diversity.

Tick Collection

Tick samples were collected at the same 12 sites used for small mammal trapping. Ticks were collected using the drag cloth method (Goddard 2007, Milne 1943). The cloths used were approximately 1- by 1-m squares of white flannel material attached to a dowel on one end and lightly weighted on the other to maximize contact with the vegetation. Each site was dragged for 20 minutes each month (May through September). The cloths were inspected approximately every 10 m during the sampling, and any ticks found on the cloths were removed and preserved in 70 percent ethanol for future processing. Ticks were identified by species and life stage (adult or nymph).

Tick collection data was separated by treatment type. One-way ANOVA analysis was used to compare populations between treatment types.

RESULTS

Small Mammal

A total of 66 individuals and 5 species were captured over 2,160 trap nights. *Peromyscus leucopus* was the most common species captured with 48 captures. This species

was captured on all treatment types. One-way ANOVA results showed significant differences between *Peromyscus leucopus* populations when comparing the unburned control vs. 5-year treatments, unburned control vs. 1-year treatments, and unburned control vs. 1-month treatments (table 1).

Combined species abundance was highest in plots that were burned within the previous year (6.11 individuals per 100 trap nights). Species abundance was lowest in plots that were unburned (0.56 individuals per 100 trap nights) (table 2). Species diversity and richness was greater in plots that were burned 1 month and 1 year ago (0.9434 and 0.8223, respectively) than those that were unburned and burned 5 years ago (0.6365 and 0.5196, respectively) (table 3).

Reptile

A total of 107 reptiles were captured, representing 12 species. Traps located in plot 1 (burned 1 month prior to study) captured 39 reptiles from 5 species. Dominant species were eastern fence lizard (*Sceloporus undulatus*) and broadhead skink (*Eumeces laticeps*). Traps located in plot 2 (burned 1 year prior to study) captured 19 reptiles from 8 species. Dominant species were the southeastern five-lined skink (*Eumeces inexpectatus*) and broadhead skink. Traps located in plot 3 (burned 5 years prior to study) captured 18 reptiles from 7 species. Dominant species were eastern fence lizard, eastern worm snake (*Carphophis amoenus*) and green

Table 1—Number of small mammals captured by treatment type in Shoal Creek District of Talladega National Forest, AL

Treatment	Total individuals	<i>Peromyscus leucopus</i>	<i>Mus musculus</i>	<i>Sigmodon hispidus</i>	<i>Tamias striatus</i>	<i>Ochrotomys nuttalli</i>
Unburned control	3	2	1	0	0	0
5 years	14	11	0	0	0	3
1 year	16	12	0	1	2	1
1 month	33	23	1	6	2	1
Total	66	48	2	7	4	5

Table 2—Number of small mammals captured per 100 trap nights by treatment type in Shoal Creek District of Talladega National Forest, AL

Treatment	<i>Peromyscus leucopus</i>	<i>Mus musculus</i>	<i>Sigmodon hispidus</i>	<i>Tamias striatus</i>	<i>Ochrotomys nuttalli</i>	All species
Unburned control	0.37	0.19	0	0	0	0.56
5 years	2.04	0	0	0	0.56	2.59
1 year	2.22	0	0.19	0.37	0.19	2.96
1 month	4.26	0.19	1.11	0.37	0.19	6.11

Table 3—Species richness and Shannon’s index of diversity for small mammals by treatment type in Shoal Creek District of Talladega National Forest, AL

Treatment	Species richness	Shannon index of diversity
Unburned control	2	0.6365
5 years	2	0.5196
1 year	4	0.8223
1 month	5	0.9434

anole (*Anolis carolinensis*). Traps located in plot 4 (unburned control) captured 31 reptiles from 8 species. Dominant species were eastern fence lizard and green anole (table 4).

According to Kruskal-Wallis one-way analysis of variance, plot 1 was found to be significantly different from plot 2 and plot 4 ($P = 0.041$ and $P = 0.099$, respectively). Comparisons of all other sites showed no significant differences.

Both species richness and Shannon index of diversity were lower in plot 1, which was burned 1 month prior to study. Both values increased in plot 2, with species richness stabilizing and species diversity steadily decreasing (table 5).

Tick

A total of 321 individuals were collected. Over 90 percent were lone star ticks (*Amblyomma americanum*), with the remaining ticks being American dog ticks (*Dermacentor*

Table 4—Number of reptiles captured in each plot in Shoal Creek District of Talladega National Forest, AL

Species	Plot 1	Plot 2	Plot 3	Plot 4	Total
<i>Anolis carolinensis</i>	3	0	3	5	11
<i>Carphophis amoenus</i>	0	0	3	0	3
<i>Coluber constrictor</i>	0	1	0	0	1
<i>Diadophis punctatus</i>	0	0	1	0	1
<i>Elaphe obsoleta</i>	0	1	0	1	2
<i>Eumeces fasciatus</i>	2	2	0	2	6
<i>Eumeces inexpectatus</i>	3	5	0	1	9
<i>Eumeces laticeps</i>	7	4	1	4	16
<i>Sceloporus undulatus</i>	24	3	7	16	50
<i>Scincella lateralis</i>	0	2	2	1	5
<i>Tantilla corona</i>	0	1	0	0	1
<i>Thamnophis sirtalis</i>	0	0	1	1	2
Total	39	19	18	31	107

Table 5—Species richness and Shannon’s index of diversity by treatment type for reptiles in Shoal Creek District of Talladega National Forest, AL

Treatment	Species richness	Shannon index of diversity
Plot 1	5	1.226
Plot 2	8	1.875
Plot 3	7	1.69
Plot 4	8	1.528

variabilis). ANOVA results showed statistically significant changes in tick populations between sites with 1-month burn treatments and sites with 5-year burn treatments. There was also a significant difference in the populations at sites 1-month postburn and unburned treatments. There was little to no difference between populations at sites with 1-month and 1-year burn treatments. There was also no significant difference in tick populations between the sites with 1-year burn treatments and sites with 5-year or unburned treatments (table 6).

CONCLUSIONS

Mammal

Recently burned plots had a high number of *Peromyscus leucopus* captured. According to Dickson (2001), white-footed mice quickly invaded pine plantations and were the most abundant small mammals the first year after a burn. *Peromyscus* spp. usually are the earliest invader of young stands due to increased ground vegetation postburn. Higher *Peromyscus* spp. populations on burned sites have been attributed to better visibility and abundance of seed, a food source for the mice, after reductions in litter cover and depth (Greenberg and others 2006).

In unburned sites, there were a low number of animal captures. Small mammal populations have been shown to be lower in older, more open forested areas that have little vegetation close to the ground. Mature forest stands with closed canopies and little herbaceous vegetation usually support a relatively low density of small mammals (Dickson 2001).

Reptile

High capture numbers found in plot 1 may be attributed to higher summer temperatures associated with open canopies. However, low species diversity in plot 1 can be attributed to a dominance of *Sceloporus undulatus*, a species which may seek refuge under objects during fires (Kahn 1960, Lillywhite and North 1974).

Richness and diversity initially increase after a prescribed burning treatment. If left undisturbed, species diversity decreases over time. This is due to the closing of the forest canopy, and the subsequent dominance of reptile species associated with this environment (Greenberg and others 1994).

Table 6—Number of ticks collected by month and treatment type in Shoal Creek District of Talladega National Forest, AL

Treatment	May	June	July	August	September	Total
----- number -----						
1-month burn	69	5	3	3	0	80
1-year burn	15	9	3	23	4	54
5-year burns	19	50	14	1	4	88
Unburned control	44	14	30	7	4	99

Tick

Burning significantly reduced populations temporarily, but numbers returned to normal within 2 to 5 years after fire disturbances. Annual and biennial prescribed burning has been shown to significantly reduce tick populations at all life stages (Davidson and others 1994). Fire mortality and reduction of leaf litter in burned areas are possible reasons for the reduction in tick populations.

While burn history is important, there are likely multiple factors determining tick populations at a given location.

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