National Park Service
U.S. Department of the Interior

Natural Resource Program Center

Fire Effects on Wildlife in Tallgrass Prairie

Natural Resource Report NPS/HTLN/NRR—2010/193

ON THE COVER
Eastern cottontail (*Sylvilagus floridanus*) observed immediately following a prescribed fire at Wilson's Creek National Battlefield in 2000. Photograph by: Heartland Inventory and Monitoring Program.

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May 2010

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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This report is available from Heartland I&M Network (http://science.nature.nps.gov/im/units/htln/fire.cfm) and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/NRPM).

Please cite this publication as:

Gaetani, M. S., K. Cook, and S. A. Leis. 2010. Fire effects on wildlife in tallgrass prairie. Natural Resource Report NPS/HTLN/NRR—2010/193. National Park Service, Fort Collins, Colorado.

NPS 920/102093, May 2010

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Abstract

In the tallgrass prairie region of North America, grasslands are often burned on a rotational schedule to prevent the encroachment of woody species and maintain the vigor of plant communities. Although prescribed fire practitioners often consider the effects of fire on plant communities, the effects of fire on wildlife are also important. Practitioners as well as park visitors inquire about the effects of fire on birds, deer, and other animals of interest. Many wildlife species focus on vegetation structure in choosing suitable habitats, and fire can temporarily alter that structure. Wildlife species have varying habitat needs, and therefore, a variety of responses to fire. To accommodate the variety of habitat needs for wildlife within grassland, fire can be implemented heterogeneously. For example, varying the time of year a burn occurs, and burning only portions of the habitat in a single year can help sustain populations. Monitoring programs aimed at quantifying populations and acceptable levels of mortality for species of interest may also help fire programs adapt to help wildlife populations thrive. This document provides information about the ability of birds, mammals, and herpetofauna to escape or survive fire. We also describe how fire induced changes to habitat can affect groups of animals and a suite of individual species.

Acknowledgments

The authors would like to thank David Peitz of the Heartland Inventory and Monitoring Network for providing support throughout the document’s progress. As well as Gary Sullivan of Wilson’s Creek National Battlefield for suggesting this document be developed. Ryan Green developed an annotated bibliography for this project.

Introduction

Fire is well documented as an important ecological process in grassland communities including those in the eastern oak woodland-tallgrass prairie transition zone (Wright 1978, Axelrod 1985, Ladd 1991). Tallgrass prairie requires fire on a relatively frequent basis of every 1 – 5 years depending on location (Frost 1998) to prevent the encroachment of woody species and maintain the integrity of plant communities (Aldous 1934, Briggs et al. 2002). Although prescribe fire practitioners often consider the effects of fire on plant communities when writing prescriptions, the effects of fire on wildlife are often overlooked.

Natural resources managers, fire practitioners, as well as park visitors often inquire about the effects of fire on birds, deer, and other animals of interest. Images like Smokey Bear and Bambi move people emotionally, and suggest that fire presents a great danger to wildlife (Jacobson et al. 2001). In reality the degree of danger depends on many things such as burn pattern, ignition type, fuel loads, weather conditions, rate of spread, and biology of the species of interest (Wright and Bailey 1982, Chapter 4; Smith 2000). Prescribed fires generally present reduced risk over wildfires in that they are typically implemented under moderate to mild conditions. Prescriptions for cool or moderate intensity fires include slow wind speeds, cool air temperatures, and often moderate to high relative humidity and fuel moistures. By contrast, wildfires can occur under more dangerous conditions such as high winds and very dry fuels. Furthermore, prescribed fires target specific areas for specific objectives, while wild fire burned uncontrolled over potentially large areas.

This document was developed in response to National Park Service Natural Resource Managers frequent requests for information they can use to improve both fire management and communication with park visitors. We summarized existing literature on the ability of birds, mammals, and herpetofauna to escape and survive fire, effects on foraging behavior, and species abilities to reproduce following fire. We also discuss how fire induced changes to habitat can affect groups of animals and a suite of individual species.

Figure 1. White-tailed deer (*Odocoileus virginianus*) observed at Wilson's Creek National Battlefield during field work in 2007. Photo by Heartland Inventory and Monitoring Program.

Grassland Birds

The effects of fire on grassland birds, whether it be prescribed or wild, are different for every species. Johnson (1997) defined three response groups to fire in mixed grass prairie: burn positive species which require the openness of areas immediately post-burn, burn negative species that avoid burned areas and prefer a woody plant component, and finally those that prefer habitats in recovery from burning with little or no woody vegetation. Variation in the frequency, timing, and size of fires help create these habitats in proximity to one another.

In recent years, the land management paradigm has begun to shift towards creating more heterogeneity in landscapes to better meet the needs of a variety of birds in one space, as well as meeting the needs of species that require a variety of habitat structures throughout their life cycles (Fuhlendorf and Engle 2001, Reinking 2005, Churchwell et al. 2008). The strategy of creating a shifting mosaic pattern of succession is healthy for the grassland ecosystem and can be beneficial for most grassland bird species. For example, patch burn grazing was demonstrated to be an effective method for maintaining a variety of vegetation structures across the study area in Oklahoma (Fuhlendorf et al. 2006). The increase in heterogeneity of vegetation structure allows for greater species diversity within a managed area (Table 1).

Table 1. Habitat preference in relation to time since burn for Midwestern birds.

Species	Habitat preference	Relation to burn	Source
*Greater prairie-chicken (*Tympanuchus cupido*).	Heterogeneous grassland	Frequent rotational	Svedarsky et al. 2003, McKee et al. 1998
*Dickcissel (*Spiza americana*)	Tall dense grass	> 3 years since burn	Zimmerman 1988
*Henslow's sparrow (*Ammodramus henslowii*)	Tall standing grasses	> 3 years since burn	Reinking 2005
Northern flicker (*Colaptes auratus*)	Snag hollows	Moderate intensity	Bange et al. 2008
Hairy woodpecker (*Picoides villosus*	Snag hollows	Moderate intensity	Bange et al. 2008
Northern saw-whet owl (*Aegolius acadicus*)	Snag hollows	Moderate intensity	Bange et. al. 2008
Field sparrow (*Spizella pusilla*)	Tall dense grass, woody edges	Infrequent burns	Best 1979, Dechant et al. 2003b
Northern bobwhite (*Colinus virginianus*)	Heterogeneous grassland with woody edges	Frequent rotational	Roseberry and Sudkamp 1998
*Grasshopper sparrow (*Ammodramus savannarum)*	Short vegetation and shallow litter	Frequent rotational	Delisle and Savidge 1997, Madden et al. 1999

*indicates grassland obligate species

Escape Mechanisms

The ability of grassland birds to escape fires is dependent upon their maturity. Adult birds capable of flight have the ability to escape most fires, but little research has been conducted to understand what triggers an escape response or how long an individual takes to be alerted. Immature birds whose wings have not fully developed are at a greater risk of direct mortality from fire. The young of birds nested in the canopy of trees or shrubs have an advantage over chicks in ground nests, because the elevation buffers them from lower intensity surface fires (Lyon et al. 2000).

Effects on Feeding

Grassland birds feed on a wide variety of foods. Fire may combust some seeds, however, may also remove materials, such as heavy litter, making seeds more accessible immediately following the burn (Best 1979). The same is true for insectivorous birds. Despite invertebrate mortality immediately after a fire, remaining insects are more easily found because of the decrease in foliage cover (Best 1979). Grasshopper Sparrows, an insectivorous species, in a study in Kansas preferred moderately grazed and annually burned tallgrass prairies, possibly because prey was more available (Klute 1994, Klute et al. 1997, Dechant et al. 2003a). Fire also benefits orders of birds beyond galliformes and passerines by creating feeding opportunities for birds of prey and scavengers as small birds and mammals are attracted to burned areas immediately post-burn (Lyon et al. 2000).

Effects on Breeding and Nesting

Mating success is an inseparable part of nesting success i.e., if birds cannot mate successfully than no chicks will be produced. Many species have specific habitat requirements for successful mating. Like with other aspects of avian life histories, certain species have positive responses to burning in terms of breeding and nesting while others have negative responses.

Consider the Greater prairie-chicken (*Tympanuchus cupido*) and Northern bobwhite quail (*Colinus virginianus*). The Greater prairie-chicken requires different habitat structures for mating, nesting, and brood rearing (Svedarsky et al. 2003, Fuhlendorf et al. 2006). Male prairie-chickens put on displays requiring a high degree of visibility for success in attracting mates (Svedarsky et al. 2003). Early spring burns can effectively clear standing vegetation and litter, thereby increasing visibility. Once a female prairie-chicken has successfully mated, ideal nesting habitat includes less than 25% litter cover and greater than 25% grass cover (McKee et al. 1998). Usually females begin nesting in late April, and therefore, must find areas with cover from the previous growing season (Svedarsky et al. 2003). Once the female prairie-chicken has successfully hatched a brood, the habitat required once again changes as the chicks move to areas that have been disturbed but still have overhead cover. These areas in recovery from disturbance allow for greater ease of movement and access to food sources than undisturbed habitats like those preferred for nesting (Svedarsky et al. 2003). These varying habitat types can be found simultaneously in areas managed for heterogeneity such as with patch burn grazing (Fuhlendorf et al. 2006).

Northern bobwhites are similar to greater-prairie chickens in that they require structurally heterogeneous habitats. Quail also favor woody edges as part of their habitat (Roseberry and Sudkamp 1998). Controlled burning has been used as a successful management method for maintaining bobwhite habitat when burns are patchy and take place at 1 – 2 year intervals (Landers and Mueller 1989, Brennan 1991).

For other species, fire may have short-term negative effects on breeding. Both male and female Dickcissel (*Spiza americana*) require tall, standing dead plants for successful reproduction. Male Dickcissels perch on tall plants to sing and females build their nests in the tall grasses and forbs (Zimmerman 1971). Robel et al. (1998) observed a decline in reproduction of Dickcissels post-burn possibly because of loss of appropriate habitat structure. However, the number of nests one year following the burn was not significantly reduced. Other prairie species such as Henslow's sparrow (*Ammodramus henslowii*) also require tall standing dead plants for males to perch on for breeding purposes. A study in Illinois grasslands found that the density of Henslow's sparrows was significantly reduced in the summer following a spring burn because of removal of standing dead materials (Herkert 1994). While fire immediately reduces the presence of the Henslow's sparrows, fire exclusion negatively affects the birds' habitat by allowing encroachment of woody vegetation (Zimmerman 1988).

Birds that nest in snags have a small advantage over ground nesting birds when fire sweeps through their habitat because of the proximity to heat and flame. However, snags are more susceptible to burning than live trees. Birds such as Northern flicker (*Colaptes auratus*), Hairy woodpecker (*Picoides villosus*), and Northern saw-whet owl (*Aegolius acadicus*), which utilize snags as their nesting site, may be negatively impacted by prescribed fires. Bange (2008) found that impacts could be mitigated by focusing management activities on maintaining the availability of large live trees and snags of favored tree species.

Unlike nests inside snags and live trees, ground nests are subject to fire at any intensity, and the season of burn sometimes determines nest success for ground nesting birds. Depending on life history and habitat needs, the effect on nesting varies from species to species. Species that nest later in the year, such as field sparrow have a neutral response to spring prescribed fire since nesting occurs after spring burns are completed (Best 1979). If fire sweeps through an area after a ground nesting bird has established a nest and laid a clutch, the clutch's survival depends on the completeness of the burn. Unburned patches and areas with bare ground may protect nests (Kruse and Piehl 1986). In cases of complete burns, the clutch is destroyed (Kruse and Piehl 1986, Svedarsky et al. 1986, Lyon et al. 2000). Some species, such as Greater prairie-chicken, will re-nest if the first nest is destroyed early enough in the season. However, other species such as Wild turkey (*Meleagris gallopavo*) are not likely to re-nest (Robbins and Myers 1992, Reinking 2005).

Mammals

The effect of fire, whether prescribed or wildfire, on mammals depends on numerous factors such as fire intensity and size, completeness, season, and frequency of burns. The categorization of mammals by body size is helpful when discussing fire effects. Within the context of this section, deer are considered large mammals while rodents like mice, voles, and shrews are treated as small mammals. In both size categories, the post-burn change in habitat structure affects local mammal populations.

Small Mammals

Escape Mechanisms

When an area burns, small mammals have a number of escape mechanisms. Many small mammals such as Deer mouse (*Peromyscus maniculatus)*, White footed mouse (*P. leucopus*), Plains pocket mouse (*Perognathus flavescens*), Northern short-tailed shrew (*Blarina brevicauda*), Masked shrew (*Sorex cinereus*), Least shrew (*Cryptotis parva*) and Thirteen-lined ground squirrel (*Spermophilus tridecemlineatus)* retreat to underground burrows (Erwin and Stasiak 1979). Some small mammals without a tendency to burrow or create underground nests, such as rabbits, attempt to flee from the flames above ground. In a study conducted by Erwin and Stasiak (1979), many fleeing mammals were observed to be successful in escaping fire. However, Other animals, however, such as immature rabbits were not. Small mammals that build above ground nests such as Western harvest mouse (*Reithrodontomys megalotis)* experienced the highest mortality, with young pups in burned nests accounting for most of the mortalities in the Erwin and Stasiak (1979) study.

Effects on Feeding

Post-burn changes in habitat structure affect accessibility to food. The removal of litter allows granivores (seed predators) access to accumulations of previously fallen and buried seeds (Wright and Bailey 1982, Kaufman et al. 1988). In addition to removing litter to expose seeds, fire can remove standing dead materiel, making previously suspended seeds available (McGee 1982b). Deer mice (*Peromyscus maniculatus)* have been shown to adjust their diets following a burn to take advantage of the post-burn availability of seeds (McGee 1982a). Species such as Western harvest mouse experience a delayed benefit from the increased availability of seeds because they also require standing vegetation as cover before inhabiting an area (Cook 1959).

Response to Change in Habitat Structure

Small mammals, especially rodent populations in prairies, exhibit varied responses to changes in habitat structure resulting from the frequency and seasonality of fire (Schramm and Willcutts 1983) Wildfires in prairies most likely occurred in the spring to autumn months historically (Bragg 1982). In a study conducted by Kaufman et al. (1988) at the Konza Prairie Research Natural Area, the Deer mouse selected recently burned areas with a high proportion of exposed soils, lush vegetation, and little or no litter. Deer mouse, which prefer a minimal litter layer and open vegetation, have a strong positive response the season directly following a fire (Kaufman et al. 1988, McMillan et al. 1995). The attraction to the burned area is likely a result of litter removal, rather than the increased level of plant productivity (Kaufman et al. 1988). In the same study, Western harvest mouse populations decreased immediately following the fire. Western harvest mouse negative response immediately following a fall burn continued into the subsequent spring because of sustained removal of the litter layer (McMillan et al. 1995).

Bats

While the body size of bats places them in the small mammal category, they have the unique advantage of flight as an escape mechanism. However, like other small mammals, the time of year a burn occurs and habitat selection are important factors in the effects of fire on each bat species.

Fires can both create snags and destroy them, therefore, simultaneously creating and destroying roosting habitat. Recent studies are inconclusive about whether burning is a beneficial forest management tool for bat habitat (Boyles and Aubrey 2006, Dickinson et al. 2009). Further investigation is needed (Dickinson et al. 2009). For bats that roost in caves, there are negative impacts associated with smoke intrusion, and smoke toxicity can negatively impact bats. (Dickinson et al. 2009).

Beyond the creation or destruction of bat habitat, burning also directly affects the Red bat (*Lasiurus borealis)* and other species of bats that utilize trees and leaf litter (Saugey et al. 1998). The negative risk posed to the Red bats is elevated during the winter months when bats enter torpor and have reduced escape capabilities (Layne 2009). If the bats are able to passively reanimate themselves, they are better able to escape a fire. This reanimation from torpor occurs above certain temperatures, usually brought about by increasing temperatures during daylight hours (Layne 2009). When not in torpor, bats have been observed to fly and find new unburned roosts nearby (Dickinson et al. 2009). Managers should take into account the diurnal temperature requirements of bats when planning for burn events in known bat habitat.

Figure 2. Red bat (*Lasiurus borealis*) roosting at Tallgrass Prairie National Preserve in August 2009, picture courtesy of Darin McCullough.

Effects on Feeding: Fires can also temporarily limit the available forage for bats immediately post-burn. In a study by Dickinson et al. (2009) involving Northern long-eared bat (*Myotis septentrionalis*), fewer flying insects were observed within the burned area the night immediately following a burn causing bats to forage outside of their normal home range. This change in behavior lasted for 6 – 7 days.

Large Mammals

Escape Mechanisms

A number of studies have noted fire-caused death of large mammals ranging from deer to bears (Lyon et al. 2000). However, recorded deaths of large mammals are generally infrequent and do not significantly alter populations (French and French 1996). This is generally attributed to the ability of large mammals to move away from most flames, and therefore, remove themselves from danger during a burn (Singer and Schullery 1989). Incidences of mortality are generally associated with large fires with severe fire behavior (Lyon et al. 2000). The ability of large mammals to escape fire is reinforced by abundant anecdotal accounts describing large mammals such as deer, elk, bison and bear walking out of the paths of oncoming flames.

Response to Change in Habitat
As mammals' body size increase, their habitat and life history needs also change. As a result, large mammals have somewhat different interactions with fire affected landscapes than small mammals. Appropriate use of fire can create suitable habitat for large mammals, such as White-tailed deer (*Odocoileus virginianus*), which feed on understory vegetation stimulated by fire (Deperno et al. 2002). Like small mammals, the time of year that a burn takes place influences a deer's response since changes in vegetation structure, nutrient content, and forage availability are all influenced by the time of year a burn takes place (Stransky and Harlow 1981). After a winter burn, protein increases in forages, fruit production decreases, and fire-tolerant vegetation persists for up to three years post-burn (Stransky and Harlow 1981). After a summer burn, woody vegetation diminishes promoting herbaceous growth and enhancing forage nutrients (Stransky and Harlow 1981). This type of response in vegetation occurs with infrequent burns and differs from the response to frequent burns (Stransky and Harlow 1981). Vegetation responds to frequent burns by favoring more fire tolerant species, and reducing the presence of woody plants at the burn site (Stransky and Harlow 1981).

Reptiles and Amphibians

Research done on the effects of fire on herpetofauna is limited, especially for the Great Plains and tallgrass prairies. Material herein covers multiple ecosystems to provide a more complete overview. Existing research shows that fire can have a range of effects on herpetofauna depending on factors such as fire regime, fire return interval, time-since-burn, season of burn, and completeness of burn.

Escape Mechanisms
Reptiles and amphibians were found to have different escape mechanisms in four different studies (Smith et al. 2001, Moseley et al. 2003, Durbian 2006, Greenberg and Waldrop 2008). In studies on snakes it was found that some species use underground retreats post-burn. For example, two massasauga snakes were found in crayfish burrows after a prescribed burn on a wildlife refuge in Missouri (Durbian 2006). After a prescribed fire in the Peloncillo Mountains of southern Arizona and New Mexico, snakes moved less frequently post-burn and used underground shelters. Reduced mobility and preference for underground shelter post-burn may result from increased exposure to predators and higher ground surface temperatures (Smith et al. 2001). Amphibians also make use of above ground deposits of fine debris as a source of refuge. In a study in the southern Appalachians, duff and woody debris amounts after prescribed fire provided sufficient cover and dampness for the protection of some salamander species (Greenberg and Waldrop 2008). Burrowing underground may help amphibians survive when the leaf litter is removed, as well (Moseley et al. 2003).

Individuals that unsuccessfully find refuge during a burn may be injured or die. Babbit and Babbitt (1951) collected 60 box turtles from excavated burrows in Dade County Florida after a spring fire. Ten of the turtles were dead and several others showed signs of scaring from previous burns. Of 12 Eastern diamondback rattlesnakes (*Crotalus adamanteus*) found in this same study, only two were still alive. When reptile and amphibian mortalities occur, they are challenging to document thoroughly (Pilliod et al. 2003). Many things can happen to an individual during or after a fire. The body of an individual could be completely consumed by the fire, the animal could find refuge underground before dying, or it could seek refuge in moving water before dying and then be washed downstream (Pilliod et al. 2003). Predators may consume or remove bodies from the burn site. Failure to find bodies however, does not necessarily signify mortality as individuals may have escaped or left the area for non fire related reasons (Pilliod et al. 2003).

An amphibian's response to fire can be connected to the time of year the burn takes place. During summer, usually the driest time of year, most amphibians are underground or near water sources. When fire is introduced to the area, the amphibians are already positioned to escape its effects. Amphibians in the temperate zone are most active on the ground surface in the spring and fall, and prescribed fires applied during these times can lead to direct mortality. Fire can also impede migration to, or dispersal from breeding sites. Late-summer and fall burns increase the risk of direct mortality for amphibians that are migrating to water or preparing to overwinter under leaf litter (Pilliod et al. 2003).

Effects on Feeding

There is a lack of research on the effects of wildland fire on the feeding habits of reptiles and amphibians. However, it has been noted that tallgrass prairie herpetofauna are usually generalist feeders. Therefore they can find other food sources when their preferred prey is not available (Wilgers and Horne 2006).

Response to Change in Habitat

In fire adapted ecosystems, both fire suppression and too frequent fire can pose threats to amphibian habitat (Schurbon and Fauth 2004). Amphibians that are most likely to be affected by fire are those that have a very narrow habitat niche. Conversely, amphibians that can tolerate a variety of habitats (generalists) are least likely to be affected (Pilliod et al. 2003). Habitat fragmentation resulting from fire could act as an impenetrable barrier to amphibians (Dodd and Smith 2003). Because of their unique physiology which requires moisture to survive, amphibians face a significant risk in crossing dry, fragmented habitats (Dodd and Smith 2003). The amount of coarse woody debris in an area, which may otherwise decompose slowly and provide habitat for amphibians and reptiles, can be reduced by a single burn event (Dodd and Smith 2003, Pilliod et al. 2003). In addition to reducing coarse materials, fire may also reduce the amount of accumulated leaf litter. The loss of litter may cause amphibians to lose migration paths and be placed at greater risk of predation and desiccation (Schurbon and Fauth 2003). While fire may have negative short term effect on certain amphibian species, it can help maintain general habitat types for species living in glade and long-leaf pine communities (Brisson et al. 2003, Schurbon and Fauth 2004) .

In a study conducted in the Flint Hills of Kansas, reptile species were found to respond differently to time since burn: Great Plains skink (*Eumeces obsoletus*) preferred annual burns, Little brown skink (*Scincella lateralis*) preferred burns every four years, and Ringneck snake (*Diadophis punctatus*) preferred unburned habitat (Wilgers and Horne 2006). The preferences reflect the kind of habitat each species prefer and the post-burn successional stage at which that habitat occurs. If an area is subjected to long-term fire suppression, then species which depend on habitats created by frequent burning can suffer. This is the case for the glade dependant Collared lizard (*Crotaphytus collaris*) living in southern Missouri. When glades are not regularly burned, they become less open, degrading the habitat quality for Collard lizard. As a result, the lizards genetic fitness is reduced and population numbers remain low (Sexton et al. 1992, Brisson et al. 2003).

The impact of fire size, frequency, and timing on herpetofauna habitat is an important consideration for the health of their populations. Wilgers and Horne (2006) found that the best way to encourage diversity in the tallgrass prairie was to create small scale habitats through mosaic burning. Burning smaller patches of land leaves areas with vegetation and litter cover for the species that need it to survive (Fogell 2004).

Fire intensity has a varied effect on reptile species across ecosystem types. In an established sand-pine scrub forest, habitat changes following a high intensity prescribed burn were found to favor a few species of open-scrub reptiles: Six-lined racerunner (*Cnemidophorus sexlineatus*), Florida scrub lizard (*Sceloporus woodi*), and Mole skink (*Eumeces egregious*) (Greenberg et al. 1994). A study conducted in an Appalachian hardwood forest also found that intense tree-kill following a very severe burn had a positive influence on the lizard abundance (Greenberg 2008). Moseley et al. (2003) explained that reduction in ground cover could lead to more thermoregulation opportunities positively affecting lizards.

Effects on Mating

Information about the effects of fire on reptile and amphibian breeding is sparse. Successful mating often depends on the availability of specific habitat. Practitioners, therefore, should consider the effects of fire on vegetation surrounding standing water where amphibians breed.

Figure 3. Plains garter snake (*Thamnophis radix*) basking at Tallgrass Prairie National Preserve in 2003. Photo by Heartland Inventory and Monitoring Program.

For example, amphibians that prefer open-canopy pools might utilize pools that were previously closed off from direct sunlight, but where vegetation was removed by fire (Renken 2006).

While there has been some debate amongst researchers within certain ecosystems about the best way to reintroduce fire as a management tool, many researchers agree that returning fire is advantageous for reptiles and amphibians when appropriately carried out. A set of guidelines issued by the Midwest Partners in Amphibian and Reptile Conservation may be found at http://mwparc.org/products/fire/plain/.

Discussion

Fire management plans for National Parks in the tallgrass prairie region often state a need for research on the effects of fire on wildlife within their borders (NPS 2007, NPS 2009). Visitors often inquire as to whether or not harm will come to wildlife during a prescribed burn. Anticipating negative effects of fire on wildlife can be an emotional issue for many people. However, effects of fire on wildlife can be positive, and park visitors may not have knowledge of this.

The effects of fire on wildlife can be separated into two categories: direct effects on the animals and indirect effects on animals through altered habitats. Many animals have evolved escape mechanisms, however, some, such as herpetofauna, are at greater risk especially at certain times of year (e.g., pre- and post-hibernation). Fire prescriptions can be designed to mitigate direct mortality by burning at times of the year when target animals are less vulnerable or avoiding critical habitats (MWPARC. 2009). Shifts in wildlife species composition are often temporary, with recovery corresponding to that of the vegetation. Species richness does not necessarily change as the result of a fire, but numbers of individuals within a species or the community composition may, as animals have varying preferences for bare ground, dense cover, or certain plant statures that are changed by fire (Schramm and Willcutts 1983). Some short-term collateral mortality is often accepted in order to maintain habitat and populations over the long-term. Using an adaptive approach, acceptable levels of mortality could be defined pre-burn and monitoring conducted. Based on the results of monitoring, aspects of a fire prescription such as seasonality, intensity, and fire extent can then be modified to benefit a species or group of species.

Many wildlife species focus on vegetation structure in choosing suitable habitats (Smith 2000). Therefore, species have a variety of responses to fire resulting from its influence on habitat structure. To accommodate the variety of habitat needs for wildlife within grassland, fire can be implemented heterogeneously (Fuhlendorf et al. 2006, Marx et al. 2008). For example, varying the time of year burns occur and burning only portions of the habitat in a single year can help sustain populations (NRCS 2008). Natural resource professionals should identify species present and whether any of those require special attention in planning efforts. Plans can then be written to minimize mortality or adjust habitat disturbances. Monitoring programs aimed at quantifying populations and acceptable levels of mortality for species of interest may also help fire programs adapt to help wildlife populations thrive.

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NPS 920/102093, May 2010

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