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The Forests and Woodlands Campaign of the Illinois Wildlife Action Plan – Segment 6

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The Forests and Woodlands Campaign of the Illinois Wildlife Action Plan – Segment 6

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Overview and Objectives of Segment 6

The Forests and Woodlands Campaign (Forest Campaign hereafter) is one of the many important campaigns outlined in the Illinois Comprehensive Wildlife Conservation Plan and Strategy (wildlife action plan). The wildlife action plan highlights very well the many current conservation issues involving Illinois' wooded habitats including the alteration or loss of natural disturbance processes, changing composition of forested habitats away from oak-hickory to maple dominance, general decline in forest quality caused by increasing numbers of invasive exotic plant species, and extensive forest fragmentation. While the wildlife action plan provides direction in the form of a general list of priority actions, the Forest Campaign, over the next several years will specifically move the wildlife action plan forward by:

1) Using the best science available to establish and continue using monitoring protocols to measure the effectiveness of forest management activities and determine whether or not wildlife are responding to these activities;

2) Establishing demonstration sites where land managers and the public can observe and learn more about forest management in action and how it benefits wildlife.

In addressing these needs, the Forest Campaign will establish or reinforce forest management partnerships in Illinois, create protocols for monitoring the effects of forest management activities on Illinois' wildlife, and document whether or not forest management activities are successfully promoting populations of focal wildlife species and meeting the goals of the wildlife action plan.

To better understand the response of wildlife populations to forest management activities under the wildlife action plan, Segment 6 of the Forest Campaign was devised to meet the following objectives (1 September 2015 through 31 August 2016):

1) Continue monitoring protocols that measure the response of forest wildlife to various forest management tools that include, but are not limited to, thinning, fire, and the removal of invasive exotic plant species;

2) Use a "before-after-treatment-control" monitoring framework (with replication) in a number of sites across Illinois to begin documenting the effects of forest management on populations of forest- and woodland-dwelling birds;

3) Identify existing and begin developing new demonstration sites that highlight successful forest management techniques and actions, and that can be used to inform and educate various constituencies.

Following Segment 6, additional grant segments will focus on continuing to monitor the response of the forest wildlife to management activities, add more species to monitoring protocols (e.g. nightjars), measure various aspects of the vegetation (e.g. forest structure and composition) at survey points, and work with partners to use study sites as demonstration areas that highlight successful forest management techniques and actions. Efforts to enter and analyze data are ongoing (particularly vegetation data), and sites will be repeatedly monitored over time as additional research is completed in the coming years. As additional analyses are completed, new information will be passed along to agency and site administrators and managers. A summary of the number of bird survey locations at each site and the forest management treatments associated with them is provided in Table 1. Vegetation surveys were completed at half of these points. Included below are general site descriptions and summaries of what was accomplished at various sites during Segment 6 of the Forest Campaign.

Oakwood Bottoms Research Summary

Oakwood Bottoms Greentree Reservoir, located in Jackson County northeast of Grand Tower, Illinois, has been managed since 1964. Pin oaks and scattered cherrybark oaks are flooded during the fall and drained before the onset of the growing season to simulate flooding conditions that would naturally be expected in the Mississippi River bottomlands. Because the Big Muddy River levee prevents natural flooding of this site, flooding is accomplished by pumping water. As a result of tight soils and little drainage relief, the area is primarily a wet forest.

Beginning in 2007 thinning was employed to open the forest canopy on almost 1400 acres of the forest, nearly 17,000 container stock oaks were planted, and prescribed fires were initiated when and where conditions allowed. The thinning is being done within smaller subplots

(ranging in size from 1 to 7 acres) within various units of the site and includes the thinning of non-oaks in the understory and overstory within sub-plots. Smaller trees and saplings are cut down while larger non-oak trees are girdled. Fire is also being used in some areas, as conditions and feasibility allow. In combination, this approach provides greater light and less competition for the oak seedlings and saplings present in the understory while leaving the larger non-oaks to serve as snags and cavity trees for use by various wildlife.

Breeding Bird Point Count Survey Data. A total of 56 species were documented at bird survey points in Oakwood Bottoms including 11 that are on the SGNC list for Illinois. For the purposes of a general summary, bird surveys associated with the different forest management treatment types were grouped together into three simple categories (Table 2). The overall numbers of species detected in each the three categories were 46, 50, and 47 in the "no treatment", "thinning", and "thinning + fire" categories, respectively. The mean species diversity per survey point was significantly different among treatment categories (Figure 1). A summary of the bird survey results from the 2015 breeding season at Oakwood Bottoms yielded results that support the conclusion that the thinning in general, and potentially prescribed fire in conjunction with thinning, is having mostly positive or neutral effects on the relative abundance of forest birds (Table 2; Figures 2-3). Of the 19 species showing some kind of response (positive, negative, or mixed) to management activities (species highlighted in Table 2), 13 species of forest birds showed a **positive response** at Oakwood Bottoms (Figures 2-3; **abundance higher in one or both treatment categories compared to no-management category**), including some species that are on the SGNC list for Illinois (Yellow-breasted Chat and Red-headed Woodpecker). Five species had a **negative response** to the treatments (Figures 2-3; **abundance higher in the no-management category than one or both of the other categories**). One species, the Ruby-throated Hummingbird, had a **mixed response** (**more abundant in one management category and less abundant in the other compared to the**

no-management category). Species that are known to associate strongly with more-open forest canopies, more-complex (heterogeneous) forest structure, or more-dense shrub layer and ground cover tended to be the ones more abundant in the forest units where thinning has occurred (Table 2). In general, it can be concluded that the forest management at Oakwood Bottoms is having a net positive or neutral effect on the diversity and abundance of breeding bird species at the site. As the effects of forest management on the structure of the forest play out over the next several years, we will be able to assess the longer term effects of management on the breeding bird community and tease apart the short- and longer-term effects of the forest management on both the bird community and tree species composition.

Cowbird Abundance. A concern for breeding forest songbirds when thinning is used to open up the forest canopy is the potential for increased brood parasitism of songbird nests by Brown-headed Cowbirds. Female cowbirds may cue in on or use more heavily areas of the forest where the canopy has been opened up. The more-open overstory may make it easier for female cowbirds to view the nest building and mating activities of potential hosts while the cowbirds are searching for nests to parasitize. This could lead to higher rates of cowbird parasitism in forests that are thinned than those not thinned. In 2016, overall cowbird detections were nearly identical to the previous year (**0.46** vs. 0.47, respectively). Cowbird detections were **not** higher in any particular management category. Therefore, it is likely that the current forest management practices at Oakwood Bottoms will **not** increase cowbird parasitism. The overall abundance of cowbirds at the site suggests that rates of brood parasitism are likely moderate throughout the site.

Lake Shelbyville Research Summary

At the Lake Shelbyville Wildlife Management Area located in east-central Illinois, oak, hickory and hard maple flourish in the uplands. Improvements to the forest which consist of thinning the trees to enhance mast production and understory growth (e.g. 150-400 acres per year since 2008), nesting cover establishment, prescribed burning, and invasive species eradication (such as bush honeysuckle and autumn olive), are all being implemented on Lake Shelbyville to enhance the overall habitat. The active management on the site, including thinning, prescribed fire, and invasive-exotic plant species eradication, lends itself to obtaining before-after-treatment-control data to better understand the effects of this management on various species of forest birds.

Breeding Bird Point Count Survey Data. A total of 70 species were documented at bird survey points in the forests at Lake Shelbyville including 12 that are on the SGNC list for Illinois. For the purposes of a general summary, bird surveys associated with the different forest management treatment types were grouped together into four simple categories (Table 3). The overall numbers of species detected in each of the categories were 56, 59, 55 and 65 in the “no treatment”, “thinning”, “fire”, and “thinning + fire” categories, respectively. The mean species diversity per survey point was not significantly among treatment categories (Figure 4). A summary of the bird survey results from the 2016 breeding season at Lake Shelbyville yielded results that support the conclusion that the thinning and prescribed fire are having an overall positive effect on the relative abundance of forest birds (Table 3). Twenty-six species had some type of response to forest management (Table 3). Eighteen species of forest birds showed a positive response to the thinning, prescribed fire, or both (higher abundance in one or more of the categories that included thinning or prescribed fire compared to the no treatment category) at Lake Shelbyville, including five species that are on the SGNC list for Illinois (Field Sparrow, Ovenbird, Northern Flicker, Kentucky Warbler, and Wood Thrush; Figures 5-7). The others that

responded favorably to forest management include many known to associate strongly with more-open forest canopies, more-complex (heterogeneous) forest structure, or more-dense shrub layer and ground cover (Table 3; Figures 5-7). Seven species responded negatively to one or more of the forest management practices (e.g. House Wren, Blue-gray Gnatcatcher and Acadian Flycatcher). American Crows were the one species showing a mixed response to forest management. Prescribed fire by itself had a positive effect on some species including Field Sparrow (FISP), Baltimore Oriole (BAOR), American Crow (AMCR) and Red-eyed Vireo (REVI) while having a negative effect on others including Northern Flicker (NOFL), Mourning Dove (MODO), and American Robin (AMRO); Figures 5-7. It is likely that negative effects associated with fire are relatively short-term in nature or may represent a trade-off whereby some species are benefitted while others are not. This highlights the importance of collecting several years of data to understand both the immediate and long-term effects of forest management on bird populations. Often there can be an initial (in the year or two after management) negative response of birds to particular forest management practices that become neutral or even positive as years accrue post-management. With additional years of data, we will tease apart the more subtle relationships between management practices and their effects on forest structure and composition and the short- and long-term abundance of various species of forest birds at this location, particularly the effects of fire and their interaction with thinning.

Cowbird Abundance. Brown-headed Cowbirds occurred throughout the site and tended to be slightly more abundant in the managed areas, but probably not enough so to result in higher parasitism rates in the managed areas. The overall rate of detection in 2016 was down from last year (**0.35** vs. 0.44, respectively) and is relatively low in comparison to some of the other sites. Cowbird abundances at these levels would suggest that rates of cowbird parasitism are likely low-to-moderate across the entire conservation area.

Trail of Tears Research Summary

The Trail of Tears State Forest is developing a forest management plan that will involve the use of thinning and fire which began in the fall of 2014 (as well as “control” no treatment areas) within a demonstration area consisting of 3 units. With this in mind, breeding birds were again surveyed in each of the units to get abundance and diversity data prior to and immediately following the management taking place. In summer 2016 we again surveyed 24 points in 3 other units where prescribed fire has been used during recent years.

Breeding Bird Point Count Survey Data. There were 50 species observed at point count locations (Table 4) including ten that are on the SGNC list for Illinois. For the purposes of a general summary, bird surveys were grouped into three categories (prescribed fire, thinning - FSI, and no treatment; Table 4). The overall numbers of species detected were 46, 39, and 33 in the no treatment, fire, and thinning categories, respectively. The lower number in the thinning category is likely the result of there being few points currently in that category (there will be more points added as many of the current no management points transition into FSI as management continues at the site). The mean species diversity per survey point was not different between the categories (Figure 8). Seventeen species responded to the forest management at Trial of Tears (Table 4; Figures 9-10). Six species responded positively to management including three on the SGNC list for Illinois (Kentucky Warbler, Wood Thrush, and Worm-eating Warbler; Table 4; Figures 9-10). Ten species responded negatively to the forest management (e.g. Louisiana Waterthrush, Ovenbird, Yellow-billed Cuckoo, and Eastern Wood Peewee), particularly to thinning (Figures 9-10), whereas one species (Red-eyed Vireo) had a mixed response. Species that nest at or near ground level (e.g. Carolina Wren, Ovenbird, Hooded Warbler) showed a typical negative response to prescribed fire, which often reverses itself in 1-2 more years post-fire. Some birds respond negatively to the immediate change in the

understory associated with prescribed fire with those negative effects muted just one year later, resulting in neutral or even positive effects on birds over the long-term. These results support the conclusion that the use of prescribed fire and thinning as forest management tools at Trail of Tears is having a neutral (not a negative) effect on breeding forest birds. Therefore, if it benefits the forest while having relatively few long-term adverse effects on breeding birds, then they are valuable management tools. With the addition of some timber harvest at the site, and continued use of prescribed fire, we will now be able to document how these species-abundance/forest management relationships change with each additional year post-fire and as more timber-stand-improvement occurs at the site.

We will continue collecting data at Trail of Tears next summer (2017), after another wave of forest management (including timber harvest) to document the immediate effects of the timber harvest on the breeding forest birds. This emerging forest management plan involves several additional management units throughout the forest where prescribed fire and/or thinning and some timber harvest are to occur, setting the stage for adding several more survey points in the forest as management occurs in the coming years. As part of the development of the forest management planning process, I have provided the planning group a draft summary of predicted bird responses to the various types of management to be used to promote various forest types (e.g. oak woodland, dry-mesic oak forest, mixed hardwood forest) and oak regeneration. Follow-up research will test these predictions as forest management in implemented.

Cowbird Abundance. Cowbirds occur throughout the Trail of Tears Forest and their overall numbers in 2016 were similar to values from 2015 and 2014 (**0.48** vs. 0.49 vs. 0.50, respectively). These values of cowbird abundance would likely result in a moderate amount of parasitism at Trail of Tears. It is promising that overall cowbird abundances are holding steady

(not increasing) with the implementation of the forest management plan at Trail of Tears, and were even less abundant in the thinned areas. We will continue monitoring the cowbirds as more and different forest management occurs on the site.

Stephen A. Forbes State Recreation Area Research Summary

Stephen A. Forbes State Recreation Area (Forbes) consists of approximately 3,000 acres of oak and hickory forest surrounding a large impounded lake in south-central Illinois, of which about a third is being actively managed in several units of various sizes. Management at Forbes is focused on maintaining open woodlands with intact canopy through the use of prescribed fire and occasional selective (undesirable and mesic species) sapling removal to promote the desired structure (e.g. density) and species composition of vegetation in the understory of the forest. The management to promote a particular structure and composition of understory vegetation in the forests at Forbes has good potential to shape the breeding bird community at the site. The staff associated with Forbes continues to actively manage several units at the site and maintains a detailed management history for the site over at least the last decade. There is some additional timber stand improvement (via funding from the National Wild Turkey Federation) scheduled to occur during the fall of 2016 which will add nicely to our experimental design at the site that has focused up until now on prescribed fire as the predominant management tool.

Breeding Bird Point Count Survey Data. A total of 59 species were documented at bird survey points in the forests at Forbes including ten that are on the SGNC list for Illinois. For the purposes of a general summary, bird surveys associated with the different forest management treatment types were grouped together into five simple categories based on the number of prescribed fires that management units experienced from 2009 to the present (Table 5). The

overall numbers of species detected in each of the categories were 39, 46, 42, 38 and 50 in the one, two, three, four and no prescribed fire categories, respectively. The mean species diversity per survey point varied significantly among management categories and was higher in the never burned category than the three categories representing more-frequent fires (e.g.2, 3, 4; Figure 11). In terms of time since last prescribed fire, the mean species diversity was significantly higher in the never burned category than all the others (Figure 12). A summary of the bird survey results from the 2016 breeding season at Forbes State Recreation Area yielded results that support the conclusion that the prescribed fire is having a mixed effect on breeding bird abundance, both in terms of the frequency of fires (Table 5; Figures 13-15) and the time since the most recent prescribed fire (Table 6; Figures 16-17). In terms of fire frequency, 27 species responded in some way to prescribed fire (4 positive, 17 negative, 6 mixed; Table 5; Figures 13-15). Of the SGNC, four responded negatively (Wood Thrush, Field Sparrow, Kentucky Warbler and Acadian Flycatcher) and two had mixed responses (Red-shouldered Hawk and Yellow-billed Cuckoo) to prescribed fire frequency. Some that responded positively included Common Grackle, American Robin, Mourning Dove and Indigo Bunting (Figures 12-13). Three of the negative responders nest either just above the ground (Kentucky Warbler and Common Yellowthroat) or within a couple meters of ground level (Northern Cardinal). It is likely that the habitat would again become suitable for nesting for these species at some point within a few years after a prescribed fire.

As would be expected, there is often a negative response in bird abundances in the first breeding season following a fall-spring prescribed fire. At Forbes, of the 14 species showing a response in the first breeding season following a prescribed fire, 11 had negative and 3 had positive responses (Table 6; Figures 16-17). Some of the more pronounced negative responses came from Wood Thrush (WOTH) that tend to forage in leaf litter, Kentucky Warblers (KEWA) that nest near the ground, and Northern Parulas (NOPA). Immediate positive responses came

from American Robins (AMRO) and Mourning Doves (MODO). In general, many of the species that at first respond negatively show a rebound in abundance with each passing year following a prescribed fire (e.g. Field Sparrow, Scarlet Tanager, Red-bellied Woodpecker, Carolina Chickadee; Figures 16-17). If prescribed fire helps the managers to achieve the forest structure and composition they desire, the mixed effects that the prescribed fire has on birds may be worth it. It may also be possible to reduce the frequency of fires over time which could also prove to have a net benefit for bird species (e.g. some prescribed fire but not too much). The addition of TSI (thinning) to some management units at Forbes will provide additional opportunities to monitor the effects of thinning in conjunction with prescribed fire on the breeding birds there.

Cowbird Abundance. Brown-headed Cowbird overall abundance at Forbes in 2016 was nearly identical to the previous year (**0.25** vs. 0.24, respectively) and was lower than at the other sites during 2016 (0.25 vs. 0.35-1.00). At Forbes, cowbird abundance was negatively affected by prescribed fire, perhaps because there were fewer suitable hosts in those areas. We could reasonably expect parasitism rates to be relatively low at Forbes compared to other sites based on the relative abundances of cowbirds among the six study sites.

Hidden Springs State Forest Research Summary

Hidden Springs State Forest covers over 1,100 acres 10 miles southeast of Shelbyville and consists of three separate tracts of gently rolling land. The terrain is broken occasionally by rugged steep hillsides and the lowlands bordering Richland Creek, which flows through the forest from the northeast to the southwest. Hidden Springs has been managed as a state forest since 1960 and has native trees including white, red, bur, post, pin, shingle and chinquapin oaks, sugar and silver maples, plus hickory, ash, sycamore, black walnut and cottonwood.

Introduced species include red cedar, tulip poplar, black locust and red, white and Scotch pines. Various forest management techniques are used at Hidden Springs, and a forest improvement demonstration area located in the southwest section of the forest shows the types of trees that would be removed in properly managed woodlands. For the Forests and Woodlands Campaign we are monitoring the response of breeding birds to two types of forest management (exotic plant species and maple control with and without the application of prescribed fire) for comparison with non-managed forests at the site.

Breeding Bird Point Count Survey Data. A total of 50 species were documented at bird survey points in the forests at Hidden Springs including 12 that are on the SGNC list for Illinois. For the purposes of a general summary, bird surveys associated with the different forest management treatment types were grouped together into three management categories that included exotics and maple control, exotics and maple control with prescribed fire, and none (Table 7). The overall number of species detected in each of the categories was 36, 44, and 36, respectively. The mean species diversity per survey point varied significantly among management categories and was higher in the exotics and maple control with prescribed fire category (Figure 18). At Hidden Springs, the exotics and maple control, and prescribed fire, are having mixed effects on the relative abundance of forest birds (Table 7; Figures 19-20). Twenty-six species had some type of response to forest management (Table 7). Fourteen species of forest birds showed a positive response to management (including SGNC Northern Flicker and Red-headed Woodpecker), eight responded negatively (including SGNC Red-shouldered Hawk, Kentucky Warbler, Wood Thrush), and four showed a mixed response (including SGNC Ovenbird). Some species abundances responded favorably to the exotics and maple control including Ovenbird (OVEN) and Northern Flicker (NOFL), while others responded favorably to the prescribed fire including Red-headed Woodpecker (RHWO), Scarlet Tanager (SCTA) and Blue Jay (BLJA); Figures 19-20. Similar to other sites, it is likely that negative effects associated

with fire are relatively short-term in nature or may represent a trade-off whereby some species are benefitted while others are not. Continuing to collect data at Hidden Springs in conjunction with their ongoing forest management at the site will provide additional opportunities to monitor the effects of thinning (largely in the understory and subcanopy) in conjunction with prescribed fire on the breeding birds there.

Cowbird Abundance. Brown-headed Cowbirds were much more common in 2016 at Hidden Springs (**0.83**) than all other sites except for Siloam Springs (1.00). At Hidden Springs, cowbird abundance was highest in the areas treated with exotics and maple control plus prescribed fire, possibly because those areas also harbor the highest diversity of breeding birds. In general we could reasonably expect parasitism rates to be considerably higher at Hidden Springs than the other sites based on their relative abundance.

Siloam Springs State Park Research Summary

Siloam Springs State Park and the associated Buckhorn Unit stand out as one of the most heavily forested areas within the relatively non-forested west-central part of Illinois. The site has over 3,000 acres of land, with much of it consisting of ridge/gully and rolling topography that is primarily wooded. Challenges in implementing timber management, minimal use of prescribed fire, and the influx of invasive-exotic plant species have all contributed to a reduction in the amount of oak-hickory and open woodland habitat present on the site. One section of the state park has been thinned and had prescribed fire applied every 3-5 years for the past 20 years. There is a lot of potential at Siloam Springs State Park to manage the site more extensively for upland oak-hickory forest, and open woodland and savanna habitat. More recently (beginning in 2015), with assistance from the National Wild Turkey Federation, there are management units where prescribed fire has been applied and units newly thinned with prescribed fire also applied.

As the management at this site continues to be completed, we will be able to track wildlife responses.

Breeding Bird Point Count Survey Data. A total of 40 species were documented at bird survey points in the forests at Siloam Springs including ten that are on the SGNC list for Illinois. For the purposes of a general summary, bird surveys associated with the different forest management treatment types were grouped together into four categories including prescribed fire in 2015, thinned plus prescribed fire in 2015, thinned plus prescribed fire every 3-5 years during the past 20 years, and none (Table 8). The overall number of species detected in each of the categories was 27, 34, 36, and 23 in the management categories, respectively. The mean species diversity per survey point varied significantly among management categories and was highest in the thinned plus prescribed fire in 2015 category, lowest in the none, and intermediate in the other two categories (thinned plus prescribed fire every 3-5 years for 20 years, prescribed fire in 2015; Figure 21). At Siloam Springs, prescribed fire and thinning are having a positive effect on the vast majority of birds breeding there. (Table 8; Figures 22-24). Thirty-three species had some type of response to forest management (Table 8). Twenty-four species of forest birds showed a positive response to management (including SGNC Yellow-billed Cuckoo, Northern Flicker, Red-headed Woodpecker, Wild Turkey, Kentucky Warbler and Acadian Flycatcher), two responded negatively (including SGNC Wood Thrush), and seven showed a mixed response (including SGNC Ovenbird). Some species abundances responded particularly favorably to the 2015 prescribed fire alone including Kentucky Warbler (KEWA) and Scarlet Tanager (SCTA), while others responded particularly well to the prescribed fire plus thinning including Yellow-billed Cuckoo (YBCU), Northern Flicker (NOFL), Wild Turkey (WITU), Ruby-throated Hummingbird (RTHU), American Robin (AMRO), and others; Figures 22-24. Data from this breeding season can serve as a strong endorsement of the forest management being implemented at Siloam Springs. Continuing to collect data at Siloam Springs in conjunction with

their ongoing and expanding forest management at the site will provide additional opportunities to monitor the effects only prescribed fire, and of thinning in conjunction with prescribed fire on the breeding birds there.

Cowbird Abundance. Brown-headed Cowbirds were much more common at Siloam Springs (**1.00**) than all other sites in 2016. At Siloam Springs, cowbird abundance was highest in the area treated with thinning plus prescribed fire every 3-5 years for the past 20 years, possibly because that area also harbored the highest diversity of breeding birds. Cowbirds seemed to avoid those parts of the forest where prescribed fire recently had been applied. In general rates of cowbird parasitism of songbird nests should be considerably higher at Siloam Springs than the other sites, but possibly similar to Hidden Springs.

Using Breeding Forest Birds to Measure Responses to Management

Breeding forest songbirds in Illinois include more than 100 different species that fall into various guilds (e.g. nesting on the ground, in shrubs, sub-canopy, or canopy; foraging in leaf litter, on bark, on shrub or tree foliage; nesting on or near the ground, in shrubs, or in the canopy; etc.), making them highly responsive to changes in forest structure and composition and, therefore, a great group to monitor in association with various forest management practices. Over 20 of these species are on the list of Species in Greatest Need of Conservation (SGNC) for Illinois. There are additional species of raptors and wading birds that are on the SGNC and also associate with the various types of forest being managed.

There are a number of attributes of forest songbirds that make them particularly well suited for studying responses to forest management. One is that most if not all of these species are territorial during the breeding season and their territory sizes are typically between 1-3 acres in size. Therefore local forest management activities done at scales of 1, 5, 10, 50, or 100 acres

are all highly relevant to these birds that occupy a relatively small area throughout the breeding season. Another attribute of songbirds is that several species are known to return the next breeding season to places where they reproduced successfully, and to move away from those areas where they failed to reproduce. This behavior tends to lead to an increase in densities in the “better” habitats and a decrease in densities in the “poorer” habitats. In this regard, relative densities are a good predictor of habitat quality with densities being highest in the best habitats. These two attributes in combination should make the songbirds highly responsive to the various types of forest management being done, and changes in their densities will tell us whether the forest management is having a positive, negative, or neutral effect on their local populations.

There is a large body of literature associated with the effects of habitat loss and fragmentation (forest loss and fragmentation here) on populations of breeding forest songbirds. In general, species diversity and the densities of some “area sensitive” species tend to decrease with decreasing forest tract size. In addition, rates of nest predation and cowbird parasitism tend to be higher in small tracts of forest and in landscapes where the forests are more highly fragmented by permanent non-forest land uses. These patterns have been well documented in Midwestern forests. Forests with a mosaic of habitat (e.g. forests where disturbance – either natural or management related – creates structural and compositional complexity) tend to have higher songbird species diversity than a similarly-sized forest lacking disturbance. In addition, disturbances within the forest, as long as they do not remain non-forest permanently, tend to have little or no long-term negative effect on rates of nest predation and cowbird parasitism.

Much of what we know about habitat requirements and habitat use in songbirds comes from observational studies documenting attributes of the forest where songbirds set up their territories. This has led to recommendations to manage forests for songbirds by achieving a particular tree species composition or vegetation structure and complexity, but the actual

responses of the songbirds to the management have usually not been measured. There have been some studies that have documented songbird responses to various kinds of silvicultural practices, but relatively few have had a research design that included a before-after-treatment-control approach. We will now be getting some before-and-after data as we have been sampling non-managed units that have recently been managed or are going to be managed in the near future, particularly at Trail of Tears and Forbes. The data on songbird responses to different types of forest management (e.g. prescribed fire, thinning, re-forestation, etc.) being collected as part of the Forests and Woodlands Campaign will add valuable and much needed information to the vast songbird literature. In addition, in the next few years we hope to determine which species of songbirds respond positively to forest management in parallel with positive responses of wild turkeys to the same management. In this way, there may be several species of breeding forest songbirds that could serve as indicators of higher and lower quality forest habitat for wild turkeys (and possibly also animals “caught” by the camera traps).

Locations to Monitor Wildlife Responses to Forest Management

Monitoring will continue with Segment 7 of the Forest and Woodlands Campaign at all of these sites in Illinois. These sites were selected based on the potential for there to be, at each site, multiple units or plots that are going to be or are being managed (treatments) as well as areas that are not being managed (controls). A goal is to have, at each site, a number of replicates each of treatment and control areas. With another couple of years of data we will be able to begin assessing the longer-term effects of the thinning and prescribed fire. We have continued collecting data from Trail of Tears State Forest in an area that is the focus of a management plan that was implemented beginning fall of 2014, Siloam Spring has greatly increased management efforts beginning in 2015, and the other sites continue to complete ongoing forest management efforts. These areas all have the capacity for monitoring wildlife responses to forest management (i.e. a before-after-treatment-control monitoring protocol).

In addition, all of these various sites are situated in landscapes dominated by or containing a fair amount of non-forest land-use. As such, the relative amounts of forest in the surrounding landscape can vary considerably from site to site. This provides us with the potential to look at not only local effects (e.g. considering land-use within a 1-km radius) of habitat fragmentation on populations of our target species, but also the effects of habitat fragmentation at larger spatial scales (e.g. 5-km radius, 10-km radius). In order to maximize the effectiveness of our monitoring protocols, we will work closely and continue to communicate regularly with site managers and staff, biologists, and foresters associated with these locations.

Additional Monitoring Techniques

Winter Bird Surveys. Illinois forests provide winter habitat for a variety of bird species. Results from our limited winter point counts at Lake Shelbyville, Trail of Tears, and Forbes (Tables 9-11; Figures 25-29) show a mixed response of birds during the winter to forest management. Abundances of birds in the winter tend to be relatively low and there are not a lot of emerging patterns of abundance during the winter relative to management as many/most species during the winter are not defending a small territory and often move throughout larger areas of forest on a daily/weekly/seasonal basis. Across all species detected, there were varied responses of birds during the winter to the different forest management categories with relatively similar numbers of species responding positively, negatively, or neutrally to management. This likely has to do with the structure of the forest vegetation and how that influences the availability of desired food and cover. For a given species, their summer (nesting) and winter habitat preferences can differ quite dramatically.

Game/Trail Camera Deployment. Game/trail cameras were deployed during leaf-off to various locations in different forest management units (Lake Shelbyville, Trail of Tears, Forbes) where there was a clear line of sight for 75-150 feet through the forest to do passive camera

“trapping”. The cameras were mounted on trees, locked in place with a cable, and a sign hung with each one describing that they are for university research (with researcher contact information provided). Cameras are weatherproof and programmed to take color images once every 10-15 seconds during daylight hours, and to also take 20 images (1 image per second for 20 seconds) each time the heat-sensing mechanism is triggered (usually medium- to large-sized mammals are responsible for this). The heat-sensing trigger allows us to also capture images during the night. These cameras are able to detect the presence of large birds (e.g. wild turkeys) and medium- to large-sized mammals walking across the line of sight of the camera.

We used the number of detections of various animals (controlling for effort) as an index of “activity” or “use” of various forest management regimes at each study area. Each camera deployment was for 4-5 days (typical rechargeable battery and memory card capacity for camera) and then batteries and memory card are changed out and camera moved to a new location. Trail cameras were deployed at 20 locations at Lake Shelbyville, 10 locations at Trail of Tears, and 10 locations at Forbes (Tables 12-14). Over 2 million images were taken and subsequently screened. Keep in mind that these particular deployments occurred during the leaf-off period and only pertain to animal activity during that period of the year. At Lake Shelbyville, detection rates for birds were higher in non-managed areas whereas detection rates for deer and opossums were higher in the managed areas (Table 12). Squirrels had a mixed response to the management at Lake Shelbyville. At Trail of Tears there were subtle or no differences in detection rates between the prescribed fire and no management categories (Table 13). At Forbes, birds and squirrels were detected at a higher rate in forests managed with prescribed fire than in non-managed forests (Table 14). Based on these detection rates, it appears that a wide variety of animals respond positively to the forest management during the leaf-off period of the year, with only a few that responded negatively.

To evaluate the mesocarnivore nest predator community in burned and unburned areas within Forbes, we conducted trail-camera surveys during June 2016. Eighteen cameras were deployed, each for a 4-week period, 9 within recently burned/thinned areas (winter/spring 2016), and 9 at locations at least 300m from recently burned/thinned areas. Cameras were baited with fatty-acid tablets to attract mesocarnivores and other potential nest predator species, and images were uploaded weekly. Among the species detected, we found that raccoons were common in both habitats and that opossums, and birds of prey (including crows) were detected at a higher rate in burned areas vs. non-burned areas (Figure 30). Wild turkeys were detected by cameras at a higher rate in the buffer (i.e. non-burned) forest compared to the forests where prescribed fire had been applied. These preliminary findings suggest that nest predators may be more abundant in areas managed with recent prescribed fire relative to non-managed areas.

Vegetation Surveys. Vegetation surveys were completed at approximately half of all survey points and summaries for vegetation structure by treatment category for each of three sites (Oakwood Bottoms, Lake Shelbyville, and Trail of Tears) can be found in Tables 15-17. These vegetation surveys will be redone in subsequent years to track changes over time, new vegetation surveys will be completed at any new sites or units within sites that come online, and vegetation data will eventually be incorporated into analyses of differences in species' abundances among different management categories at the various study sites. Worth noting for the vegetation at Oakwood Bottoms (Table 15) is the relatively fewer small trees, more large trees, more shrubs, and more ground cover in the managed compared to non-managed areas. Also, the TSI + Rx Fire category has the most snags. Worth noting for the vegetation at Lake Shelbyville (Table 16) is the relatively fewer small trees in the TSI categories, lower shrub densities in the managed areas, and higher ground cover in the prescribed fire areas. Worth noting for the vegetation at Trail of Tears (Table 17) is the lower shrub density and ground cover in the prescribed fire areas compared to the non-managed areas. These differences are

likely the drivers of differences in bird species composition and abundance among management categories at each site during the breeding season.

Preliminary Nightjar Surveys. Nightjar (Chuck-Will's-Widows and Eastern Whip-Poor-Wills) surveys were conducted four times (two in May and two in June) each at Trail of Tears (10 locations) and Forbes (21 locations) during the 2016 breeding season. Beginning this year we included playback of both Whips and Chucks songs at each survey location. At Trail of Tears there was only one Eastern Whip-Poor-Will detected and detections of other nocturnal birds included (from most to least) Barred Owls, Yellow-billed Cuckoos, Eastern Wood Peewees, and Eastern Screech Owls. At Forbes, Eastern Whip-Poor-Wills were detected at 15, and Chuck-Will's-Widows at 11, of the 21 locations surveyed. Detections of other nocturnal birds at Forbes included (from most to least) Barred Owls, Eastern Screech Owls, Great Horned Owls, Common Nighthawks, and a Barn Owl. These surveys will be continued in Segment 7 and attempts will be made to better determine the specific location of singing nightjars (e.g. compass bearing from observers to nightjar) to place them in particular forest units and management types. Using playbacks of nightjars seems to have increased detection probabilities beyond the typical owl playbacks used for the typical MOON surveys.

Establishment of Demonstration Sites

Oakwood Bottoms has an ongoing forest management plan involving fire and thinning to promote oak regeneration and a return to an oak-dominated forest composition. Oakwood Bottoms also has multiple units or plots that are going to be or are being managed (treatments) and also has areas that are not being managed (controls), allowing for a true assessment of how the management is affecting both the forest and wildlife. Multiple management units now exist at Trail of Tears State Forest (management began fall of 2014) and these units include

“control” areas where no management will occur and management areas (e.g. prescribed fire followed by thinning, thinning followed by prescribed fire, etc.). Forbes, Hidden Springs, Siloam Springs, and Lake Shelbyville all can also serve as superb demonstration areas where the process and results of forest management can easily be shown to interested constituencies. Forbes is an exceptional venue for highlighting what several years of prescribed fire can achieve in terms of forest plant species composition and structure, and now with some tree thinning taking place, the site is even more valuable as a demonstration area.

Ultimately, our goal for the Forests and Woodlands Campaign in Illinois is to contribute substantially to the growing body of research associated with the effects of forest management on populations of wildlife, and to use the data collected in Illinois to reinforce existing or establish new approaches to forest management that are applicable to forests throughout Illinois and other states in the Midwest.

Table 1. Study sites, and number of breeding bird points surveyed in various management types during Segment 6 of the Forest Campaign.

Location	Management	Points Surveyed	Replicates
Oakwood Bottoms (Shawnee National Forest)	No Management	30	2
	Thinning Only	56	2
	Thinning + Rx Fire	40	2
Lake Shelbyville (U.S. Army Corp of Engineers land and some IDNR land)	No Management	40	2
	Thinning Only	57	2
	Rx Fire Only	35	2
	Thinning + Rx Fire	68	2
Trail of Tears State Forest	No Management	50	2
	Thinning Only	7	2
	Rx Fire Only	33	2
Stephen A. Forbes State Recreation Area	No Management	19	2
	Rx Fire 1x Since 2009	7	2
	Rx Fire 2x Since 2009	19	2
	Rx Fire 3x Since 2009	12	2
	Rx Fire 4x Since 2009	9	2
Hidden Springs State Forest	No Management	10	2
	Exotics and Maple Control	10	2
	Exotics and Maple Control + Frequent Rx Fire	10	2
Siloam Springs State Park	No Management	8	2
	Thinning + Rx Fire every 3-5 Years For Past 20 Years	8	2
	Thinning + Rx Fire 2015	8	2
	Rx Fire Only 2015	8	2

Table 2. Results of bird surveys completed during the 2016 **breeding** season at Oakwood Bottoms (U.S. Forest Service), Illinois. Species ranked from least to most abundant based on total point counts. Values represent number of individuals seen per point (averaged for 2 visits to each point) averaged across points within each category.

		Number per 100-m radius point			
		Management			
Species Code*	Species**	TSI (n=56)	TSI + Rx Fire (n=40)	None (n=30)	Total (n=126)
AMRO	American Robin	0.00	0.00	0.02	0.01
BWWA	***Blue-winged Warbler***	0.01	0.00	0.00	0.01
CHSP	Chipping Sparrow	0.01	0.00	0.00	0.01
FISP	***Field Sparrow***	0.01	0.00	0.00	0.01
MIKI	***Mississippi Kite***	0.00	0.01	0.00	0.01
RWBL	Red-winged Blackbird	0.00	0.00	0.02	0.01
WOTH	***Wood Thrush***	0.01	0.00	0.00	0.01
CERW	***Cerulean Warbler***	0.01	0.03	0.00	0.01
GREG	Great Egret	0.00	0.00	0.05	0.01
HOWA	Hooded Warbler	0.01	0.00	0.03	0.01
HOWR	House Wren	0.01	0.03	0.00	0.01
CEDW	Cedar Waxwing	0.00	0.01	0.05	0.02
BDOW	Barred Owl	0.04	0.01	0.00	0.02
NOFL	***Northern Flicker***	0.02	0.03	0.05	0.03
SCTA	Scarlet Tanager	0.01	0.05	0.03	0.03
WEWA	***Worm-eating Warbler***	0.00	0.08	0.02	0.03
AMGO	American Goldfinch	0.04	0.04	0.02	0.03
GRCA	Gray Catbird	0.04	0.05	0.00	0.03
HAWO	Hairy Woodpecker	0.04	0.00	0.10	0.04
LOWA	Louisiana Waterthrush	0.08	0.03	0.03	0.05
MODO	Mourning Dove	0.05	0.09	0.00	0.05
BLJA	Blue Jay	0.07	0.05	0.10	0.07
RSHA	***Red-shouldered Hawk***	0.10	0.05	0.07	0.08
YEWA(+)	Yellow Warbler	0.13	0.03	0.05	0.08
YTWA(+)	Yellow-throated Warbler	0.13	0.05	0.02	0.08
FICR(-)	Fish Crow	0.09	0.06	0.15	0.10
YTVI(+)	Yellow-throated Vireo	0.11	0.16	0.03	0.11
RTHU(-+)	Ruby-throated Hummingbird	0.06	0.19	0.12	0.12
SUTA	Summer Tanager	0.09	0.16	0.13	0.12
PIWO(+)	Pileated Woodpecker	0.13	0.16	0.08	0.13
CARW(+)	Carolina Wren	0.20	0.23	0.13	0.19
YBCH(+)	***Yellow-breasted Chat***	0.18	0.34	0.05	0.20
AMCR(+)	American Crow	0.15	0.41	0.17	0.24
RHWO(+)	***Red-headed Woodpecker***	0.12	0.65	0.08	0.28
DOWO	Downy Woodpecker	0.30	0.34	0.25	0.30
GCFL(-)	Great Crested Flycatcher	0.15	0.41	0.52	0.32
AMRE(+)	American Redstart	0.54	0.19	0.13	0.33
EAWP	Eastern Wood Peewee	0.29	0.41	0.38	0.35
EATO(+)	Eastern Towhee	0.45	0.36	0.20	0.36
NOCA	Northern Cardinal	0.41	0.35	0.30	0.37
KEWA	***Kentucky Warbler***	0.38	0.43	0.45	0.41

Table 2 (continued)

		Number per 100-m radius point			
		Management			
Species Code*	Species**	TSI (n=56)	TSI + Rx Fire (n=40)	None (n=30)	Total (n=126)
CACH	Carolina Chickadee	0.34	0.58	0.40	0.43
RBWO(-)	Red-bellied Woodpecker	0.42	0.34	0.60	0.44
BHCO	Brown-headed Cowbird	0.42	0.49	0.48	0.46
WBNU	White-breasted Nuthatch	0.44	0.69	0.57	0.55
INBU(+)	Indigo Bunting	0.54	0.76	0.45	0.59
YBCU	***Yellow-billed Cuckoo***	0.51	0.74	0.62	0.61
PROW	Prothonotary Warbler	0.76	0.76	0.83	0.78
NOPA	Northern Parula	0.86	0.71	1.08	0.87
BGGN	Blue-gray Gnatcatcher	0.74	1.09	0.93	0.90
REVI(-)	Red-eyed Vireo	1.04	0.64	0.98	0.90
COYE(+)	Common Yellowthroat	1.02	1.41	0.78	1.09
WEVI(+)	White-eyed Vireo	1.10	1.36	0.75	1.10
TUTI(-)	Tufted Titmouse	0.90	1.38	1.32	1.15
ACFL	***Acadian Flycatcher***	1.58	1.24	1.63	1.48

* (+) = positive or (-) = negative response of relative abundance to management.

** Species on the Species in Greatest Need of Conservation (SGNC) list are given in bold and italics.

*** Rx Fire = prescribed fire; TSI = Timber Stand Improvement (e.g. thinning).

= species that were less abundant overall but responded to forest management.

= species that were more abundant overall and responded to forest management.

Table 3. Results of bird surveys completed during the 2016 **breeding** season at Lake Shelbyville - U.S. Army Corp of Engineers, Illinois. Species ranked from least to most abundant based on total point counts. Values represent number of individuals seen per point (averaged for 2 visits to each point) averaged across points within each category.

		Number per 100-m radius point				
		Management***				
Species Code*	Species**	Rx Fire (n=35)	TSI (n=57)	Rx Fire + TSI (n=68)	None (n=40)	Total (n=200)
BDOW	Barred Owl	0.00	0.00	0.01	0.00	0.01
BWWA	***Blue-winged Warbler***	0.00	0.00	0.01	0.00	0.01
DICK	Dickcissel	0.00	0.01	0.00	0.00	0.01
FICR	Fish Crow	0.00	0.00	0.00	0.01	0.01
GREG	Great Egret	0.00	0.00	0.01	0.00	0.01
WEWA	***Worm-eating Warbler***	0.00	0.00	0.01	0.00	0.01
PROW	Prothonotary Warbler	0.00	0.00	0.01	0.00	0.01
WEVI	White-eyed Vireo	0.00	0.00	0.01	0.01	0.01
WITU	***Wild Turkey***	0.00	0.02	0.00	0.00	0.01
BRTH	Brown Thrasher	0.03	0.00	0.00	0.01	0.01
YTWA	Yellow-throated Warbler	0.00	0.02	0.00	0.01	0.01
TUVU	Turkey Vulture	0.00	0.00	0.01	0.03	0.01
EAKI	Eastern Kingbird	0.03	0.01	0.01	0.00	0.01
EAPH	Eastern Phoebe	0.03	0.00	0.01	0.03	0.01
YEWA	Yellow Warbler	0.00	0.01	0.02	0.01	0.01
BANS	Barn Swallow	0.07	0.00	0.01	0.00	0.02
NRWS	Northern Rough-winged Swallow	0.00	0.01	0.03	0.03	0.02
PIWO	Pileated Woodpecker	0.03	0.02	0.01	0.03	0.02
COGR	Common Grackle	0.01	0.01	0.01	0.06	0.02
YBCH	***Yellow-breasted Chat***	0.07	0.02	0.01	0.00	0.02
BEKI	Belted Kingfisher	0.01	0.02	0.05	0.00	0.03
LOWA	Louisiana Waterthrush	0.01	0.04	0.01	0.05	0.03
YTVI	Yellow-throated Vireo	0.06	0.03	0.01	0.04	0.03
CHSP	Chipping Sparrow	0.01	0.02	0.01	0.10	0.03
RHWO	***Red-headed Woodpecker***	0.00	0.04	0.05	0.03	0.03
YBCU	***Yellow-billed Cuckoo***	0.06	0.05	0.02	0.00	0.03
NOPA	Northern Parula	0.07	0.02	0.01	0.08	0.04
RTHA	Red-tailed Hawk	0.01	0.09	0.02	0.00	0.04
TRES	Tree Swallow	0.07	0.02	0.06	0.00	0.04
CANG	Canada Goose	0.00	0.08	0.03	0.09	0.05
CEDW	Cedar Waxwing	0.01	0.04	0.10	0.03	0.05
EABL	Eastern Bluebird	0.11	0.01	0.01	0.13	0.05
GBHE	Great Blue Heron	0.06	0.04	0.10	0.03	0.06
SCTA	Scarlet Tanager	0.04	0.10	0.06	0.06	0.07
SOSP(+)	Song Sparrow	0.03	0.15	0.05	0.01	0.07
RBGR	Rose-breasted Grosbeak	0.06	0.07	0.07	0.09	0.07
RTHU	Ruby-throated Hummingbird	0.11	0.06	0.04	0.11	0.07
HAWO	Hairy Woodpecker	0.04	0.11	0.05	0.09	0.08
HOWR(-)	House Wren	0.07	0.09	0.01	0.20	0.08
FISP(+)	***Field Sparrow***	0.20	0.09	0.04	0.06	0.09
BAOR(+)	Baltimore Oriole	0.17	0.07	0.07	0.08	0.09
GRCA(+)	Gray Catbird	0.10	0.17	0.05	0.06	0.10
OVEN(+)	***Ovenbird***	0.13	0.11	0.11	0.05	0.10
NOFL(+)	***Northern Flicker***	0.03	0.11	0.17	0.05	0.11
SUTA(+)	Summer Tanager	0.09	0.12	0.16	0.06	0.12
KEWA(+)	***Kentucky Warbler***	0.03	0.14	0.18	0.06	0.12
RWBL(+)	Red-winged Blackbird	0.11	0.25	0.10	0.03	0.13
AMGO(-)	American Goldfinch	0.29	0.07	0.09	0.23	0.15

Table 3 (continued)

		Number per 100-m radius point				
		Management***				
Species Code*	Species**	Rx Fire (n=35)	TSI (n=57)	Rx Fire + TSI (n=68)	None (n=40)	Total (n=200)
COYE(+)	Common Yellowthroat	0.11	0.28	0.11	0.08	0.15
WAVI(+)	Warbling Vireo	0.10	0.13	0.24	0.11	0.16
MODO(+)	Mourning Dove	0.09	0.16	0.27	0.16	0.19
BGGN(-)	Blue-gray Gnatcatcher	0.14	0.17	0.17	0.39	0.21
ACFL(-)	***Acadian Flycatcher***	0.36	0.18	0.07	0.48	0.24
AMCR(+-)	American Crow	0.51	0.18	0.14	0.30	0.25
CARW(-)	Carolina Wren	0.39	0.23	0.18	0.31	0.26
EATO(-)	Eastern Towhee	0.30	0.32	0.18	0.35	0.28
WOTH(+)	***Wood Thrush***	0.16	0.53	0.26	0.20	0.31
BHCO	Brown-headed Cowbird	0.40	0.25	0.43	0.29	0.35
GCFL(+)	Great Crested Flycatcher	0.40	0.27	0.48	0.30	0.37
REVI(+)	Red-eyed Vireo	0.71	0.41	0.35	0.35	0.43
BLJA	Blue Jay	0.53	0.60	0.57	0.51	0.56
INBU(+)	Indigo Bunting	0.61	0.61	0.64	0.36	0.57
RBWO(+)	Red-bellied Woodpecker	0.73	0.58	0.60	0.43	0.58
DOWO	Downy Woodpecker	0.56	0.67	0.51	0.63	0.59
CHIC	Chickadee Spp.	0.70	0.59	0.63	0.59	0.62
AMRO(-)	American Robin	0.33	0.94	0.69	0.88	0.74
WBNU	White-breasted Nuthatch	0.63	0.76	0.86	0.61	0.74
NOCA	Northern Cardinal	0.99	0.68	0.68	0.84	0.76
TUTI	Tufted Titmouse	1.19	0.90	0.80	1.03	0.94
EAWP(+)	Eastern Wood Peewee	0.90	1.01	1.35	1.03	1.11

* (+) = positive or (-) = negative response of relative abundance to management.

** Species on the Species in Greatest Need of Conservation (SGNC) list are given in bold and italics.

*** Rx Fire = prescribed fire; TSI = Timber Stand Improvement (e.g. thinning).

= species that were less abundant overall but responded to forest management.

= species that were more abundant overall and responded to forest management.

Table 4. Results of bird surveys completed during the 2016 **breeding** season at Trail of Tears State Forest, Illinois. Species ranked from least to most abundant based on total point counts. Values represent number of individuals seen per point (averaged for 2 visits to each point) averaged across points within each category.

		Number per 100-m radius point			
		Management***			
Species Code*	Species**	Rx Fire (n=33)	FSI (n=7)	None (n=50)	Total (n=90)
AMRO	American Robin	0.02	0.00	0.00	0.01
CHSW	***Chimney Swift***	0.00	0.00	0.01	0.01
EABL	Eastern Bluebird	0.00	0.07	0.00	0.01
FISP	Field Sparrow	0.00	0.00	0.01	0.01
RTHA	Red-tailed Hawk	0.00	0.00	0.01	0.01
YBCH	***Yellow-breasted Chat***	0.00	0.00	0.01	0.01
BDOW	Barred Owl	0.00	0.00	0.02	0.01
MODO	Mourning Dove	0.03	0.00	0.00	0.01
AMRE	American Redstart	0.00	0.07	0.02	0.02
CEDW	Cedar Waxwing	0.00	0.00	0.03	0.02
EAKI	Eastern Kingbird	0.06	0.00	0.00	0.02
HOWR	House Wren	0.00	0.00	0.04	0.02
AMGO	American Goldfinch	0.06	0.00	0.01	0.03
HAWO	Hairy Woodpecker	0.02	0.07	0.03	0.03
YEWA	Yellow Warbler	0.00	0.00	0.05	0.03
EATO	Eastern Towhee	0.00	0.07	0.05	0.03
INBU	Indigo Bunting	0.03	0.07	0.03	0.03
RBGR	Rose-breasted Grosbeak	0.05	0.00	0.04	0.04
CHSP	Chipping Sparrow	0.03	0.00	0.06	0.04
RTHU	Ruby-throated Hummingbird	0.05	0.07	0.04	0.04
RSHA	***Red-shouldered Hawk***	0.05	0.07	0.05	0.05
AMCR	American Crow	0.06	0.00	0.07	0.06
NOFL	***Northern Flicker***	0.08	0.07	0.10	0.09
PIWO(-)	Pileated Woodpecker	0.14	0.00	0.09	0.10
YTVI	Yellow-throated Vireo	0.15	0.07	0.11	0.12
CARW(-)	Carolina Wren	0.05	0.21	0.19	0.14
LOWA(-)	Louisiana Waterthrush	0.14	0.00	0.17	0.14
DOWO(-)	Downy Woodpecker	0.20	0.00	0.15	0.16
WEVI(+)	White-eyed Vireo	0.14	0.57	0.16	0.18
KEWA(+)	***Kentucky Warbler***	0.30	0.21	0.14	0.21
NOCA	Northern Cardinal	0.23	0.21	0.20	0.21
CACH	Carolina Chickadee	0.24	0.14	0.23	0.23
SUTA(+)	Summer Tanager	0.17	0.36	0.27	0.24
SCTA	Scarlet Tanager	0.21	0.29	0.28	0.26
BLJA(+)	Blue Jay	0.42	0.14	0.18	0.27
GCFL(-)	Great Crested Flycatcher	0.36	0.14	0.27	0.29
OVEN(-)	***Ovenbird***	0.20	0.21	0.38	0.30
HOWA(-)	Hooded Warbler	0.24	0.29	0.40	0.33
NOPA	Northern Parula	0.39	0.36	0.40	0.39
YBCU(-)	***Yellow-billed Cuckoo***	0.48	0.21	0.42	0.43
WOTH(+)	***Wood Thrush***	0.59	0.29	0.41	0.47
BHCO(-)	Brown-headed Cowbird	0.45	0.29	0.53	0.48

Table 4 (continued)

		Number per 100-m radius point			
		Management***			
Species Code*	Species**	Rx Fire (n=33)	FSI (n=7)	None (n=50)	Total (n=90)
RBWO	Red-bellied Woodpecker	0.59	0.57	0.45	0.51
WEWA(+)	***Worm-eating Warbler***	0.70	0.64	0.50	0.58
BGGN	Blue-gray Gnatcatcher	0.80	0.79	0.76	0.78
WBNU	White-breast Nuthatch	0.79	0.93	0.86	0.84
REVI(+-)	Red-eyed Vireo	1.06	0.50	0.79	0.87
EAWP(-)	Eastern Wood Peewee	1.14	0.43	0.97	0.99
TUTI	Tufted Titmous	1.32	1.00	1.15	1.20
ACFL	***Acadian Flycatcher***	2.18	2.21	2.03	2.10

* (+) = positive or (-) = negative response of relative abundance to management.

** Species on the Species in Greatest Need of Conservation (SGNC) list are given in bold and italics.

*** Rx Fire = prescribed fire; FSI = Forest Stand Improvement (e.g. thinning).

= species that were less abundant overall but responded to forest management.

= species that were more abundant overall and responded to forest management.

Table 5. Results of bird surveys completed during the 2016 breeding season at Stephen A. Forbes State Recreation Area, Illinois.
Species ranked from least to most abundant based on total point counts. Values represent number of individuals seen per point (averaged for 2 visits to each point) averaged across points within each category.

		Number per 100-m radius point					
			Rx Fires since 2009				
Species Code*	Species**	1 (n=7)	2 (n=19)	3 (n=12)	4 (n=9)	None Ever (n=19)	Total (n=66)
BRTH	Brown Thrasher	0.00	0.00	0.00	0.00	0.03	0.01
EAKI	Eastern Kingbird	0.00	0.00	0.00	0.00	0.03	0.01
GRCA	Gray Catbird	0.07	0.00	0.00	0.00	0.00	0.01
HAWO	Hairy Woodpecker	0.00	0.03	0.00	0.00	0.00	0.01
HOFI	House Finch	0.00	0.03	0.00	0.00	0.00	0.01
RHWO	***Red-headed Woodpecker***	0.07	0.00	0.00	0.00	0.00	0.01
TRSW	Tree Swallow	0.00	0.00	0.04	0.00	0.00	0.01
CAGO	Canada Goose	0.00	0.03	0.00	0.00	0.03	0.02
CEDW	Cedar Waxwing	0.00	0.00	0.00	0.00	0.05	0.02
NOFL	***Northern Flicker***	0.07	0.03	0.00	0.00	0.00	0.02
PUFI	Purple Finch	0.00	0.03	0.00	0.06	0.00	0.02
KILL	Killdeer	0.00	0.05	0.00	0.06	0.00	0.02
LOWA	Louisiana Waterthrush	0.14	0.00	0.00	0.00	0.03	0.02
CARW	Carolina Wren	0.00	0.03	0.04	0.00	0.05	0.03
EABL	Eastern Bluebird	0.00	0.05	0.00	0.00	0.05	0.03
EAPH	Eastern Phoebe	0.07	0.03	0.04	0.00	0.03	0.03
EATO	Eastern Towhee	0.00	0.00	0.04	0.11	0.03	0.03
PUMA	Purple Martin	0.07	0.00	0.04	0.00	0.05	0.03
TUVU	Turkey Vulture	0.07	0.11	0.00	0.00	0.00	0.04
RBGR	Rose-breasted Grosbeak	0.00	0.11	0.00	0.06	0.03	0.05
BLGR	Blue Grosbeak	0.00	0.00	0.17	0.06	0.05	0.05
YTVI	Yellow-throated Vireo	0.00	0.03	0.04	0.11	0.08	0.05
PIWO	Pileated Woodpecker	0.07	0.03	0.17	0.06	0.05	0.07
WEVI	White-eyed Vireo	0.07	0.05	0.04	0.00	0.13	0.07
YBCH	***Yellow-breasted Chat***	0.00	0.00	0.04	0.00	0.21	0.07
OVEN	***Ovenbird***	0.07	0.11	0.00	0.00	0.13	0.08
WAVI	Warbling Vireo	0.07	0.05	0.08	0.06	0.11	0.08
CHSP	Chipping Sparrow	0.07	0.05	0.08	0.00	0.16	0.08
GBHE	Great Blue Heron	0.00	0.16	0.00	0.17	0.05	0.08
COGR(+)	Common Grackle	0.14	0.00	0.21	0.28	0.00	0.09
RSHA(-+)	***Red-shouldered Hawk***	0.00	0.00	0.08	0.28	0.13	0.09
WOTH(-)	***Wood Thrush***	0.14	0.03	0.08	0.06	0.29	0.13
AMRO(+)	American Robin	0.21	0.13	0.17	0.22	0.05	0.14
SUTA(-+)	Summer Tanager	0.00	0.11	0.08	0.33	0.18	0.14
MODO(+)	Mourning Dove	0.14	0.13	0.25	0.28	0.11	0.17
FISP(-)	***Field Sparrow***	0.07	0.18	0.04	0.28	0.24	0.17
KEWA(-)	***Kentucky Warbler***	0.29	0.11	0.08	0.00	0.34	0.17
NOPA(-)	Northern Parula	0.21	0.08	0.04	0.17	0.37	0.18
SCTA(-)	Scarlet Tanager	0.21	0.03	0.17	0.28	0.29	0.18
AMGO(-)	American Goldfinch	0.21	0.11	0.04	0.28	0.34	0.20
COYE(-)	Common Yellowthroat	0.14	0.26	0.17	0.17	0.29	0.23
GCFL(-+)	Great Crested Flycatcher	0.14	0.11	0.33	0.44	0.21	0.23
BHCO(-)	Brown-headed Cowbird	0.14	0.13	0.08	0.33	0.47	0.25
RTHU(-)	Ruby-throated Hummingbird	0.00	0.18	0.08	0.39	0.53	0.27
DOWO	Downy Woodpecker	0.43	0.24	0.21	0.22	0.34	0.28
RWBL(-)	Red-winged Blackbird	0.43	0.05	0.29	0.39	0.42	0.29
BLJA(-+)	Blue Jay	0.14	0.18	0.42	0.67	0.32	0.33

Table 5 (continued)

		Number per 100-m radius point					
			Rx Fires since 2009				
Species Code*	Species**	1 (n=7)	2 (n=19)	3 (n=12)	4 (n=9)	None Ever (n=19)	Total (n=66)
YBCU(+-)	***Yellow-billed Cuckoo***	0.57	0.39	0.21	0.22	0.37	0.35
INBU(+)	Indigo Bunting	0.43	0.47	0.50	0.78	0.53	0.53
BGGN(-)	Blue-gray Gnatcatcher	0.21	0.37	0.58	0.33	0.89	0.54
REVI(-)	Red-eyed Vireo	0.64	0.71	0.33	0.06	0.82	0.58
ACFL(-)	***Acadian Flycatcher***	0.50	0.61	0.42	0.56	0.95	0.65
RBWO(-)	Red-bellied Woodpecker	0.29	0.74	0.54	0.22	1.11	0.69
NOCA(-)	Northern Cardinal	0.64	0.66	0.50	0.33	1.16	0.73
CACH(-)	Carolina Chickadee	1.14	0.61	0.54	0.83	1.11	0.81
TUTI	Tufted Titmouse	1.21	1.03	0.54	1.00	1.05	0.96
WBNU	White-breasted Nuthatch	0.71	0.95	0.92	1.11	1.08	0.98
AMCR(-)	American Crow	0.71	0.76	1.29	1.33	1.29	1.08
EAWP(-+)	Eastern Wood Peewee	1.43	1.61	1.13	2.22	1.66	1.60

* (+) = positive or (-) = negative response of relative abundance to prescribed fire.

** Species on the Species in Greatest Need of Conservation (SGNC) list are given in bold and italics.

= species that were less abundant overall but responded to forest management.

= species that were more abundant overall and responded to forest management.

Table 6. Results of bird surveys completed during the 2016 **breeding** season at Stephen A. Forbes State Recreation Area, Illinois.
Species ranked from least to most abundant based on total point counts. Values represent number of individuals seen per point (averaged for 2 visits to each point) averaged across points within each category.

		Number per 100-m radius point					
		Years After Rx Fire					
Species Code*	Species**	0 (n=26)	1 (n=8)	2 (n=11)	3+ (n=3)	No Rx Ever (n=18)	Total (n=66)
BRTH	Brown Thrasher	0.00	0.00	0.00	0.00	0.03	0.01
EAKI	Eastern Kingbird	0.00	0.00	0.00	0.00	0.03	0.01
GRCA	Gray Catbird	0.00	0.00	0.05	0.00	0.00	0.01
HAWO	Hairy Woodpecker	0.00	0.00	0.05	0.00	0.00	0.01
HOFI	House Finch	0.02	0.00	0.00	0.00	0.00	0.01
RHWO	***Red-headed Woodpecker***	0.00	0.00	0.05	0.00	0.00	0.01
TRSW	Tree Swallow	0.00	0.06	0.00	0.00	0.00	0.01
CAGO	Canada Goose	0.00	0.00	0.05	0.00	0.03	0.02
CEDW	Cedar Waxwing	0.00	0.00	0.00	0.00	0.06	0.02
PUFI	Purple Finch	0.02	0.06	0.00	0.00	0.00	0.02
NOFL	***Northern Flicker***	0.02	0.00	0.00	0.17	0.00	0.02
KILL	Killdeer	0.02	0.06	0.05	0.00	0.00	0.02
LOWA	Louisiana Waterthrush	0.02	0.00	0.05	0.00	0.03	0.02
CARW	Carolina Wren	0.04	0.00	0.00	0.00	0.06	0.03
EABL	Eastern Bluebird	0.04	0.00	0.00	0.00	0.06	0.03
EAPH	Eastern Phoebe	0.04	0.00	0.05	0.00	0.03	0.03
EATO	Eastern Towhee	0.02	0.13	0.00	0.00	0.03	0.03
PUMA	Purple Martin	0.04	0.00	0.00	0.00	0.06	0.03
TUVU	Turkey Vulture	0.10	0.00	0.00	0.00	0.00	0.04
RBGR	Rose-breasted Grosbeak	0.08	0.06	0.00	0.00	0.03	0.05
BLGR	Blue Grosbeak	0.02	0.25	0.09	0.00	0.00	0.05
YTVI	Yellow-throated Vireo	0.06	0.00	0.05	0.00	0.08	0.05
PIWO	Pileated Woodpecker	0.06	0.19	0.05	0.00	0.06	0.07
WEVI	White-eyed Vireo	0.04	0.00	0.09	0.00	0.14	0.07
YBCH	***Yellow-breasted Chat***	0.02	0.00	0.00	0.00	0.22	0.07
OVEN	***Ovenbird***	0.08	0.00	0.05	0.00	0.14	0.08
WAVI	Warbling Vireo	0.06	0.13	0.09	0.00	0.08	0.08
CHSP	Chipping Sparrow	0.04	0.13	0.14	0.00	0.11	0.08
GBHE	Great Blue Heron	0.12	0.00	0.18	0.00	0.03	0.08
COGR	Common Grackle	0.00	0.63	0.09	0.00	0.00	0.09
RSHA	***Red-shouldered Hawk***	0.02	0.25	0.00	0.33	0.14	0.09
WOTH(-)	***Wood Thrush***	0.00	0.13	0.14	0.17	0.31	0.13
AMRO(+)	American Robin	0.23	0.13	0.09	0.00	0.06	0.14
SUTA	Summer Tanager	0.10	0.38	0.05	0.00	0.19	0.14
MODO(+)	Mourning Dove	0.29	0.13	0.05	0.00	0.11	0.17
FISP(-)	***Field Sparrow***	0.10	0.25	0.23	0.00	0.25	0.17
KEWA(-)	***Kentucky Warbler***	0.10	0.00	0.23	0.00	0.36	0.17
NOPA(-)	Northern Parula	0.08	0.00	0.23	0.17	0.39	0.18
SCTA(-)	Scarlet Tanager	0.08	0.25	0.23	0.50	0.22	0.18
AMGO(-)	American Goldfinch	0.12	0.19	0.14	0.33	0.33	0.20
COYE	Common Yellowthroat	0.25	0.25	0.05	0.17	0.31	0.23
GCFL	Great Crested Flycatcher	0.27	0.31	0.05	0.33	0.22	0.23
BHCO(-)	Brown-headed Cowbird	0.10	0.38	0.14	0.17	0.50	0.25
RTHU	Ruby-throated Hummingbird	0.17	0.19	0.18	0.17	0.53	0.27
DOWO	Downy Woodpecker	0.21	0.38	0.23	0.33	0.36	0.28
RWBL(-)	Red-winged Blackbird	0.12	0.63	0.27	0.00	0.44	0.29
BLJA	Blue Jay	0.38	0.50	0.09	0.17	0.33	0.33

Table 6 (continued)

		Number per 100-m radius point					
			Years After Rx Fire				
Species Code*	Species**	0 (n=26)	1 (n=8)	2 (n=11)	3+ (n=3)	No Rx Ever (n=18)	Total (n=66)
YBCU(-)	***Yellow-billed Cuckoo***	0.29	0.13	0.55	0.50	0.39	0.35
INBU	Indigo Bunting	0.44	0.81	0.50	0.67	0.53	0.53
BGGN	Blue-gray Gnatcatcher	0.58	0.25	0.00	0.50	0.94	0.54
REVI	Red-eyed Vireo	0.54	0.06	0.64	0.00	0.83	0.58
ACFL	***Acadian Flycatcher***	0.56	0.19	0.73	0.67	0.94	0.65
RBWO(-)	Red-bellied Woodpecker	0.44	0.19	0.91	0.83	1.11	0.69
NOCA	Northern Cardinal	0.56	0.25	0.68	0.67	1.22	0.73
CACH(-)	Carolina Chickadee	0.52	0.69	1.05	1.00	1.17	0.83
TUTI	Tufted Titmouse	0.94	0.63	1.00	1.33	1.06	0.96
WBNU	White-breasted Nuthatch	0.94	1.13	0.68	1.00	1.14	0.98
AMCR(+)	American Crow	1.40	0.56	0.36	0.67	1.36	1.08
EAWP	Eastern Wood Peewee	1.54	1.56	1.50	1.50	1.72	1.60

* (+) = positive or (-) = negative response of relative abundance to immediate effects of prescribed fire ("0" category).

** Species on the Species in Greatest Need of Conservation (SGNC) list are given in bold and italics.

= species that were less abundant overall but responded to immediate effects of Rx Fire.

= species that were more abundant overall and responded to immediate effects of Rx Fire.

Table 7. Results of bird surveys completed during the 2016 **breeding** season at Hidden Springs State Forest, Illinois. Species ranked from least to most abundant based on total point counts. Values represent number of individuals seen per point (averaged for 2 visits to each point) averaged across points within each category.

		Number per 100-m radius point			
		Management***			
Species Code*	Species**	Ex/Map (n=10)	Ex/Map + Rx Fire(n=10)	None (n=10)	Total (n=30)
AMRE	American Redstart	0.00	0.00	0.10	0.03
BDOW	Barred Owl	0.10	0.00	0.00	0.03
PROW	***Prothonotary Warbler***	0.00	0.00	0.10	0.03
RBGR	Rose-breasted Grosbeak	0.00	0.10	0.00	0.03
RTHA	Red-tailed Hawk	0.00	0.10	0.00	0.03
WITU	***Wild Turkey***	0.00	0.10	0.00	0.03
WODU	***Wood Duck***	0.00	0.10	0.00	0.03
AMCR	American Crow	0.00	0.10	0.10	0.07
AMRO	American Robin	0.10	0.10	0.00	0.07
GRCA	Gray Catbird	0.10	0.00	0.10	0.07
HOWR	House Wren	0.00	0.10	0.10	0.07
YBCH	***Yellow-breasted Chat***	0.00	0.20	0.00	0.07
OVEN(+-)	***Ovenbird***	0.20	0.00	0.10	0.10
SUTA(+)	Summer Tanager	0.10	0.20	0.00	0.10
GBHE	Great Blue Heron	0.00	0.40	0.00	0.13
MODO(+)	Mourning Dove	0.20	0.20	0.00	0.13
NOFL(+)	***Northern Flicker***	0.30	0.10	0.00	0.13
PIWO	Pileated Woodpecker	0.10	0.20	0.10	0.13
WEVI	White-eyed Vireo	0.10	0.10	0.20	0.13
AMGO(+)	American Goldfinch	0.30	0.20	0.00	0.17
COYE(+)	Common Yellowthroat	0.10	0.30	0.10	0.17
LOWA(-)	Louisiana Waterthrush	0.00	0.00	0.50	0.17
RHWO(+)	***Red-headed Woodpecker***	0.20	0.40	0.00	0.20
RSHA(-)	***Red-shouldered Hawk***	0.00	0.30	0.30	0.20
SCTA(+)	Scarlet Tanager	0.00	0.60	0.00	0.20
WAVI(+)	Warbling Vireo	0.30	0.20	0.10	0.20
YBCU	***Yellow-billed Cuckoo***	0.20	0.20	0.20	0.20
HAWO(-+)	Hairy Woodpecker	0.00	0.70	0.20	0.30
NOPA	Northern Parula	0.30	0.20	0.40	0.30
EATO(+)	Eastern Towhee	0.50	0.50	0.10	0.37
YTWA(-)	Yellow-throated Warbler	0.20	0.50	0.40	0.37
KEWA(-)	***Kentucky Warbler***	0.40	0.20	0.70	0.43
YTVI(-+)	Yellow-throated Vireo	0.20	0.70	0.40	0.43
RBWO(+)	Red-bellied Woodpecker	0.70	0.60	0.30	0.53
CHIC(-)	Chickadee Spp.	0.20	0.50	1.00	0.57
BLJA(+)	Blue Jay	0.20	1.60	0.00	0.60
RTHU	Ruby-throated Hummingbird	0.60	0.50	0.70	0.60
WOTH(-)	***Wood Thrush***	0.90	0.30	0.90	0.70
REVI	Red-eyed Vireo	0.60	0.80	0.90	0.77
DOWO	Downy Woodpecker	0.70	0.90	0.80	0.80

Table 7 (continued)

		Number per 100-m radius point			
		Management***			
Species Code*	Species**	Ex/Map (n=10)	Ex/Map + Rx Fire(n=10)	None (n=10)	Total (n=30)
BHCO(+)	Brown-headed Cowbird	0.70	1.10	0.70	0.83
GCFL(+)	Great Crested Flycatcher	1.10	1.20	0.50	0.93
CARW(-+)	Carolina Wren	0.40	1.50	1.00	0.97
WBNU(+)	White-breasted Nuthatch	0.90	2.00	1.20	1.37
NOCA	Northern Cardinal	1.50	1.70	1.20	1.47
TUTI(-)	Tufted Titmouse	1.30	2.00	1.90	1.73
INBU	Indigo Bunting	1.80	2.20	1.80	1.93
EAWP(-)	Eastern Wood Peewee	1.40	2.20	2.30	1.97
BGGN	Blue-gray Gnatcatcher	1.80	2.20	2.00	2.00
ACFL	***Acadian Flycatcher***	2.20	2.50	2.60	2.43

* (+) = positive or (-) = negative response of relative abundance to management.

** Species on the Species in Greatest Need of Conservation (SGNC) list are given in bold and italics.

*** Ex/Map = exotics and maple removal; Ex/Map + Rx = exotics and maple removal + frequent Rx Fire.

= species that were less abundant overall but responded to forest management.

= species that were more abundant overall and responded to forest management.

Table 8. Results of bird surveys completed during the 2016 **breeding** season at Siloam Springs State Park, Illinois. Species ranked from least to most abundant based on total point counts. Values represent number of individuals seen per point (averaged for 2 visits to each point) averaged across points within each category.

		Number per 100-m radius point				
		Management***				
Species Co	Species**	Rx Fire 2015 (n=8)	Thin + Rx Fire 2015 (n=8)	Thin + Rx Fire 20 yr (n=8)	None (n=8)	Total (n=32)
EATO	Eastern Towhee	0.00	0.00	0.13	0.00	0.03
GBHE	Great Blue Heron	0.00	0.00	0.13	0.00	0.03
YBCH	***Yellow-breasted Chat***	0.00	0.00	0.13	0.00	0.03
BAOR	Baltimore Oriole	0.00	0.00	0.25	0.00	0.06
BDOW	Barred Owl	0.00	0.13	0.13	0.00	0.06
RSHA	***Red-shouldered Hawk***	0.13	0.13	0.00	0.00	0.06
LOWA(-+)	Louisiana Waterthrush	0.00	0.00	0.25	0.13	0.09
YBCU(+)	***Yellow-billed Cuckoo***	0.00	0.00	0.50	0.00	0.13
NOFL(+)	***Northern Flicker***	0.00	0.63	0.00	0.00	0.16
RHWO(+)	***Red-headed Woodpecker***	0.25	0.38	0.00	0.00	0.16
COYE(+)	Common Yellowthroat	0.00	0.13	0.63	0.00	0.19
WITU(+)	***Wild Turkey***	0.00	0.25	0.50	0.00	0.19
KEWA(+)	***Kentucky Warbler***	0.50	0.25	0.00	0.13	0.22
OVEN(-+)	***Ovenbird***	0.00	0.50	0.13	0.25	0.22
RBGR(+)	Rose-breasted Grosbeak	0.13	0.50	0.25	0.00	0.22
WOTH(-)	***Wood Thrush***	0.25	0.13	0.25	0.38	0.25
PIWO(+)	Pileated Woodpecker	0.25	0.63	0.25	0.00	0.28
SUTA(-+)	Summer Tanager	0.00	0.63	0.25	0.25	0.28
AMGO(+)	American Goldfinch	0.00	0.88	0.50	0.00	0.34
CARW(+)	Carolina Wren	0.25	0.63	0.50	0.00	0.34
RBWO(+-)	Red-bellied Woodpecker	0.25	1.00	0.13	0.25	0.41
NOCA(+)	Northern Cardinal	0.25	1.25	0.50	0.13	0.53
SCTA(+)	Scarlet Tanager	1.13	0.88	0.38	0.00	0.59
YTVI(-+)	Yellow-throated Vireo	0.25	0.88	0.75	0.50	0.59
HAWO(+)	Hairy Woodpecker	0.63	1.38	0.38	0.13	0.63
RTHU(+)	Ruby-throated Hummingbird	0.38	1.13	0.75	0.25	0.63
AMRO(+)	American Robin	0.25	1.25	1.13	0.00	0.66
BLJA(+)	Blue Jay	0.50	0.38	1.38	0.38	0.66
NOPA(+)	Northern Parula	0.75	0.88	0.75	0.25	0.66
REVI(+)	Red-eyed Vireo	0.88	1.38	0.63	0.38	0.81
DOWO(+)	Downy Woodpecker	1.13	0.88	0.88	0.50	0.84
GCFL(+)	Great Crested Flycatcher	1.00	1.63	0.38	0.63	0.91
INBU(+)	Indigo Bunting	0.63	1.50	1.13	0.50	0.94
BHCO(-+)	Brown-headed Cowbird	0.00	1.25	1.88	0.88	1.00
CHIC(-)	Chickadee Spp.	1.38	1.00	0.75	1.25	1.09
WBNU(+)	White-breasted Nuthatch	1.25	1.75	2.00	1.00	1.50
TUTI(-+)	Tufted Titmouse	1.25	2.00	1.38	1.50	1.53
ACFL(+)	***Acadian Flycatcher***	1.50	2.13	1.25	1.38	1.56
BGGN	Blue-gray Gnatcatcher	1.50	2.00	1.50	1.50	1.63
EAWP(+)	Eastern Wood Peewee	2.13	2.38	1.38	1.50	1.84

* (+) = positive or (-) = negative response of relative abundance to management.

** Species on the Species in Greatest Need of Conservation (SGNC) list are given in bold and italics.

*** Thin +Rx Fire 20 yr = Thinned and Rx Fire every 3-5 years for past 20 years

= species that were less abundant overall but responded to forest management.

= species that were more abundant overall and responded to forest management.

Table 9. Results of bird surveys completed during the 2015-2016 **winter** season at Lake Shelbyville - U.S. Army Corp of Engineers, Illinois
Species ranked from least to most abundant based on total point counts. Values represent number of individuals seen per point averaged across points within each category.

		Number per 100-m radius point				
		Management***				
Species Code*	Species**	Rx Fire (n=12)	TSI (n=18)	Rx Fire + TSI (n=23)	None (n=13)	Total (n=66)
AMGO	American Goldfinch	0.08	0.00	0.00	0.00	0.02
EABL	Eastern Bluebird	0.08	0.00	0.00	0.00	0.02
BRCR	***Brown Creeper***	0.08	0.00	0.04	0.00	0.03
DEJU	Dark-eyed Junco	0.00	0.00	0.09	0.00	0.03
GCKI	Golden-crowned Kinglet	0.08	0.00	0.04	0.00	0.03
PIWO	Pileated Woodpecker	0.00	0.06	0.00	0.08	0.03
RSHA	***Red-shouldered Hawk***	0.00	0.11	0.00	0.00	0.03
COGR	Common Grackle	0.00	0.00	0.04	0.15	0.05
EAPH	Eastern Phoebe	0.00	0.00	0.04	0.15	0.05
RWBL	Red-winged Blackbird	0.00	0.00	0.04	0.23	0.06
MODO(-)	Mourning Dove	0.00	0.00	0.09	0.23	0.08
HOSP(-)	House Sparrow	0.00	0.00	0.00	0.46	0.09
AMRO(-)	American Robin	0.00	0.00	0.22	0.23	0.12
NOFL(+)	***Northern Flicker***	0.00	0.06	0.26	0.08	0.12
BHCO(-)	Brown-headed Cowbird	0.00	0.00	0.30	0.23	0.15
CARW	Carolina Wren	0.17	0.17	0.13	0.15	0.15
HAWO(+)	Hairy Woodpecker	0.17	0.33	0.04	0.08	0.15
BLJY	Blue Jay	0.25	0.33	0.17	0.23	0.24
DOWO(-)	Downy Woodpecker	0.08	0.39	0.26	0.46	0.30
NOCA(-)	Northern Cardinal	0.08	0.17	0.26	0.85	0.32
RBWO	Red-bellied Woodpecker	0.42	0.61	0.39	0.54	0.48
CHIC(-)	Chickadee spp.	0.50	0.61	0.43	0.92	0.59
WBNU(+)	White-breasted Nuthatch	0.83	0.83	0.78	0.62	0.77
TUTI(-)	Tufted Titmouse	0.42	0.94	1.04	1.31	0.95
AMCR(-)	American Crow	1.83	2.56	2.26	2.92	2.39

* (+) = positive or (-) = negative response of relative abundance to management.

** Species on the Species in Greatest Need of Conservation (SGNC) list are given in bold and italics.

*** Rx Fire = prescribed fire; TSI = Timber Stand Improvement (e.g. thinning).

= species that were less abundant overall but responded to forest management.

= species that were more abundant overall and responded to forest management.

Table 10. Results of bird surveys completed during the 2015-2016 **winter** at Trail of Tears State Forest, Illinoi
Species ranked from least to most abundant based on total point counts. Values represent number of individuals seen per point averaged across points within each category.

		Number per 100-m radius point			
		Management***			
Species Code*	Species**	Rx Fire (n=11)	FSI (n=2)	None (n=17)	Total (n=30)
CARW	Carolina Wren	0.09	0.00	0.00	0.03
DEJU	Dark-eyed Junco	0.09	0.00	0.00	0.03
GCKI	Golden-crowned Kinglet	0.00	0.00	0.06	0.03
NOFL	***Northern Flicker***	0.09	0.00	0.00	0.03
RSHA	***Red-shouldered Hawk***	0.00	0.00	0.06	0.03
WIWR	Winter Wren	0.09	0.00	0.00	0.03
YBSA	Yellow-bellied Sapsucker	0.00	0.00	0.06	0.03
BLJA(+)	Blue Jay	0.09	0.50	0.06	0.10
RWBL(-+)	Red-winged Blackbird	0.00	0.50	0.12	0.10
BRCR(+-)	***Brown Creeper***	0.18	0.00	0.12	0.13
AMCR(-+)	American Crow	0.00	1.00	0.24	0.20
TUTI(+)	Tufted Titmouse	0.18	1.00	0.18	0.23
DOWO(-)	Downy Woodpecker	0.09	0.00	0.41	0.27
RBWO(-)	Red-bellied Woodpecker	0.27	0.50	0.47	0.40
PIWO(+)	Pileated Woodpecker	0.36	2.00	0.41	0.50
CACH	Carolina Chickadee	0.45	0.50	0.59	0.53
WBNU	White-breasted Nuthatch	0.64	0.50	0.65	0.63

* (+) = positive or (-) = negative response of relative abundance to management.

** Species on the Species in Greatest Need of Conservation (SGNC) list are given in bold and italics.

*** Rx Fire = prescribed fire; FSI = Forest Stand Improvement (e.g. thinning).

= species that were less abundant overall but responded to forest management.

= species that were more abundant overall and responded to forest management.

Table 11. Results of bird surveys completed during the 2015-2016 **winter** season at Stephen A. Forbes State Recreation Area, Illinois. Species ranked from least to most abundant based on total point counts. Values represent number of individuals seen per point averaged across points within each category.

		Number per 100-m radius point					
		Rx Fires since 2009					
Species Code*	Species**	1 (n=2)	2 (n=6)	3 (n=3)	4 (n=4)	None Ever (n=7)	Total (n=22)
HAWO	Hairy Woodpecker	0.00	0.17	0.00	0.00	0.00	0.05
RSHA	***Red-shouldered Hawk***	0.00	0.00	0.00	0.25	0.00	0.05
AMGO	American Goldfinch	0.00	0.00	0.00	0.00	0.29	0.09
CARW(-+)	Carolina Wren	0.00	0.00	0.00	0.25	0.14	0.09
NOCA(-)	Northern Cardinal	0.00	0.00	0.00	0.00	0.29	0.09
WITU(-+)	***Wild Turkey***	0.00	0.00	0.00	0.25	0.14	0.09
PIWO(-)	Pileated Woodpecker	0.00	0.00	0.00	0.25	0.29	0.14
RWBL(+)	Red-winged Blackbird	0.00	0.33	0.00	0.25	0.00	0.14
DOWO(+)	Downy Woodpecker	0.00	0.50	0.00	0.25	0.14	0.23
TUTI(-)	Tufted Titmouse	0.50	0.33	0.00	0.00	0.43	0.27
BLJA(+)	Blue Jay	1.00	0.33	0.67	0.75	0.14	0.45
RBWO	Red-bellied Woodpecker	0.50	0.50	1.00	0.25	0.43	0.50
CACH(+)	Carolina Chickadee	0.00	0.83	1.00	0.50	0.29	0.55
WBNU(-+)	White-breasted Nuthatch	0.00	0.50	2.00	1.75	0.86	1.00
AMCR(+)	American Crow	2.00	2.33	2.67	1.25	1.71	1.95

* (+) = positive or (-) = negative response of relative abundance to prescribed fire.

** Species on the Species in Greatest Need of Conservation (SGNC) list are given in bold and italics.

= species that were less abundant overall but responded to forest management.

= species that were more abundant overall and responded to forest management.

Table 12. Summary of trail camera deployments at Lake Shelbyville during late 2015 to early 2016. Detections are an index of animal activity at each point of deployment.

	Number of detections per 1000 images taken				
	Management*				
Animal**	Rx Fire (n=6)***	TSI (n=5)	TSI + Rx Fire (n=3)	None (n=6)	Total (n=20)
Bird(-)	0.046	0.151	0.114	0.237	0.140
Squirrel	0.251	0.546	0.265	0.314	0.346
Deer(+)	0.256	0.261	0.269	0.172	0.234
Turkey	0.027	0.000	0.000	0.000	0.008
Opossum(+)	0.034	0.058	0.048	0.000	0.032
Raccoon	0.008	0.014	0.000	0.023	0.013
Bobcat	0.000	0.000	0.000	0.000	0.000
Fox	0.000	0.044	0.000	0.000	0.011
Coyote	0.000	0.029	0.024	0.000	0.011

* TSI = thinning; Rx Fire = prescribed fire.

** (+) = positive or (-) = negative response of relative animal activity to management.

*** n=number of points sampled. Cameras were deployed twice at eacn point with each deployment collecting >10,000 images.

Table 13. Summary of trail camera deployments at Trail of Tears during late 2015 to early 2016. Detections are an index of animal activity at each point of deployment.

	Number of detections per 1000 images taken		
	Management*		
Animal**	Rx Fire (n=5)***	None (n=5)	Total (n=10)
Bird	0.107	0.053	0.080
Squirrel	0.427	0.455	0.441
Deer	0.278	0.251	0.264
Turkey	0.205	0.236	0.221
Opossum	0.000	0.021	0.011
Raccoon	0.011	0.022	0.017
Bobcat	0.000	0.000	0.000
Fox	0.000	0.022	0.011
Coyote	0.000	0.000	0.000

* Rx Fire = prescribed fire.

** (+) = positive or (-) = negative response of relative animal activity to management.

*** n=number of points sampled. Cameras were deployed twice at eacn point with each deployment collecting >10,000 images.

Table 14. Summary of trail camera deployments at Forbes State Park during late 2015 to early 2016. Detections are an index of animal activity at each point of deployment.

	Number of detections per 1000 images taken		
	Management*		
Animal**	Rx Fire (n=5)***	None (n=5)	Total (n=10)
Bird(+)	0.445	0.177	0.311
Squirrel(+)	0.933	0.586	0.759
Deer	0.614	0.628	0.621
Turkey	0.270	0.318	0.294
Opossum	0.009	0.000	0.004
Raccoon	0.000	0.000	0.000
Bobcat	0.000	0.000	0.000
Fox	0.000	0.040	0.020
Coyote	0.000	0.000	0.000

* TSI = thinning; Rx Fire = prescribed fire.

** (+) = positive or (-) = negative response of relative animal activity to management.

*** n=number of points sampled. Cameras were deployed twice at eacn point with each deployment collecting >10,000 images.

Table 15. Structural aspects of the forest vegetation at Forest Campaign sites (Oakwood Bottoms). Averages per point presented.

	Management Type* (number of veg survey points)		
Vegetation Characteristic	None (15)	TSI (28)	TSI + Rx Fire (19)
Size A Trees (3-10" dbh)	26.1	6.4	14.3
Size B Trees (11-24" dbh)	5.3	4.2	3.1
Size C Trees (25-38" dbh)	0.2	0.4	0.8
Size D Trees (>38" dbh)	0.0	0.1	0.1
Size A Snags (3-10" dbh)	1.7	1.2	3.3
Size B Snags (11-24" dbh)	0.5	1.0	0.8
Size C Snags (25-38" dbh)	0.1	0.1	0.4
Size D Snags (>38" dbh)	0.0	0.0	0.1
Shrub Density**	15.0	37.7	68.2
Shrub Height (m)	1.3	2.0	1.9
Ground Cover (%)	51.0	81.0	79.0
Canopy Cover (%)	55.0	47.0	53.0
Canopy Height (m)	17.0	15.0	16.0

* TSI = Timber Stand Improvement (thinning); Rx Fire = Prescribed Fire.

** number of woody stems < 2-inch dbh detected along 2 perpendicular transects through center of 11-meter-diameter veg survey location.

Table 16. Structural aspects of the forest vegetation at Forest Campaign sites (Lake Shelbyville). Averages per point presented.

	Management Type* (number of veg survey points)			
Vegetation Characteristic	None (21)	TSI (29)	Rx Fire (17)	TSI + Rx Fire (33)
Size A Trees (3-10" dbh)	23.1	14.4	22.1	13.0
Size B Trees (11-24" dbh)	6.1	8.0	7.5	8.3
Size C Trees (25-38" dbh)	0.3	0.5	0.1	0.3
Size D Trees (>38" dbh)	0.0	0.0	0.0	0.1
Size A Snags (3-10" dbh)	4.3	3.1	4.1	3.2
Size B Snags (11-24" dbh)	0.1	0.4	0.3	0.9
Size C Snags (25-38" dbh)	0.1	0.1	0.0	0.1
Size D Snags (>38" dbh)	0.0	0.0	0.0	0.0
Shrub Density**	43	29.5	30.4	39.0
Shrub Height (m)	1.4	1.9	1.7	1.7
Ground Cover (%)	55.0	53.0	62.0	70.0
Canopy Cover (%)	61.0	72.0	77.0	65.0
Canopy Height (m)	14.0	17.0	16.0	17.0

* TSI = Timber Stand Improvement (thinning); Rx Fire = Prescribed Fire.

** number of woody stems < 2-inch dbh detected along 2 perpendicular transects through center of 11-meter-diameter veg survey location.

Table 17. Structural aspects of the forest vegetation at Forest Campaign sites (Trail of Tears). Averages per point presented.

	Management Type* (number of veg survey points)	
Vegetation Characteristic	None (24)	Rx Fire (17)
Size A Trees (3-10" dbh)	12.2	18.8
Size B Trees (11-24" dbh)	4.3	2.9
Size C Trees (25-38" dbh)	0.6	0.8
Size D Trees (>38" dbh)	0.1	0.0
Size A Snags (3-10" dbh)	1.7	1.2
Size B Snags (11-24" dbh)	0.3	0.3
Size C Snags (25-38" dbh)	0.0	0.2
Size D Snags (>38" dbh)	0.0	0.0
Shrub Density**	46.6	26.1
Shrub Height (m)	1.5	2.0
Ground Cover (%)	57.0	50.0
Canopy Cover (%)	66.0	79.0
Canopy Height (m)	20.0	23.0

* TSI = Timber Stand Improvement (thinning); Rx Fire = Prescribed Fire.

** number of woody stems < 2-inch dbh detected along 2 perpendicular transects through center of 11-meter-diameter veg survey location.

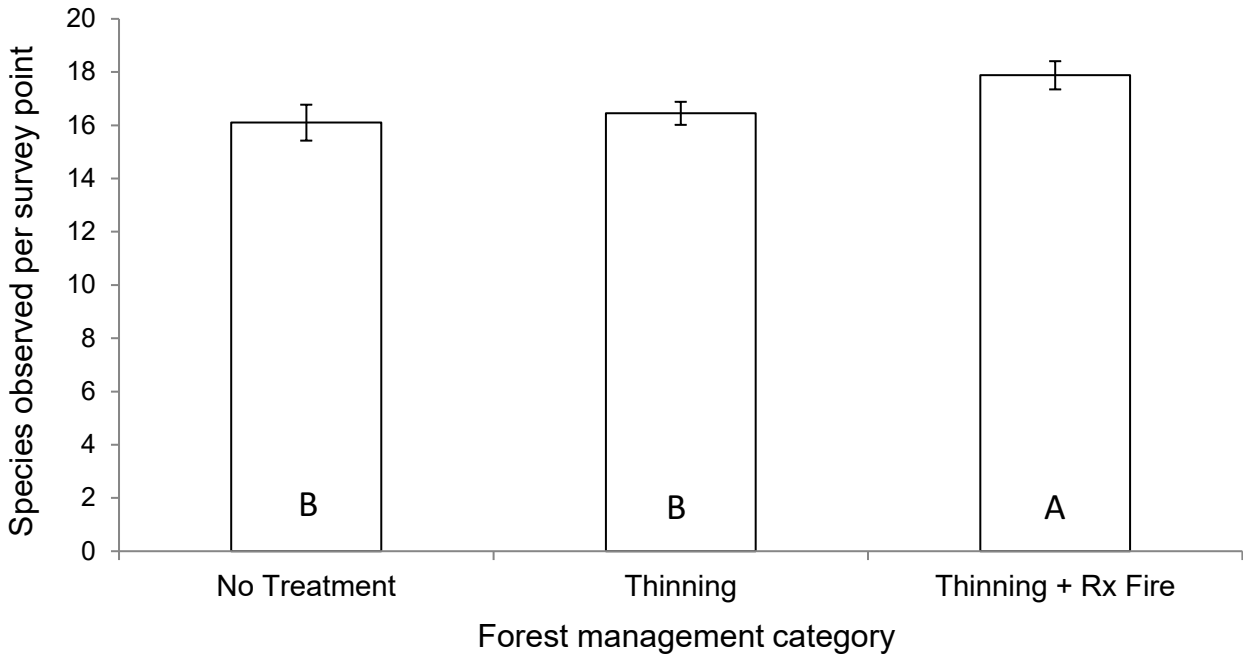

Figure 1. Index of species diversity (mean number of species observed per 100-m-radius survey point) compared among forest treatment categories at **Oakwood Bottoms** during the 2016 breeding season. Standard errors (+ and -) shown. Categories with the same letter in the column are not significantly (*P*>0.05) different from each other. See Table 1 for number of survey points per category.

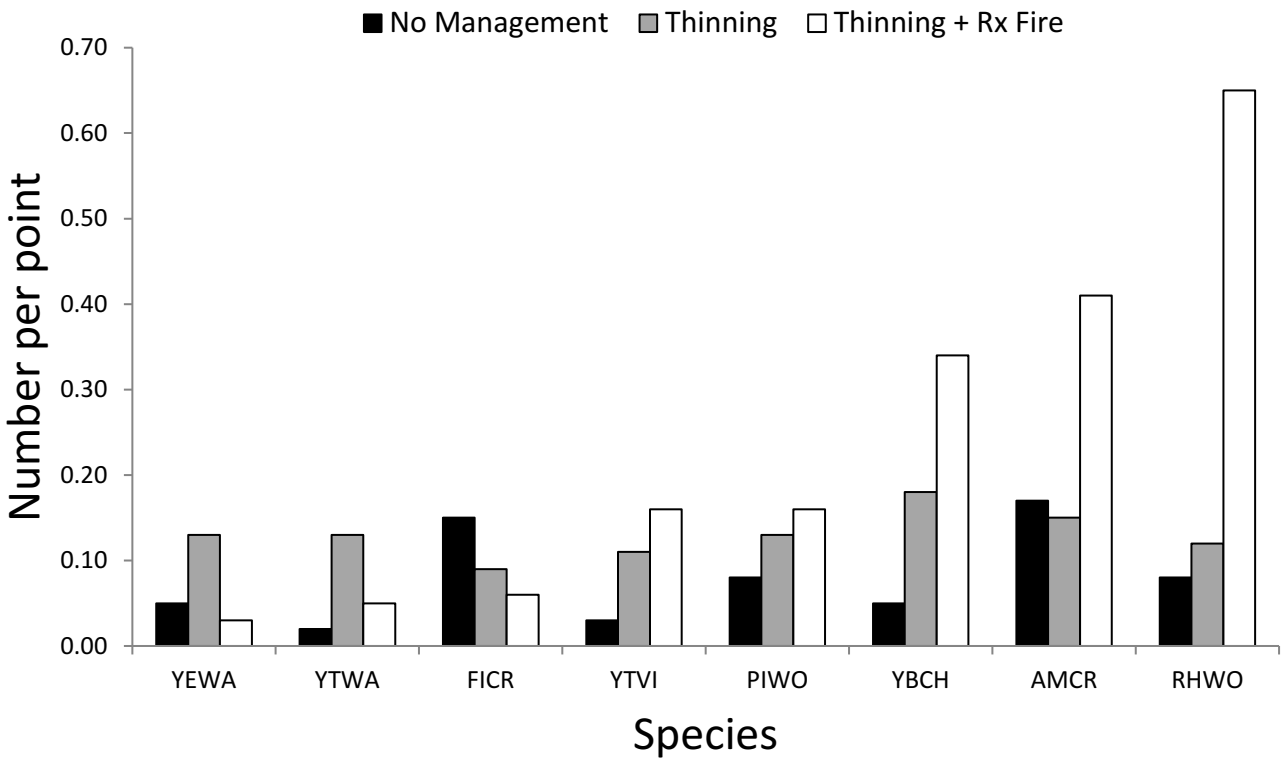

Figure 2. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Oakwood Bottoms** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 2.

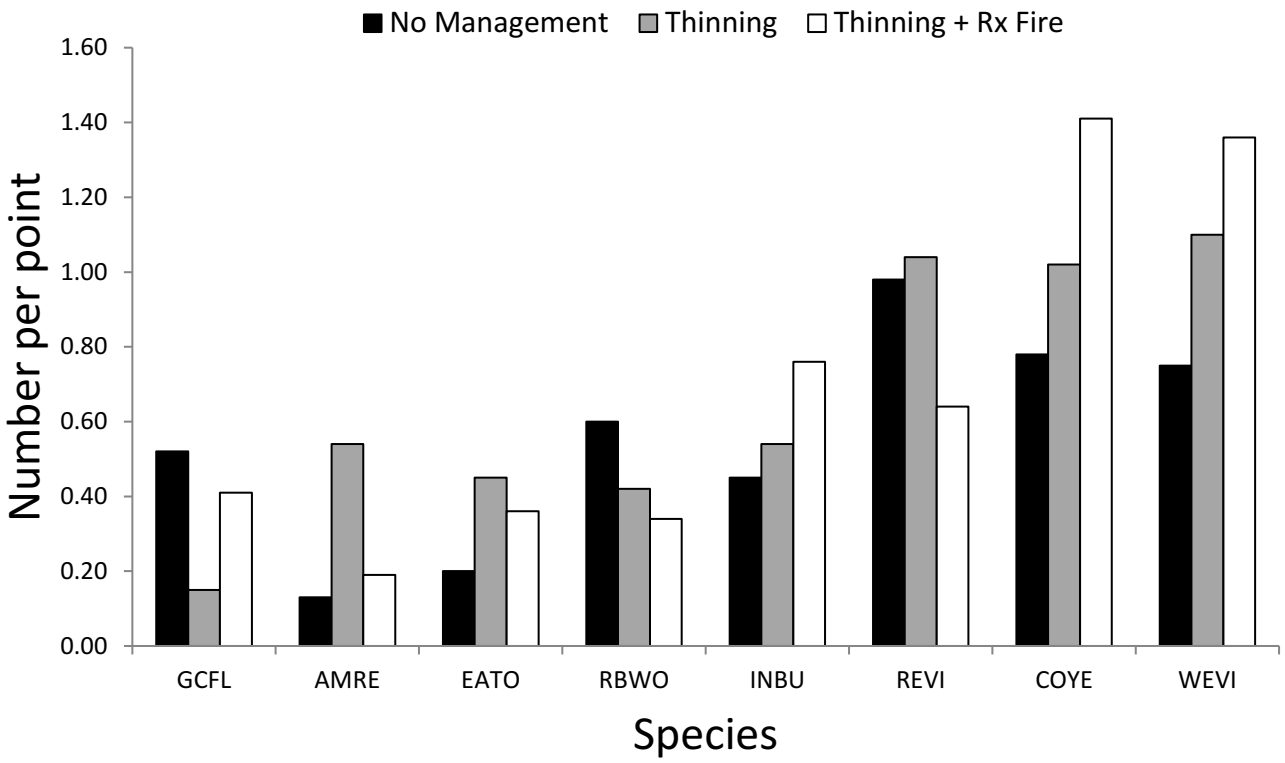

Figure 3. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Oakwood Bottoms** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 2.

Figure 4. Index of species diversity (mean number of species observed per 100-m-radius survey point) compared among forest treatment categories at **Lake Shelbyville** during the 2016 breeding season. Standard errors (+ and -) shown. Categories with the same letter in the column are not significantly (*P*>0.05) different from each other. See Table 1 for number of survey points per category.

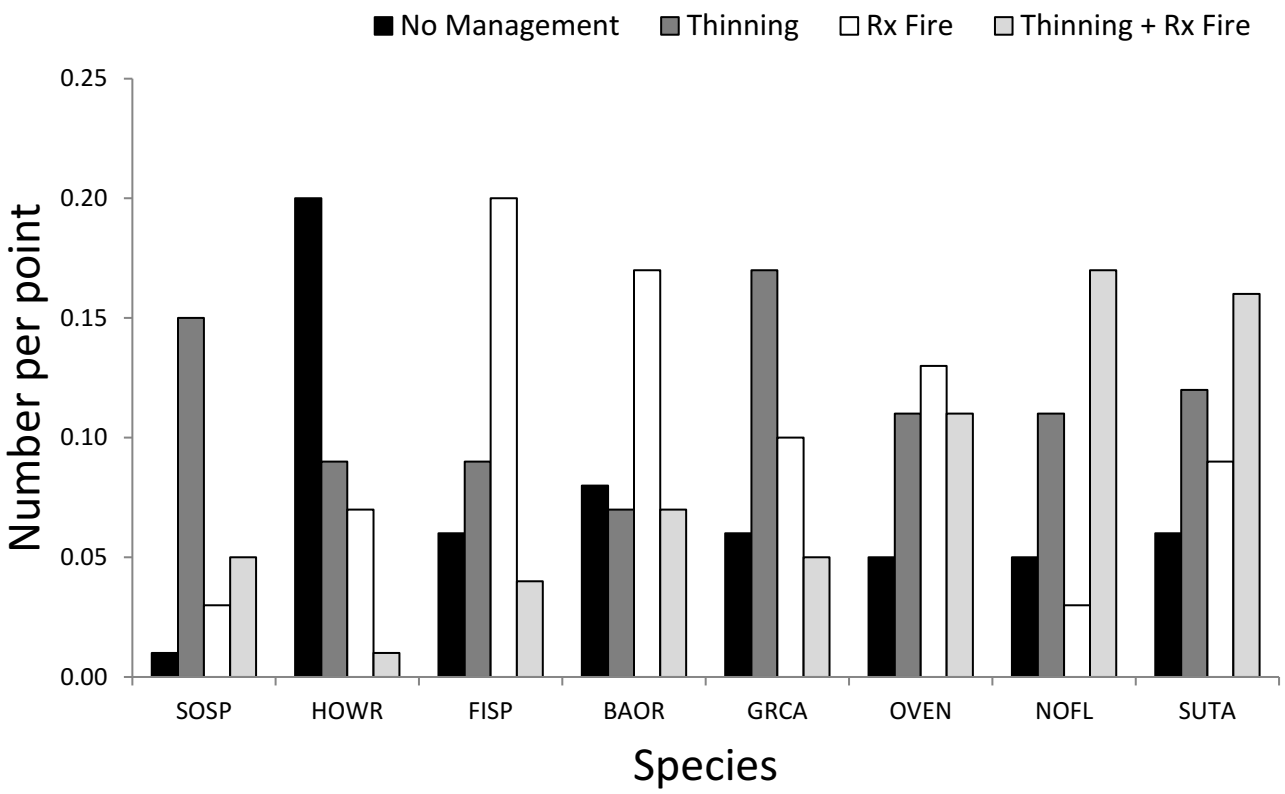

Figure 5. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Lake Shelbyville** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 3.

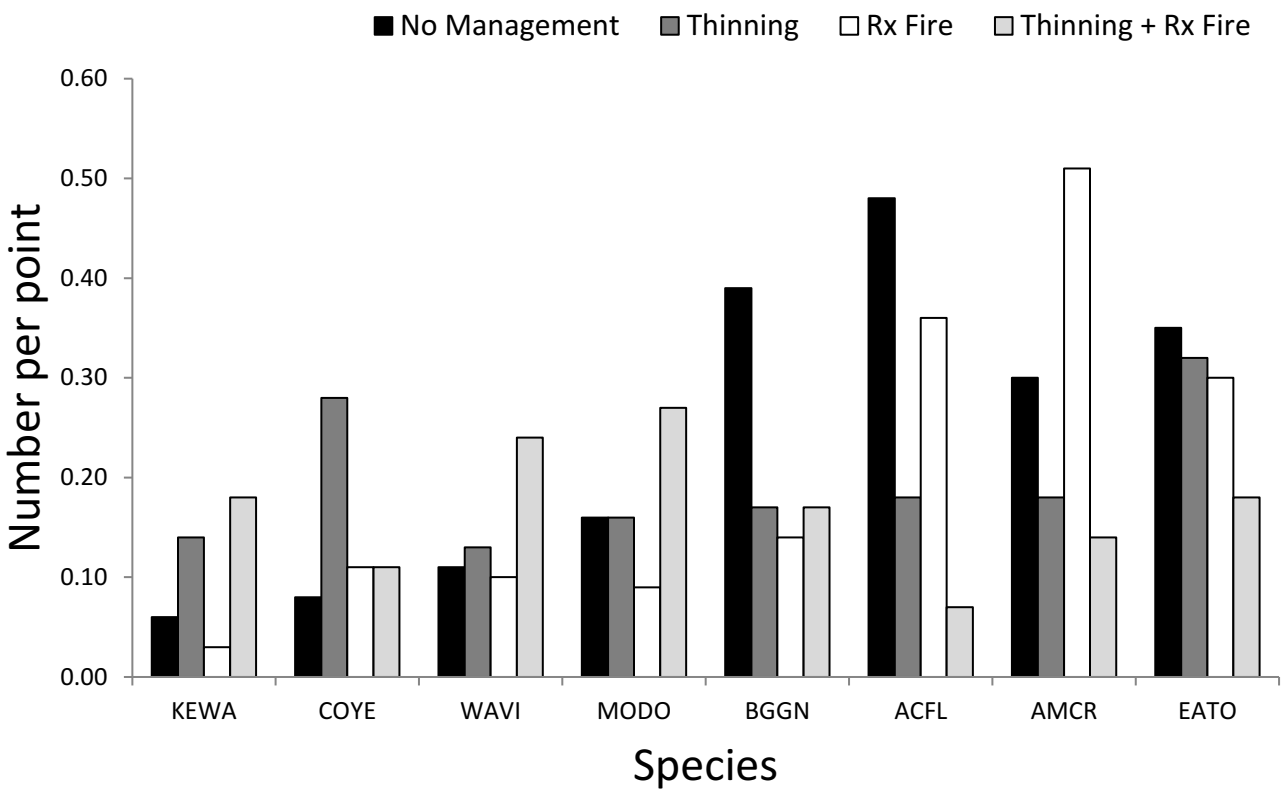

Figure 6. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Lake Shelbyville** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 3.

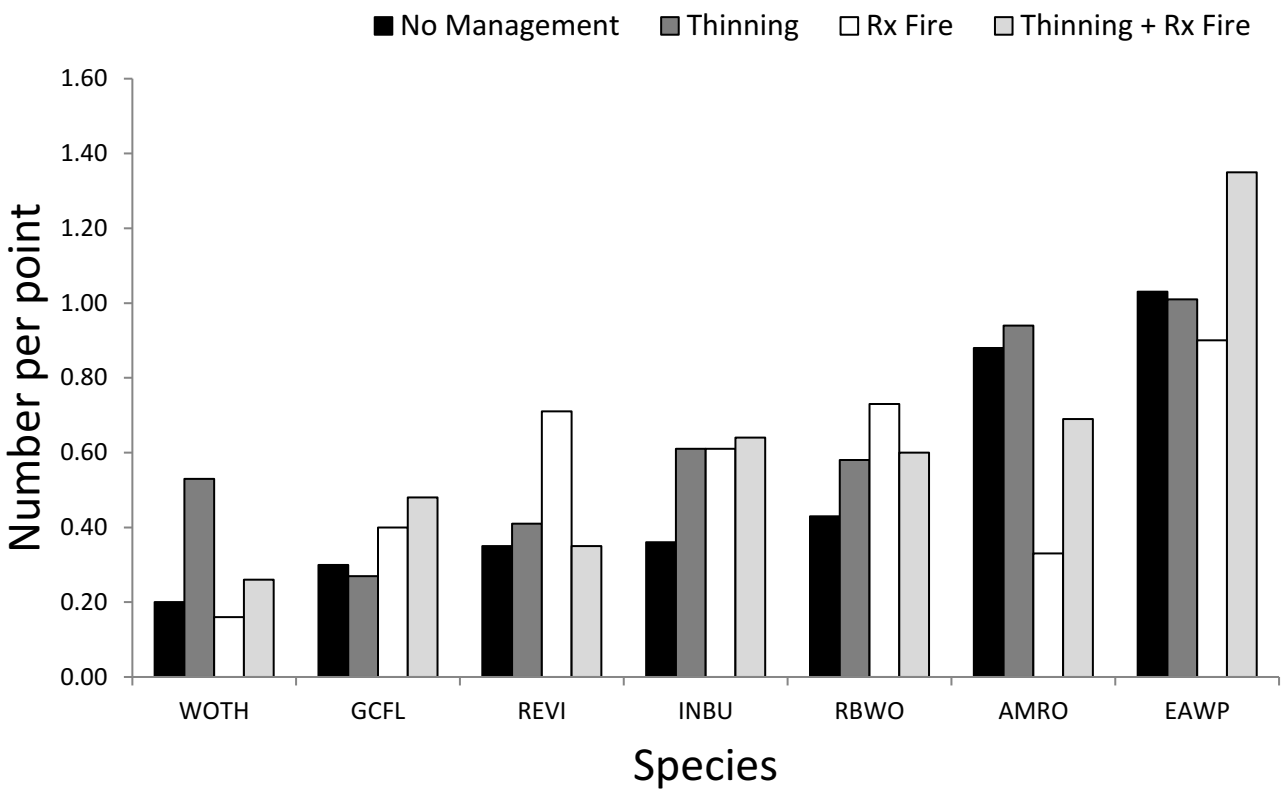

Figure 7. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Lake Shelbyville** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 3.

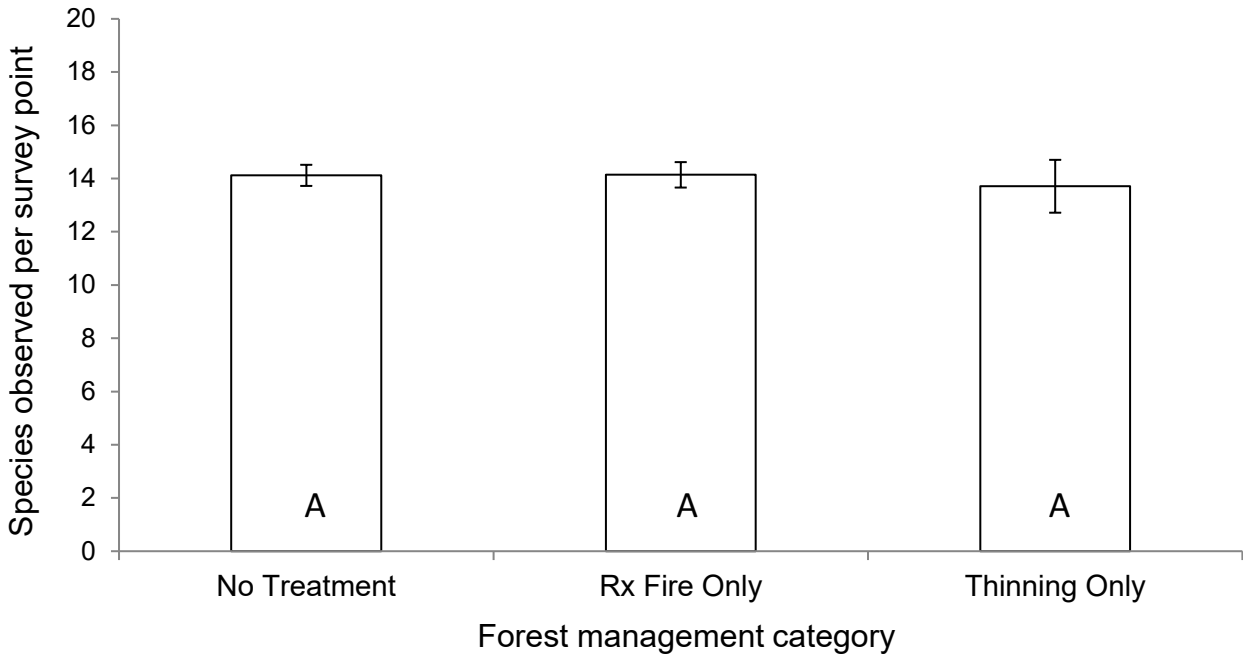

Figure 8. Index of species diversity (mean number of species observed per 100-m-radius survey point) compared among forest treatment categories at **Trail of Tears State Forest** during the 2016 breeding season. Standard errors (+ and -) shown. Categories with the same letter in the column are not significantly (*P*>0.05) different from each other. See Table 1 for number of survey points per category.

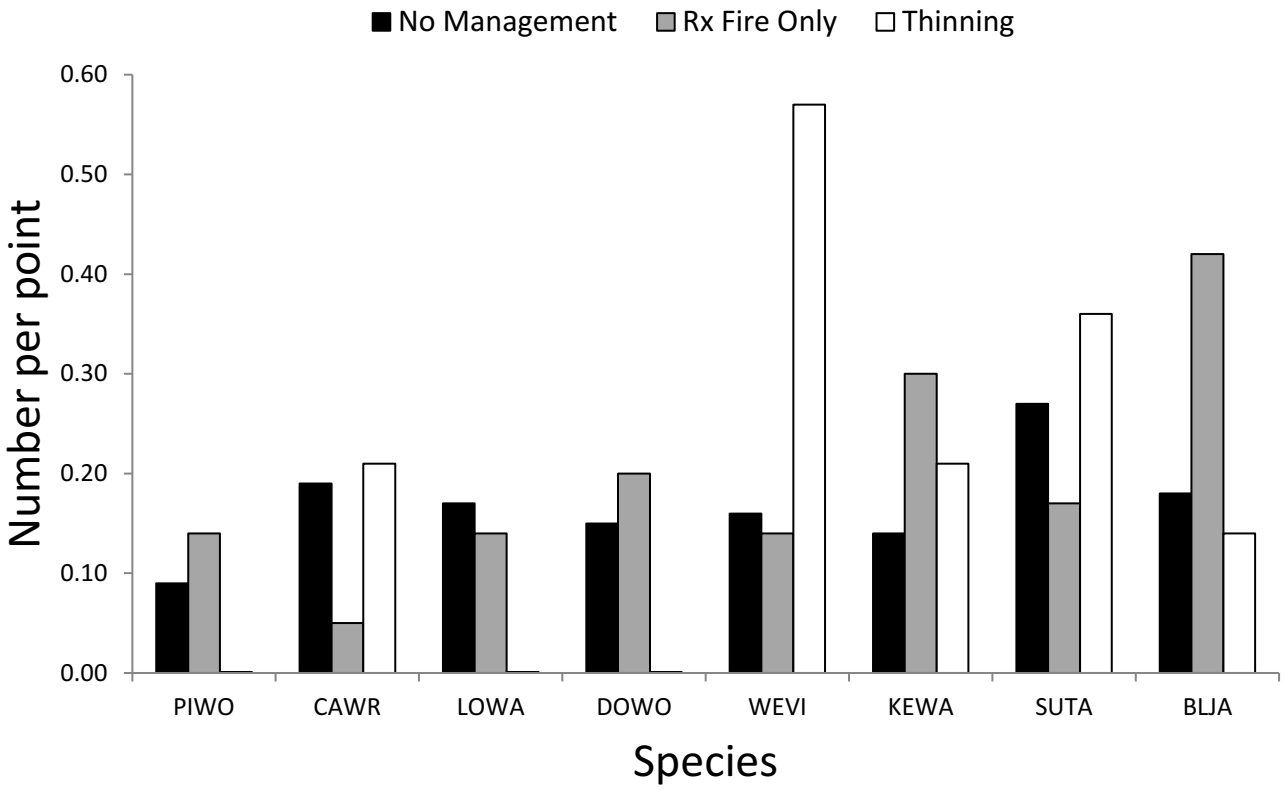

Figure 9. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Trail of Tears State Forest** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 4.

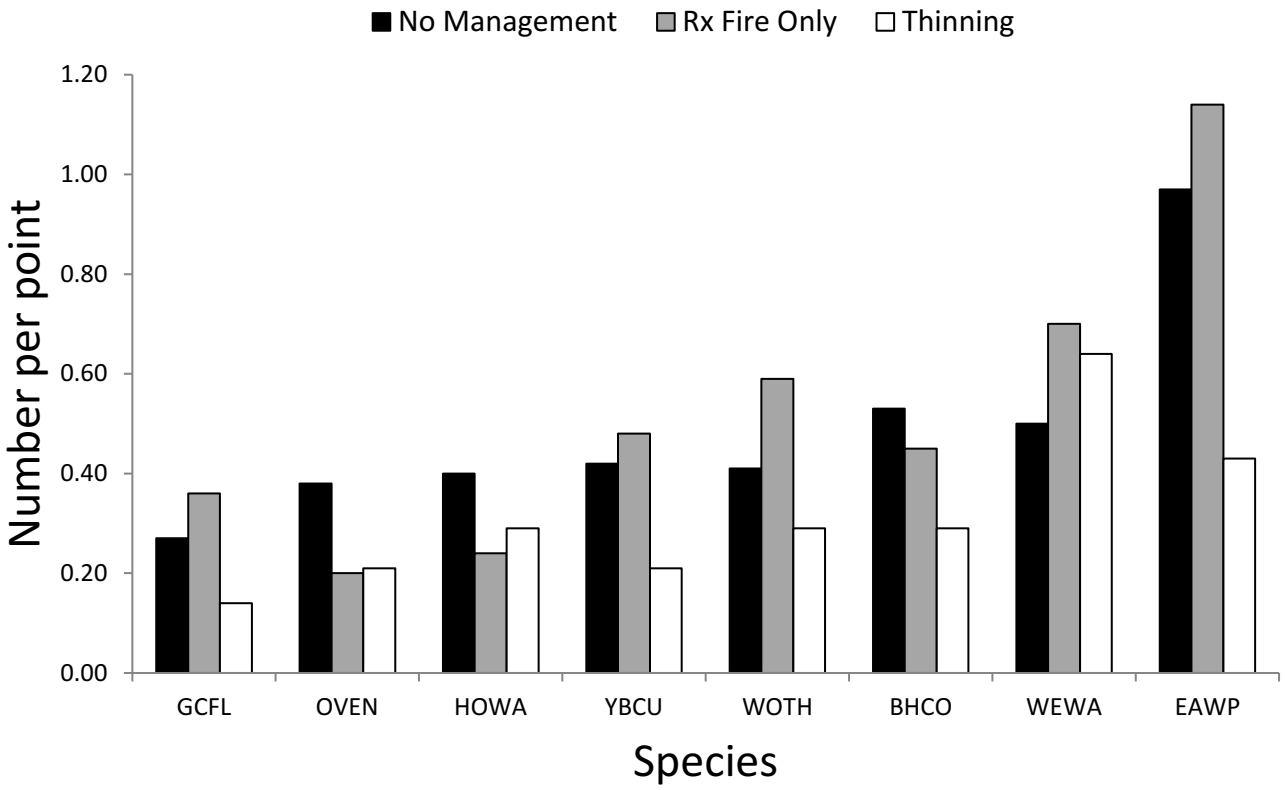

Figure 10. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Trail of Tears State Forest** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 4.

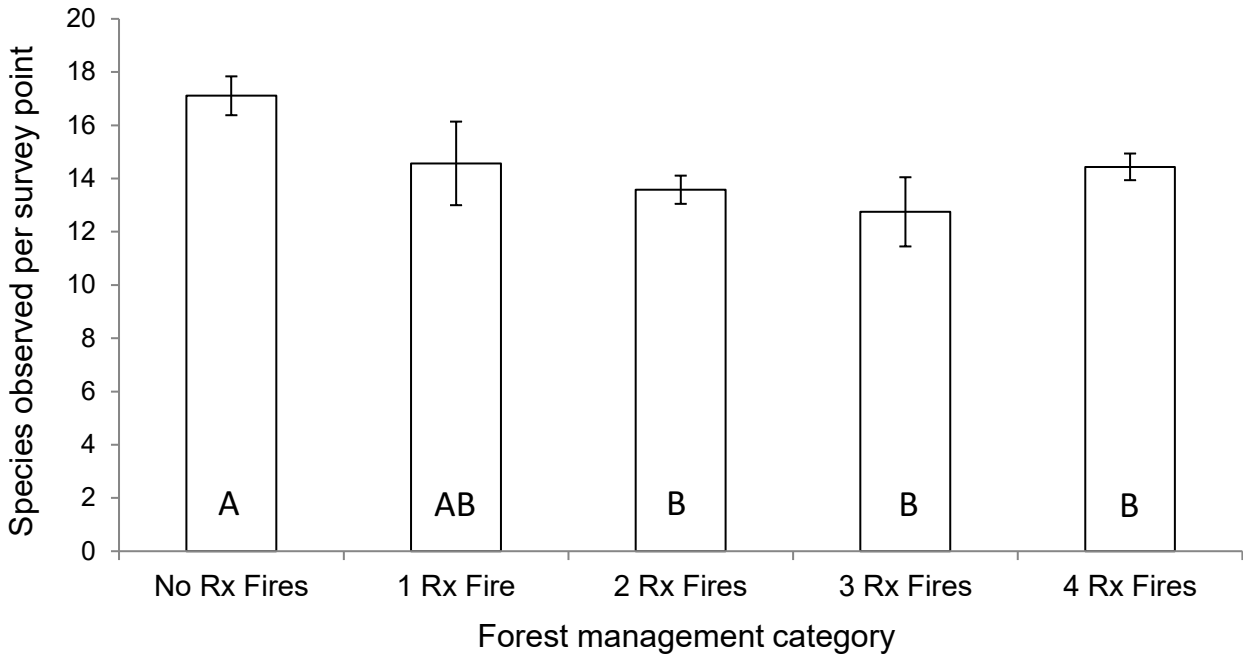

Figure 11. Index of species diversity (mean number of species observed per 100-m-radius survey point) compared among forest treatment categories at **Forbes State Recreation Area** during the 2016 breeding season. Standard errors (+ and -) shown. Categories with the same letter in the column are not significantly (*P*>0.05) different from each other. See Table 1 for number of survey points per category.

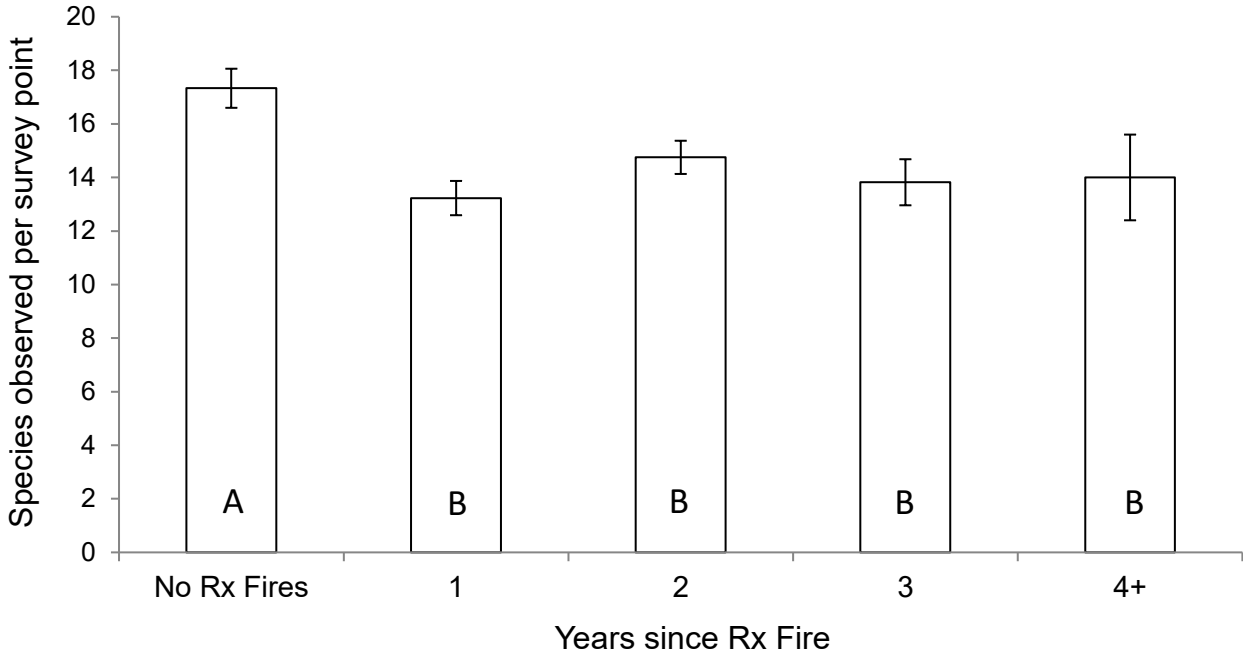

Figure 12. Index of species diversity (mean number of species observed per 100-m-radius survey point) compared among forest treatment categories at **Forbes State Recreation Area** during the 2016 breeding season. Standard errors (+ and -) shown. Categories with the same letter in the column are not significantly (*P*>0.05) different from each other. Number of survey points per category from left to right was 18, 26, 8, 11, and 3.

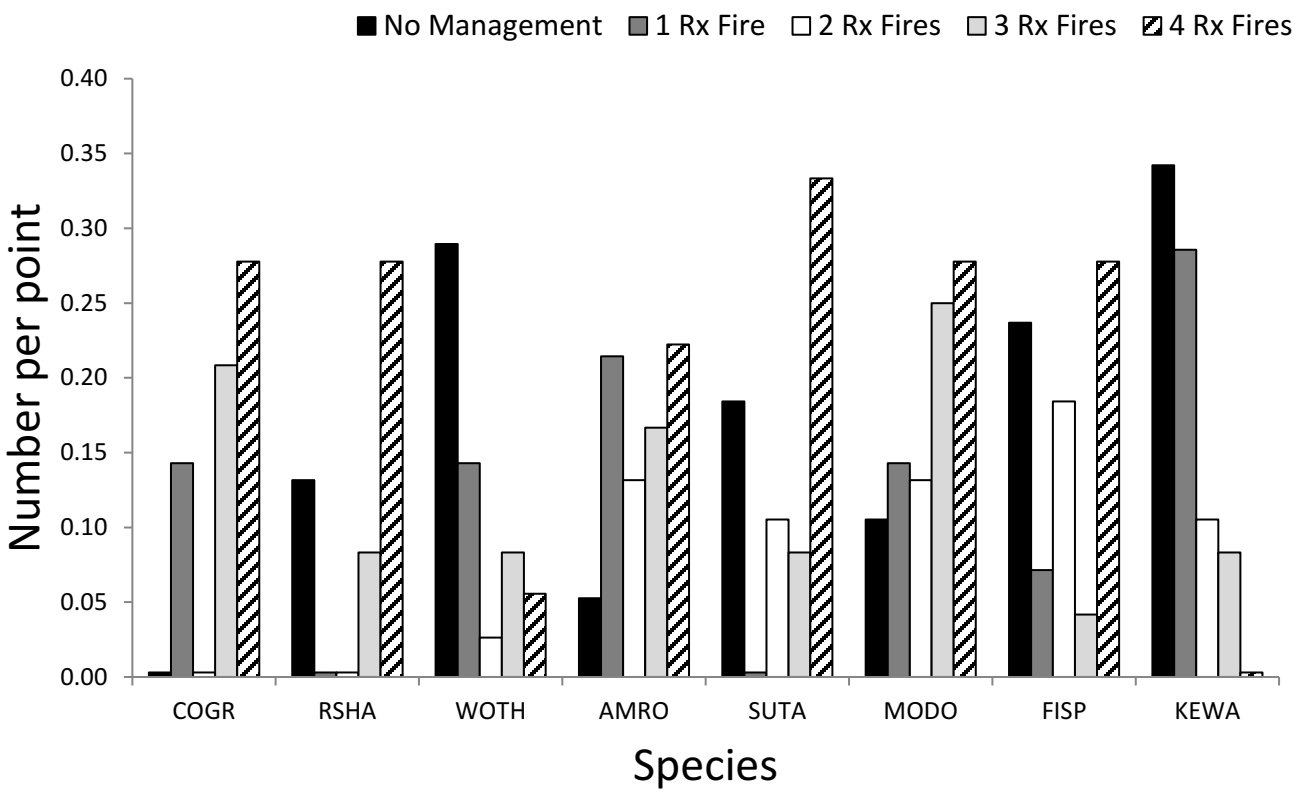

Figure 13. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Forbes State Recreation Area** during the 2016 breeding season in forests that have experienced different numbers of Rx Fires since 2009. Species codes are given in Table 5.

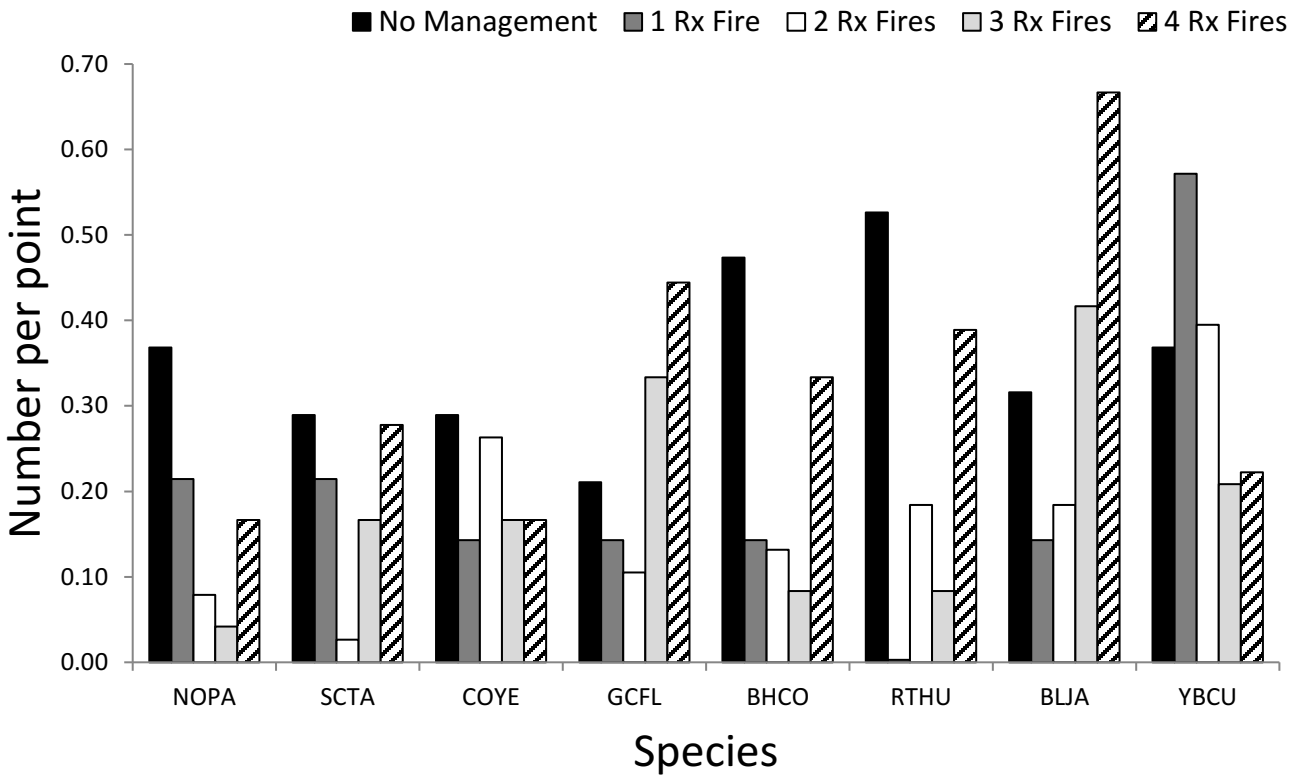

Figure 14. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Forbes State Recreation Area** during the 2016 breeding season in forests that have experienced different numbers of Rx Fires since 2009. Species codes are given in Table 5.

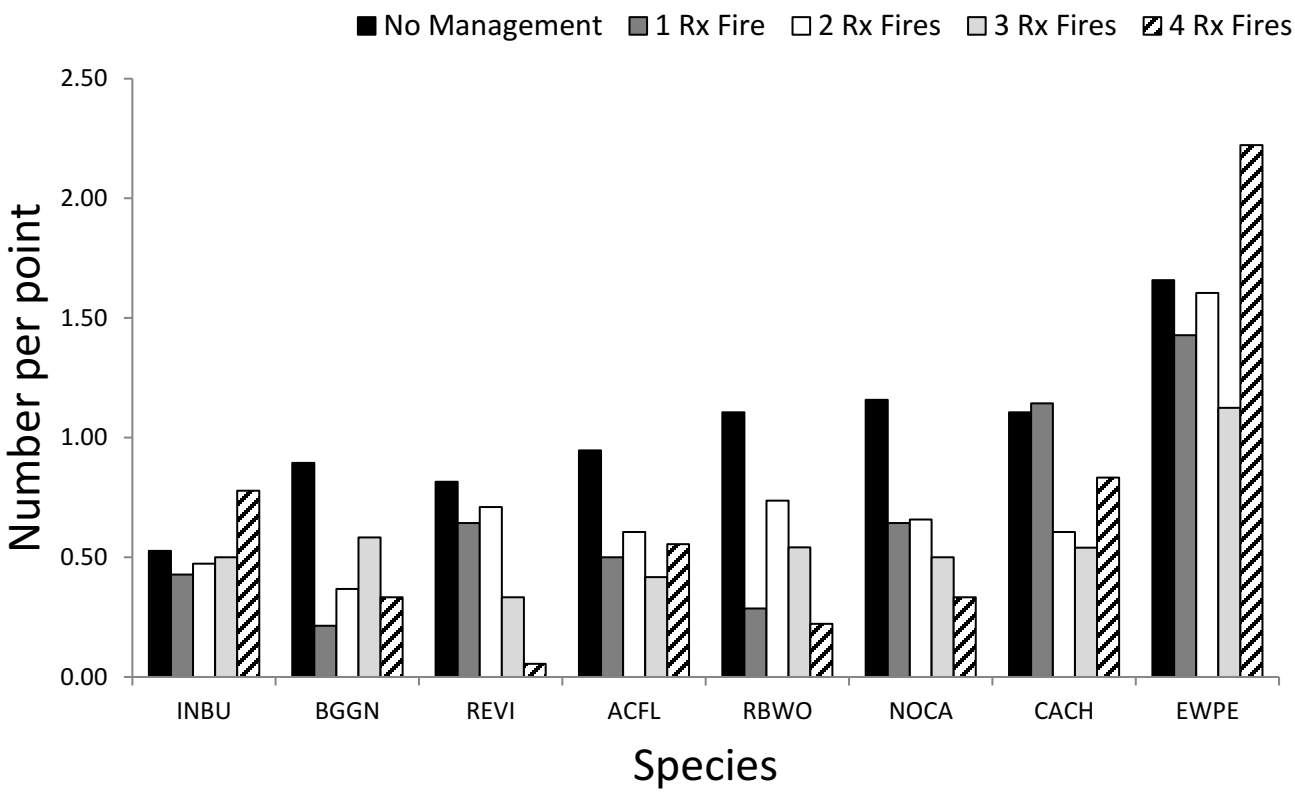

Figure 15. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Forbes State Recreation Area** during the 2016 breeding season in forests that have experienced different numbers of Rx Fires since 2009. Species codes are given in Table 5.

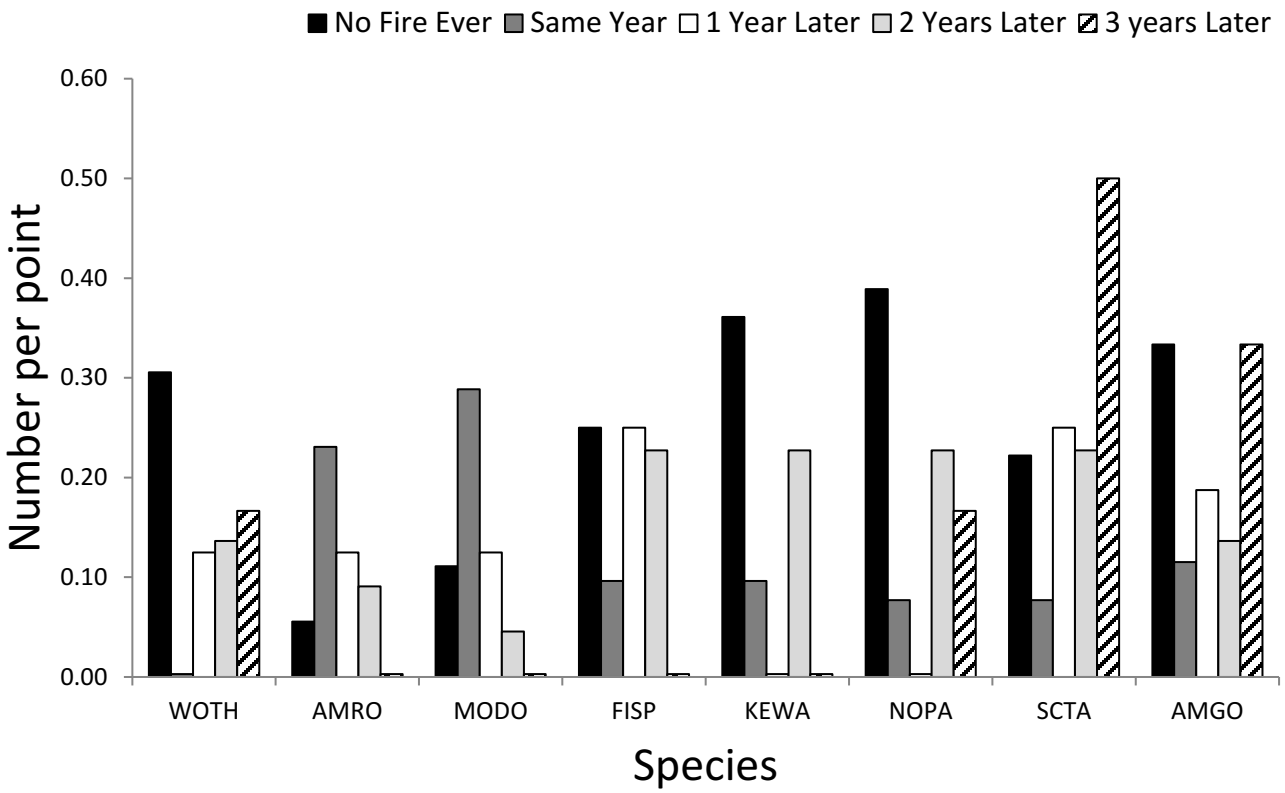

Figure 16. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Forbes State Recreation Area** during the 2016 breeding season in forests relative to time since last Rx Fire. Species codes are given in Table 6.

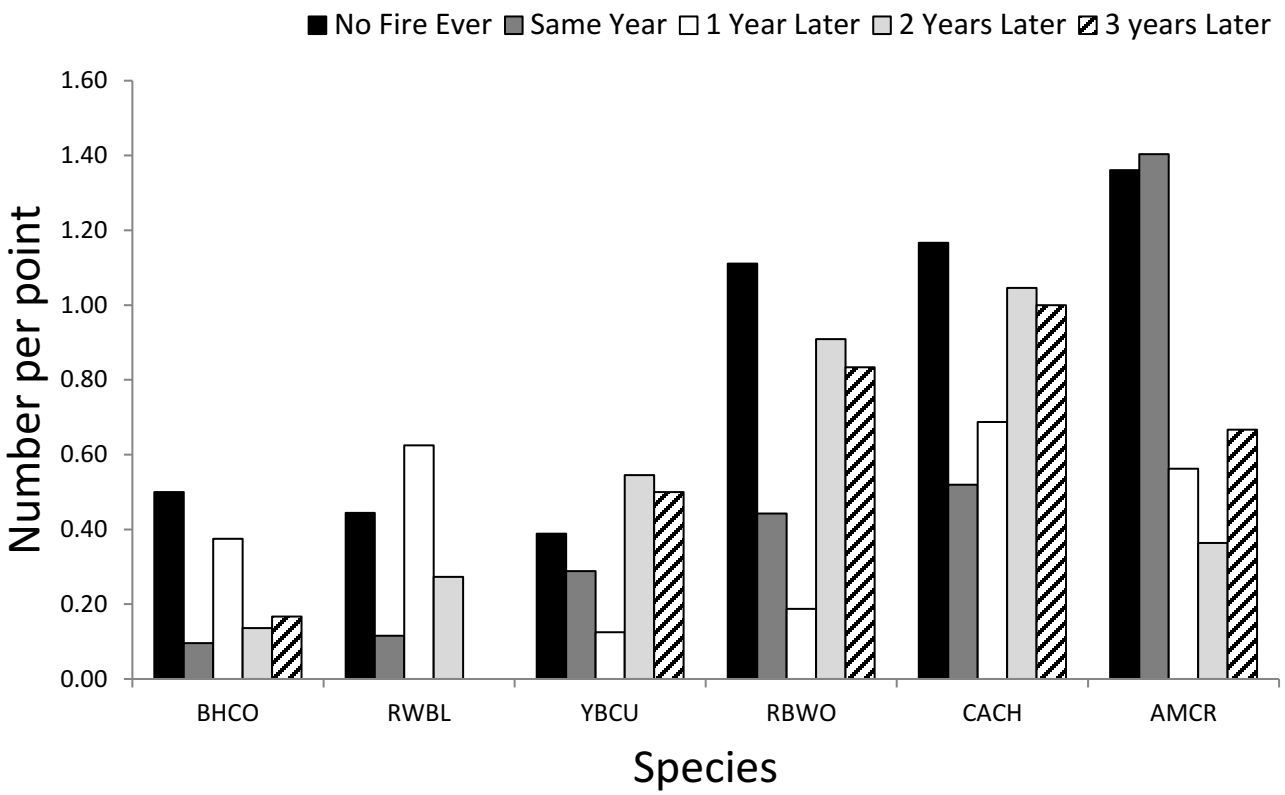

Figure 17. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Forbes State Recreation Area** during the 2016 breeding season in forests relative to time since last Rx Fire. Species codes are given in Table 6.

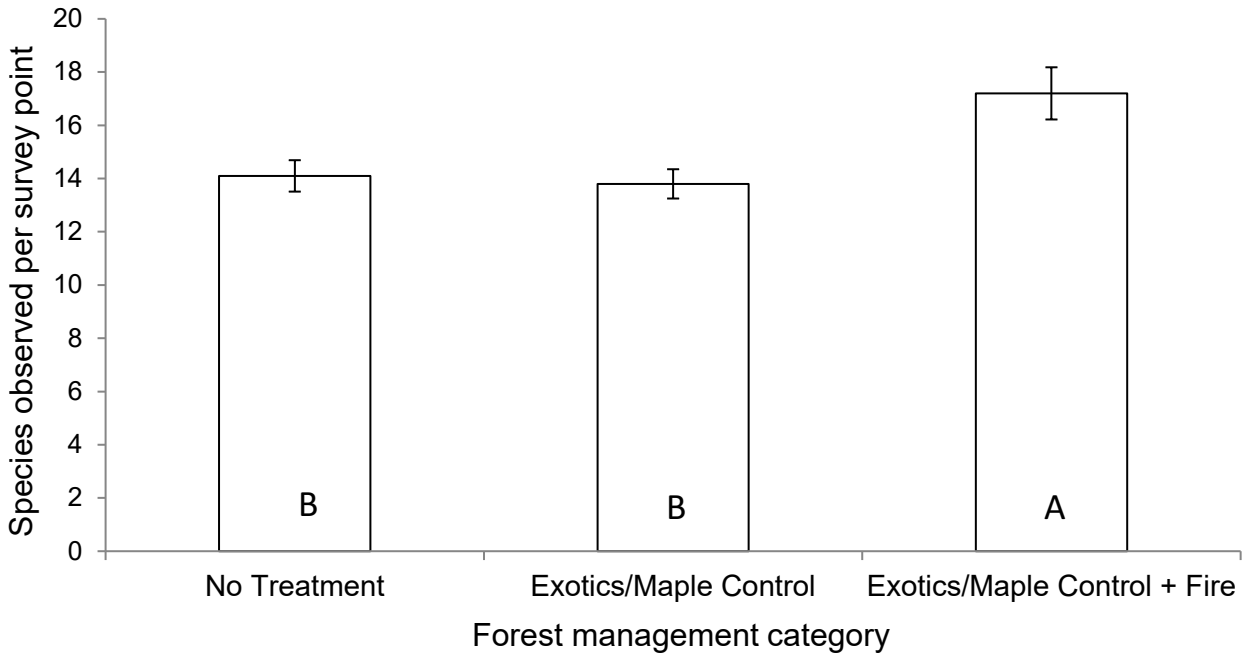

Figure 18. Index of species diversity (mean number of species observed per 100-m-radius survey point) compared among forest treatment categories at **Hidden Springs State Forest** during the 2016 breeding season. Standard errors (+ and -) shown. Categories with the same letter in the column are not significantly (*P*>0.05) different from each other. See Table 1 for number of survey points per category.

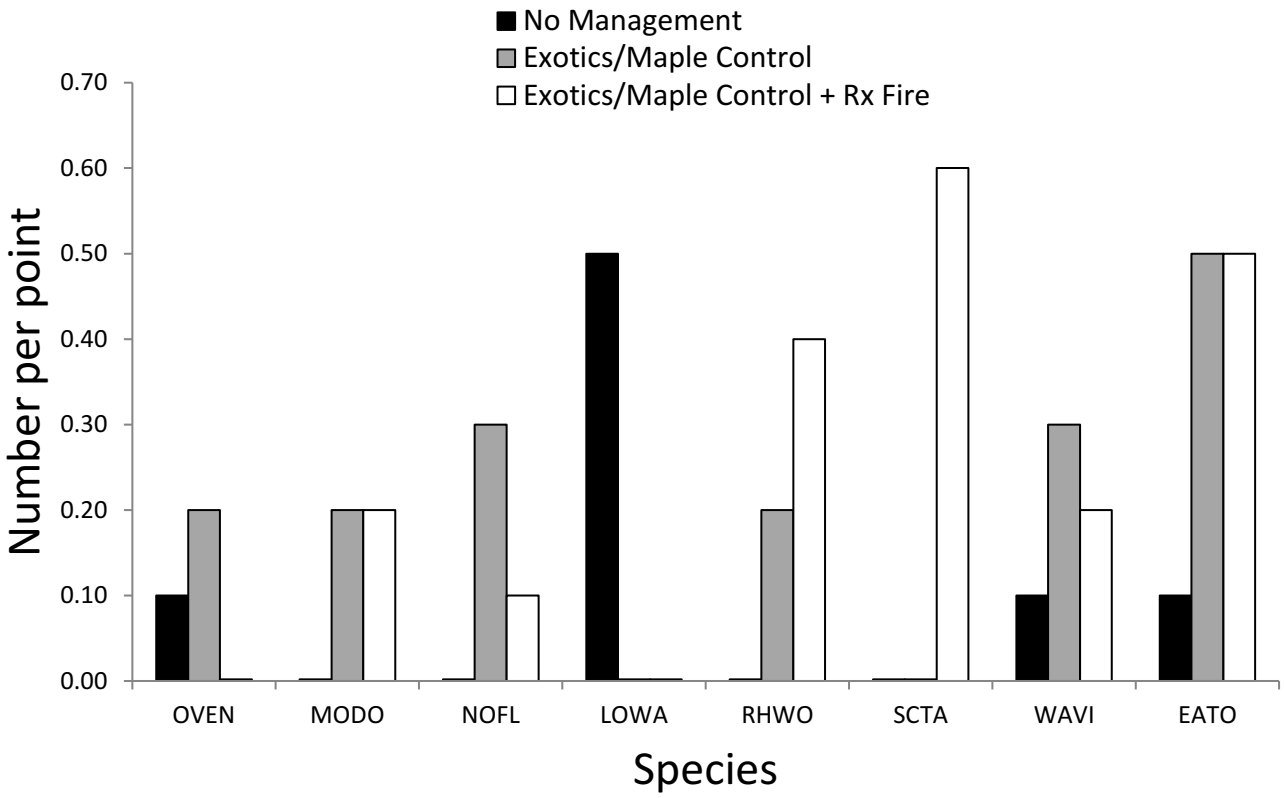

Figure 19. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Hidden Springs State Forest** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 7.

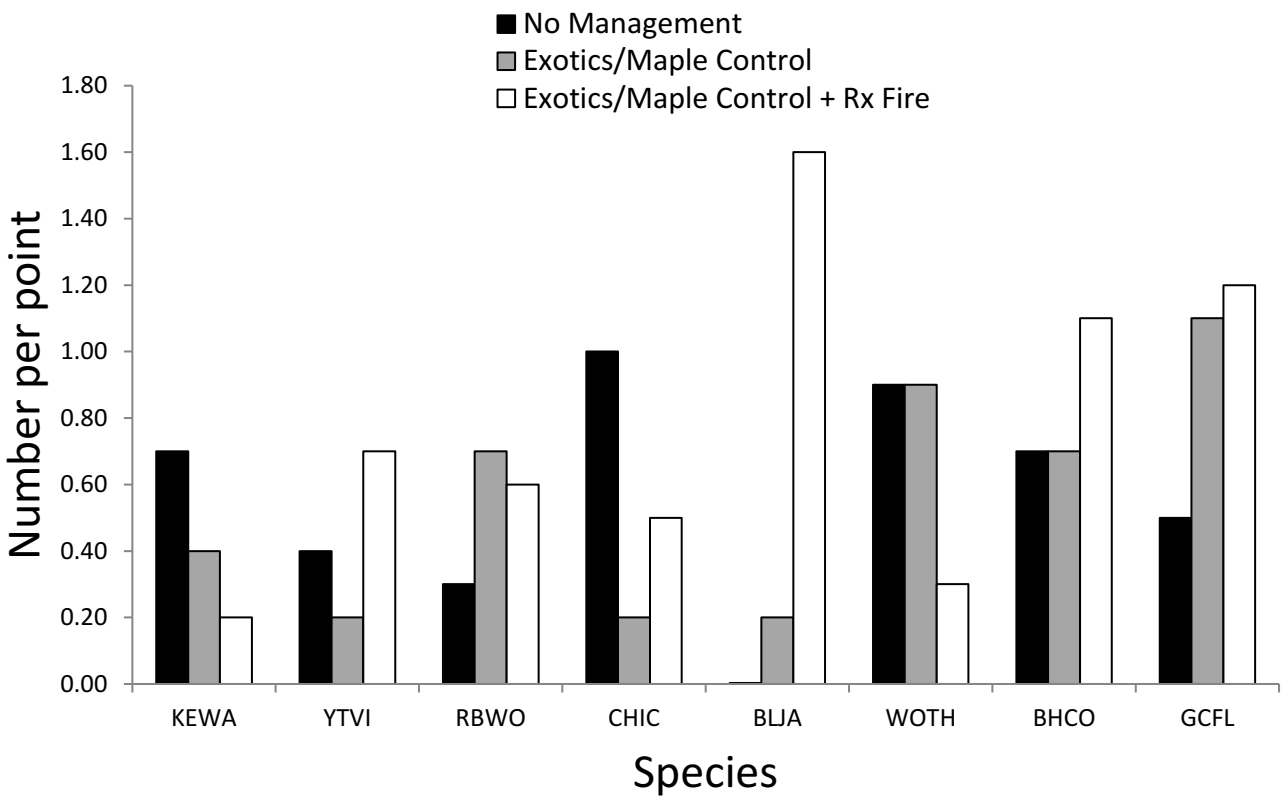

Figure 20. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Hidden Springs State Forest** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 7.

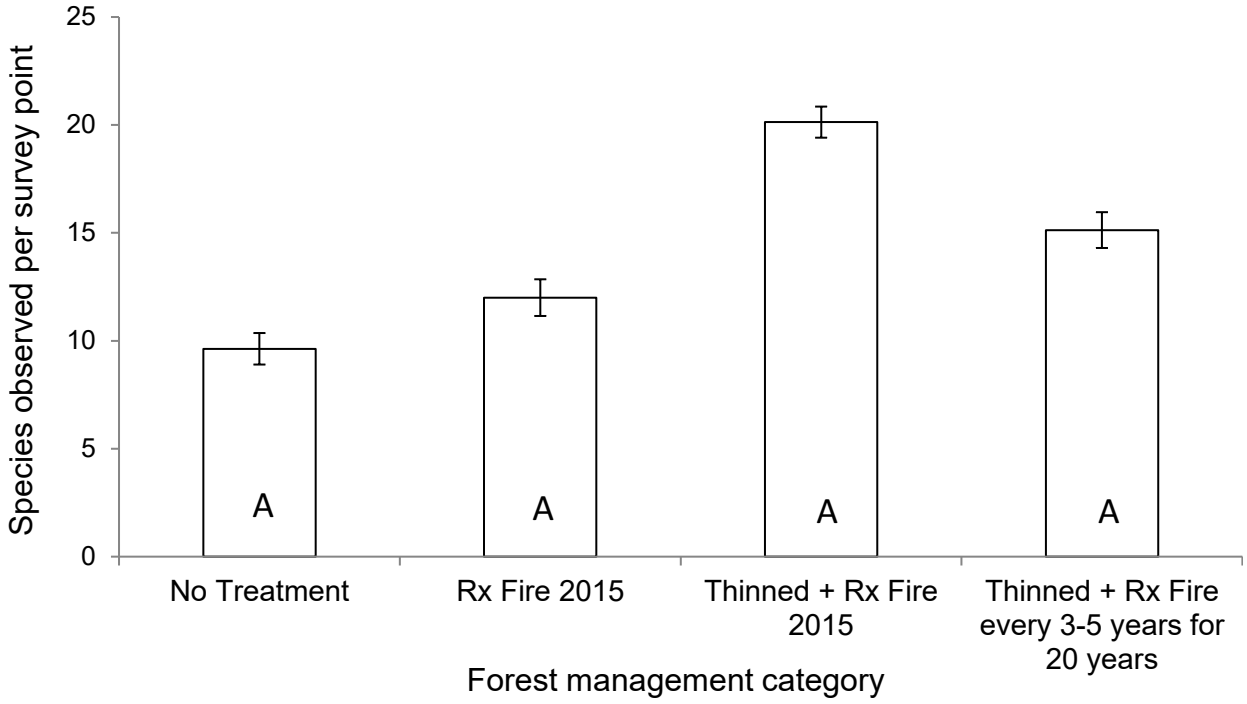

Figure 21. Index of species diversity (mean number of species observed per 100-m-radius survey point) compared among forest treatment categories at **Siloam Springs State Park** during the 2016 breeding season. Standard errors (+ and -) shown. Categories with the same letter in the column are not significantly (*P*>0.05) different from each other. See Table 1 for number of survey points per category.

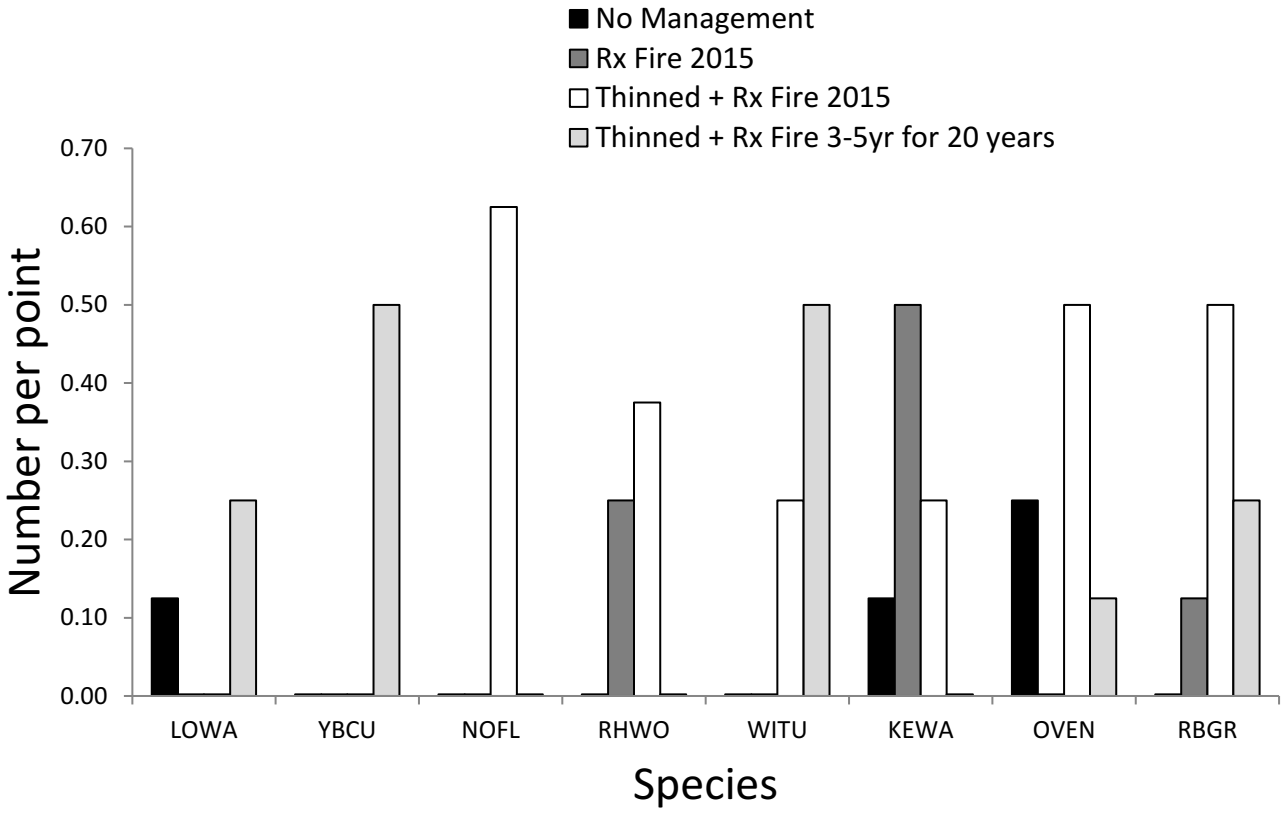

Figure 22. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Siloam Springs State Park** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 8.

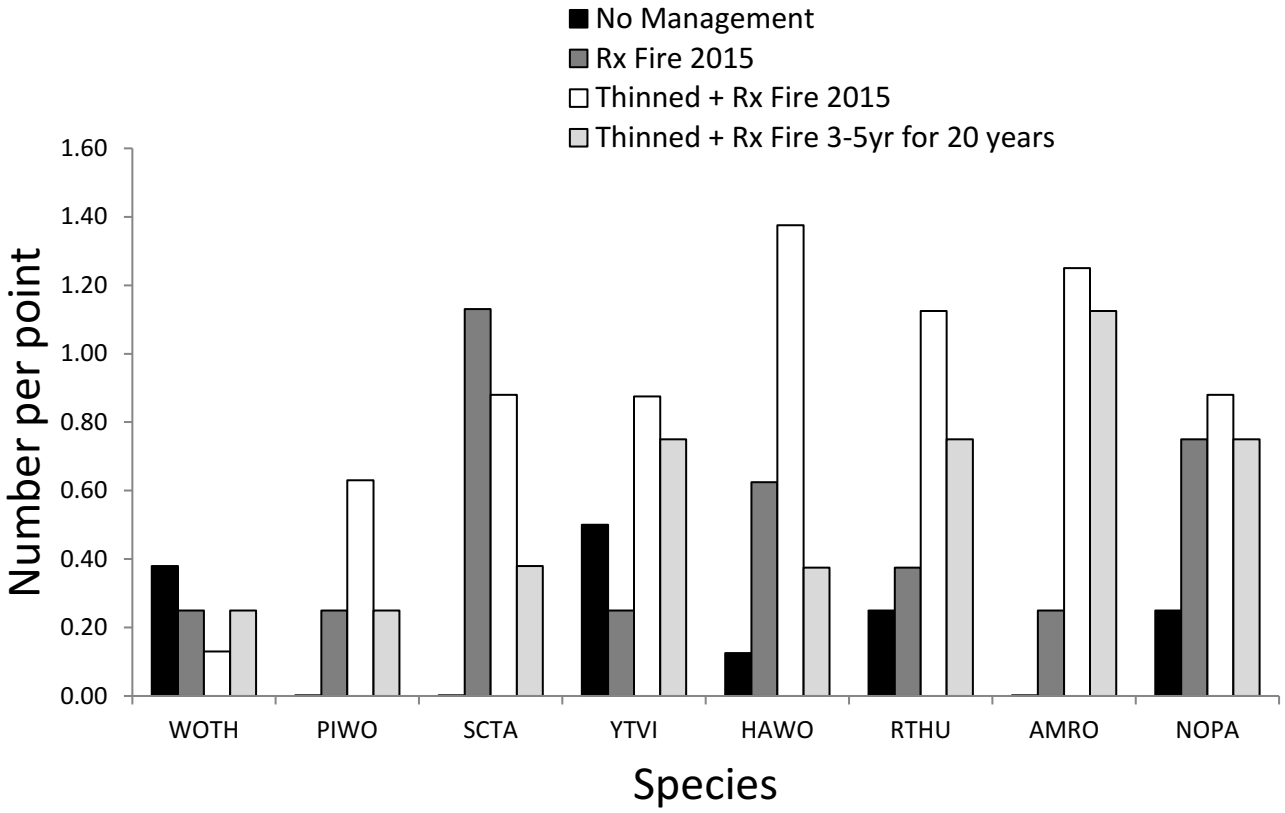

Figure 23. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Siloam Springs State Park** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 8.

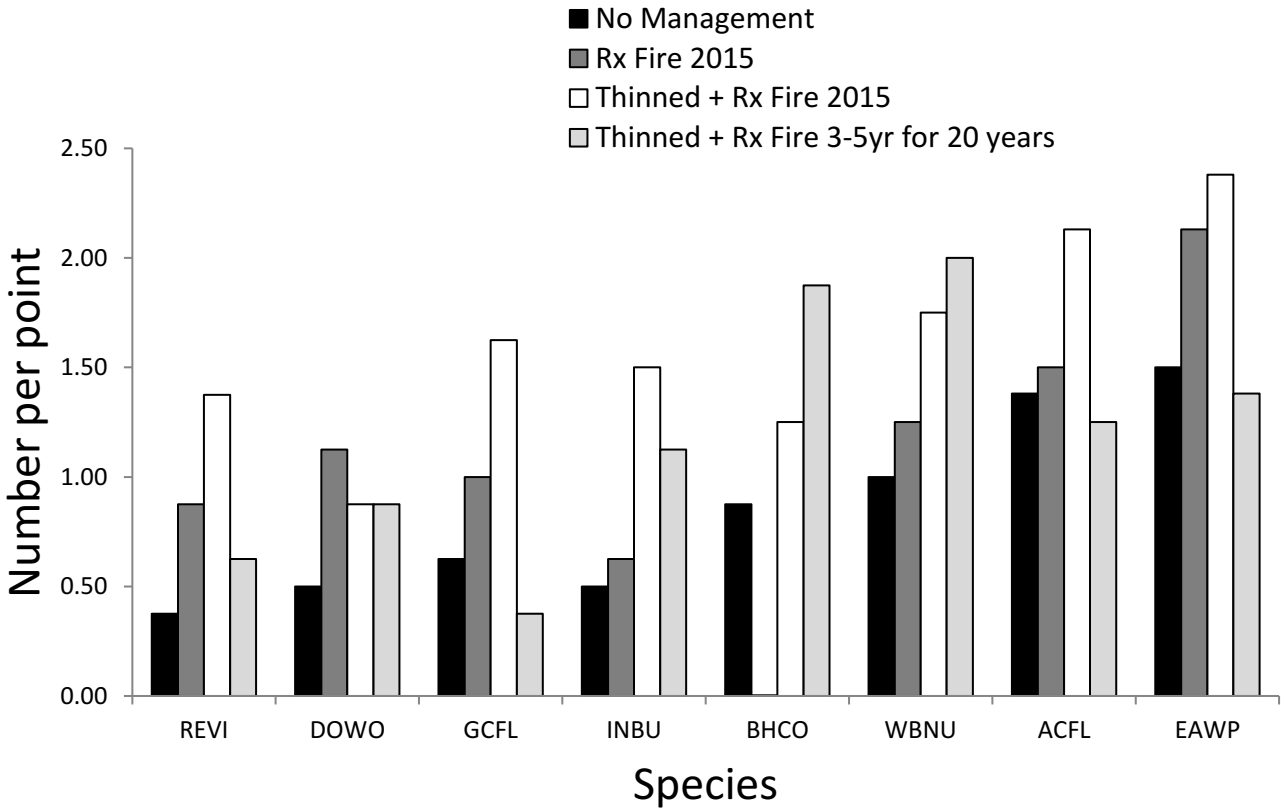

Figure 24. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Siloam Springs State Park** during the 2016 breeding season in forests that have experienced different types of management. Species codes are given in Table 8.

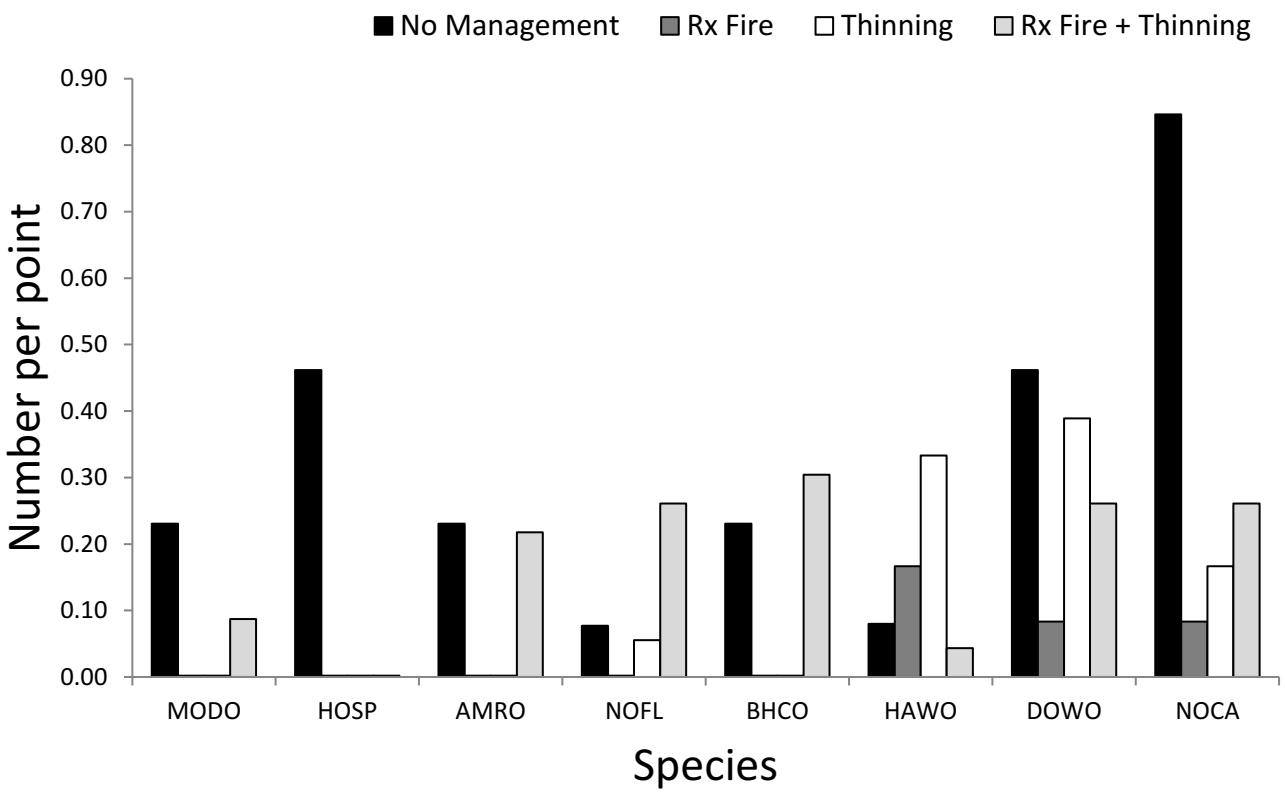

Figure 25. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Lake Shelbyville** during the 2015-2016 **winter** season in forests that have experienced different types of management. Species codes are given in Table 9.

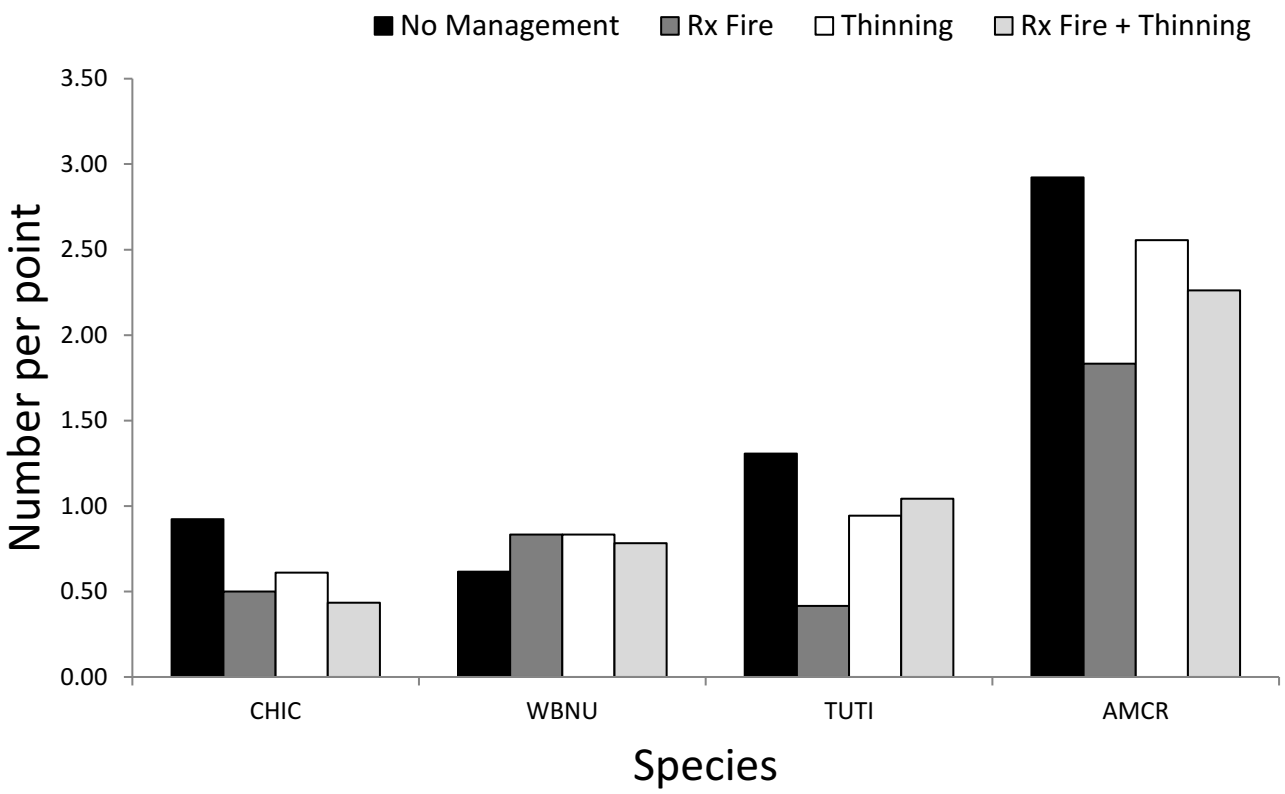

Figure 26. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Lake Shelbyville** during the 2015-2016 **winter** season in forests that have experienced different types of management. Species codes are given in Table 9.

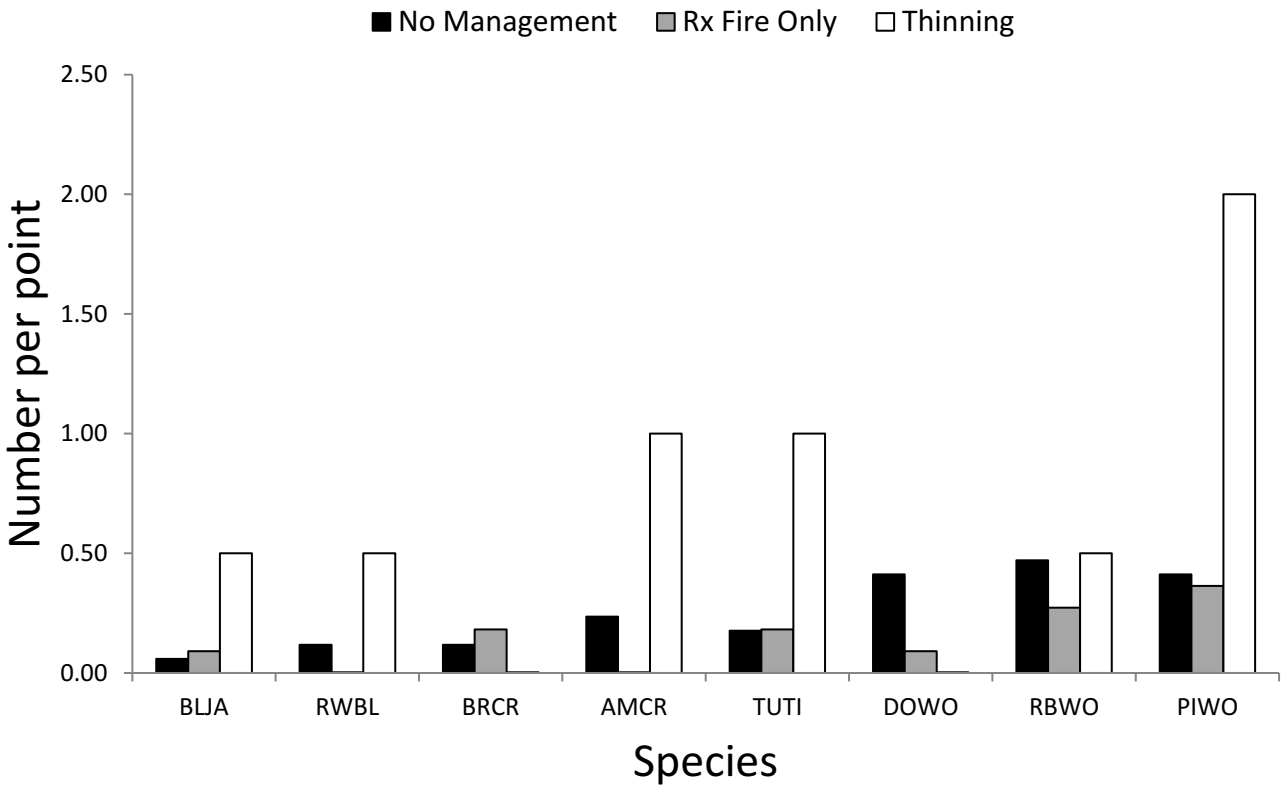

Figure 27. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Trail of Tears** during the 2015-2016 **winter** season in forests that have experienced different types of management. Species codes are given in Table 10.

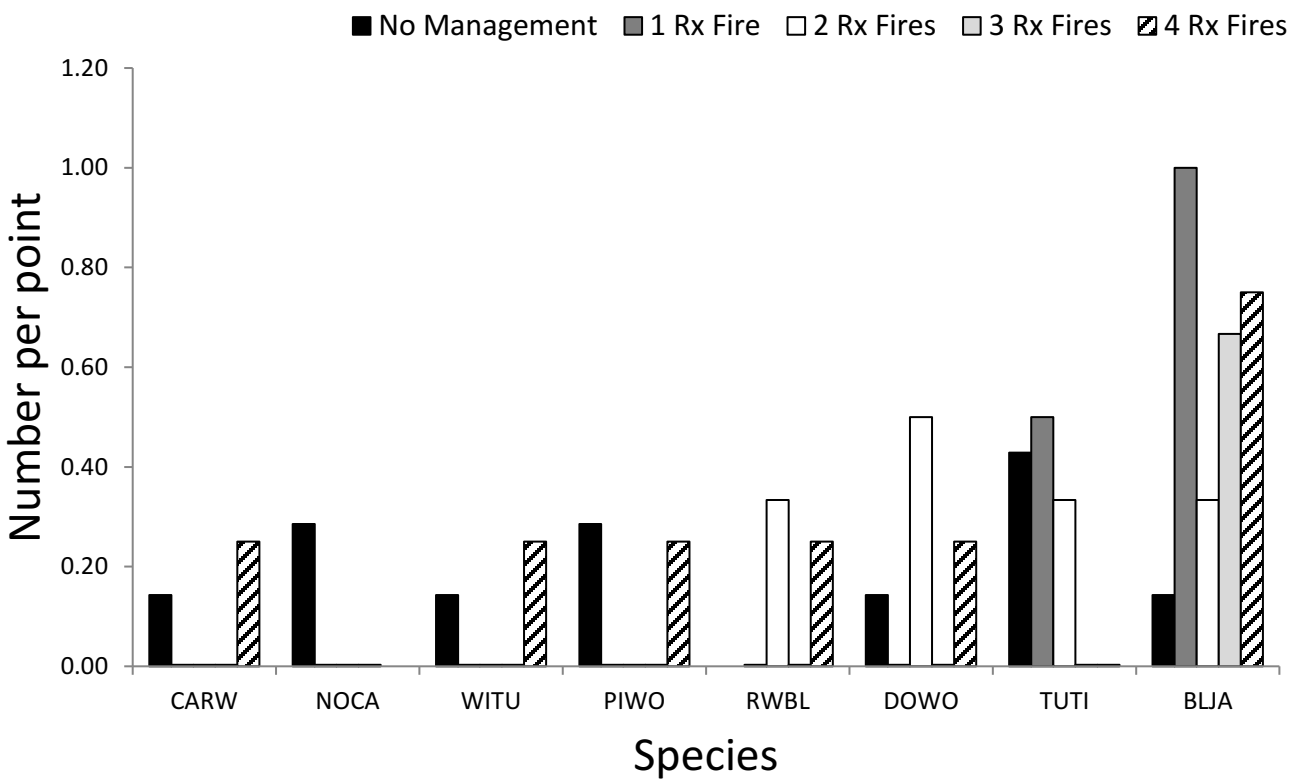

Figure 28. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Forbes** during the 2015-2016 **winter** season in forests that have experienced different types of management. Species codes are given in Table 11.

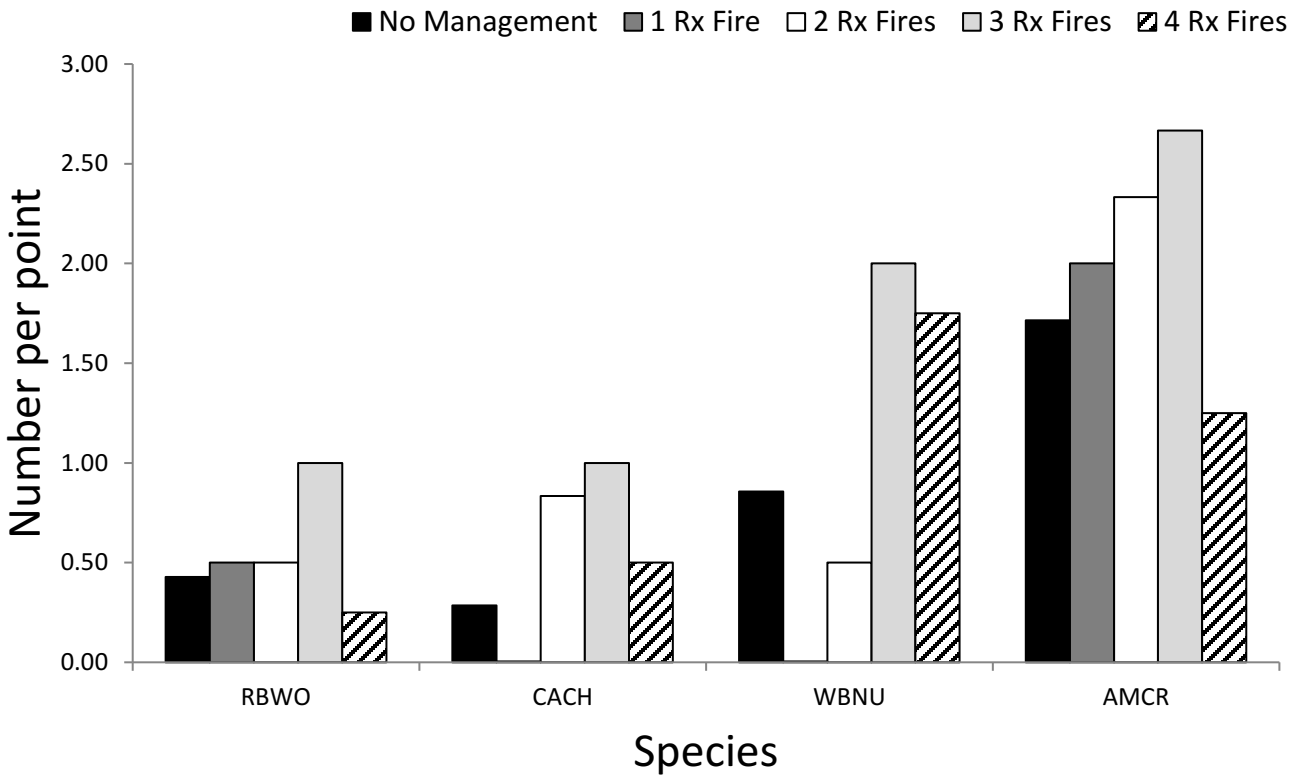

Figure 29. Relative abundance (number of individuals observed per 100-m-radius survey point) of various bird species at **Forbes** during the 2015-2016 **winter** season in forests that have experienced different types of management. Species codes are given in Table 11.

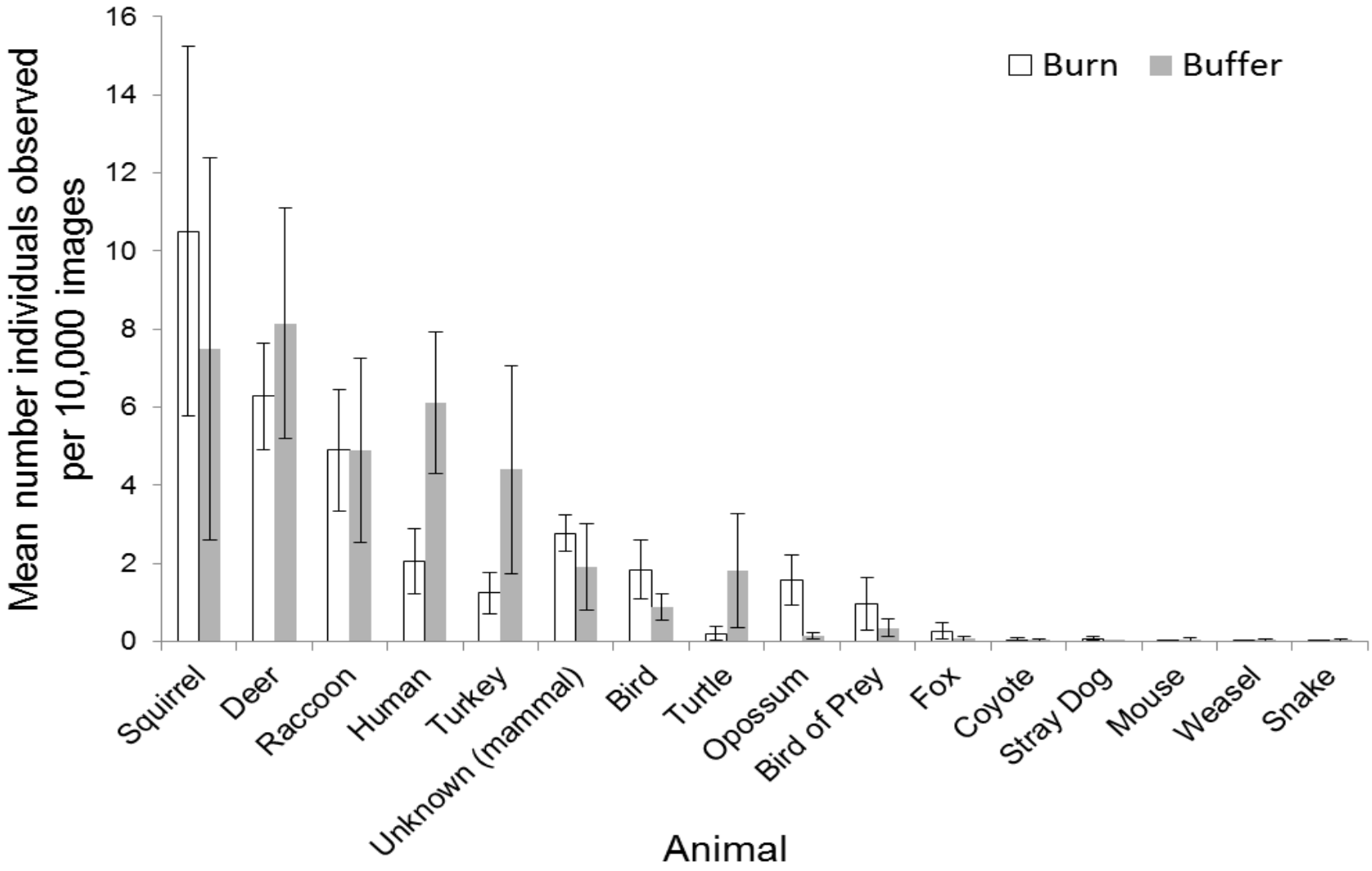

Figure 30. Mean ± 1SE camera captures of various animals that were photographed at **baited** camera traps during summer 2016 in forests where prescribed fire has occurred (burn) or not (buffer) at **Forbes State Park**. Total number of images screened was 258,855 and 188,668 in the burn and buffer categories, respectively.