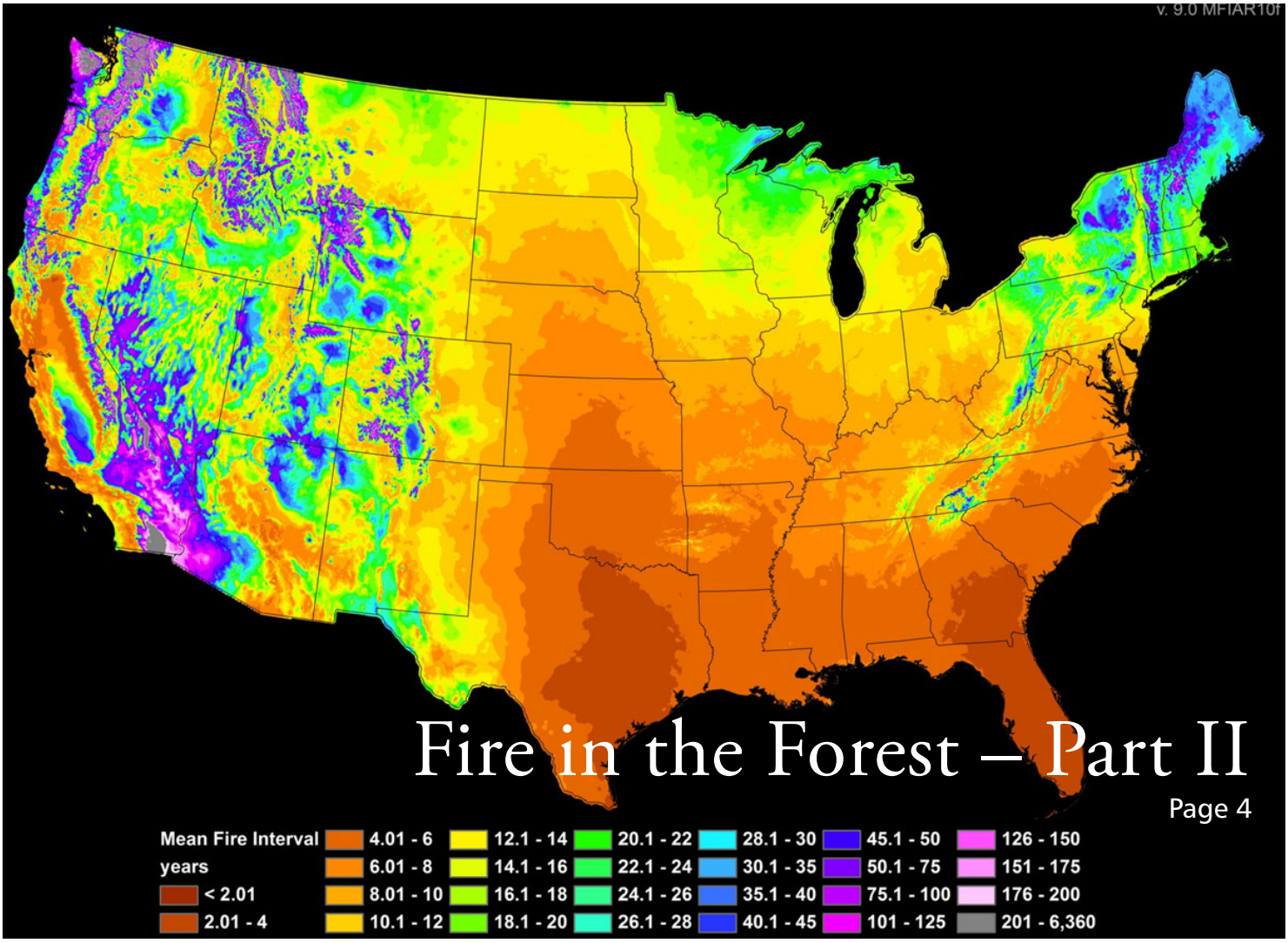
Forest News

Georgia ForestWatch Quarterly Newsletter Summer 2022



Fire in the Forest – Part II

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From the director

Establishing priorities

J.D. McCrary
Executive Director

In this newsletter we opted to wrap up our series on fire and its use, and effects, on the forest. Thank you to Jess Riddle for sharing with us his time and expertise on the subject. At GAFW we have an obligation to pursue data driven policies and recommendations and will only use peer-reviewed studies from academic experts in their fields to develop and support our outreach. In short, we go where the data leads us and we trust the experts.

Our pursuit does not come easy and is open to evolution as additional studies are reviewed. GAFW's current position supports the use of prescribed fire that mimics natural (lightning) fire regimes or that can effectively protect life and property and supports allowing lightning ignited fires to burn where they do not threaten life or property but does not support allowing other wildfires to burn.

Thankfully GAFW is a membership organization whose members reflect a broad range of diverse expertise and thought. We have many members who support the prescribed fire actions of the U.S. Forest Service (USFS) and feel their budget should be increased to prioritize more burning and those on the other end of the spectrum who believe that all fires in the national forest should be suppressed at all costs. The truth almost certainly lies within the two opposing ends. Consider that for a century the USFS's most popular spokesman was Smoky the Bear who was the face of one of the longest public information campaigns in our nation's history. It was so successful that even though the USFS policy on fire has changed most of us still fear the wildfires Smoky warned us against.

At the end of our research GAFW has landed, for now, on a fire position that has less to do with fire and more to do with complexities of the entire ecosystem and the bureaucracy of managing the land. GAFW recognizes the historical role fire has played in our state's landscape however feels the increased support of prescribed burning is reducing much needed financial support for the Chattahoochee Oconee National Forests' (CONF) most pressing concerns of clean water and watershed resiliency. GAFW feels CONF management, and the U.S. Forest Service (USFS), budget priorities should focus on road and trail maintenance over the current resources directed towards prescribed fire. Only when the USFS can proactively manage (including law enforcement), or permanently close, all roads that aggressively contribute to waterway sedimentation upstream, downstream, and within the CONF should the USFS then look at funding a rotation of prescribed fires.

Important priorities like infrastructure maintenance are not anywhere near as exciting as fire. Nor do these environmental priorities have the same visceral reactions as fire. However, we need to ensure clean water and clean air first and foremost. Once these fiscal priorities are established, we can then begin to address prescribed fire as an effective management tool in the Blue Ridge Mountains.

Prefer to receive your newsletter in electronic format ONLY?
If so, please contact us at info@gafw.org or 706-867-0051.

Save the Date!

The Georgia ForestWatch Fall Retreat will be held at

LAKE WINFIELD SCOTT PAVILION

on

Saturday, October 15th, 2022

Plan now to attend for informative programming, good food, and plenty of fun and fellowship with other ForestWatchers.

Let us know if you'd like to reserve a campsite at Vogel State Park.

You can email us at info@gafw.org or call 706-867-0051

WILDERNESS MONITORING

Are you interested in counting visitors along our trails? Help collect data on the number people and dogs along one of these trails:

- *Raven Cliffs Falls (Raven Cliffs Wilderness)*
- *AT Blood Mt./Byron Herbert Reece (Blood Mtn. Wilderness)*
- *Woody Gap to Jarrard Gap (Blood Mtn. Wilderness)*

We are seeking volunteers to provide valuable data to the US Forest Service (USFS) about Wilderness areas in Georgia. After a short virtual or in-person training, you can sign up to hike along the Appalachian Trail and other popular trails and document the number of visitors you encounter. This is a great opportunity for college credit in applicable courses such as social change, environmental studies, land management, and/or GIS.

Since the Wilderness Act of 1964, we have been fortunate to have permanently protected areas of land where one can go to get away from the hustle and bustle of development and human noise.

Georgia ForestWatch, in partnership with Southern Appalachian Wilderness Stewards (SAWS) and the US Forest Service, is coordinating trained volunteers and communicating valuable data so USFS Recreation Managers can make the best decisions regarding Wilderness areas.

Georgia ForestWatch's mission is to enhance the health of over 867,000 acres of Georgia's national forest by protecting our forests and streams, advocating for natural processes, and identifying opportunities to improve forest management.

WHAT'S INVOLVED:

1. Receive or watch all training resources.
2. Download Survey123 APP to your mobile device.
3. Upload survey and maps.
4. Sign up for survey date(s).
5. Sign in and collect data with personal device for 4 hours in designated monitoring area.
6. Send in/export data using Survey123 APP.
7. Do it again on the same trail or choose another!

For More Information

SCAN ME

GAFW.ORG/wilderness-monitoring

southern appalachian WILDERNESS stewards

Contributors: ForestWatch thanks the following team of staff members, board members, and volunteers who collaborated to produce this issue of the newsletter: Lyn Hopper, Andrew Linker, Maria Klouda, J.D. McCrary, Jess Riddle.

Cover photo credit: Richard P. Guyette & Others, Public Domain

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Georgia ForestWatch is a 501(c)3 nonprofit educational corporation.

Georgia ForestWatch sees a future where people can enjoy forests that have reached their full majesty, where intact natural processes support healthy ecosystems and thriving biodiversity, and clean streams supply water to millions of Georgians. We believe this future requires the protection and appreciation of Georgia's national forests, and the watersheds, native plants and wildlife they encompass.

Our mission is to enhance the health of over 867,000 acres of Georgia's national forest by portecting our forests and streams, advocating for natural processes, and identifying opportunities to improve forest management.

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Fire in the Forest – Part II

by Jess Riddle

Part I of "Fire in the Forest" was published in the Spring 2022 *Forest News*. We explored the way natural fire in the southern Appalachians and the Chattahoochee National Forest differs from wildfires out west, and some key ways to understand the effects of fire (frequency, intensity, and timing). We also presented our position on fire:

Georgia ForestWatch supports the use of prescribed fire that mimics natural (lightning) fire regimes, or that can effectively protect life and property. Georgia ForestWatch also supports allowing lightning-ignited fires to burn where they do not threaten life or property but does not support allowing other wildfires to burn.

You can find the entire article with extensive source articles and references at: gafw.org/fire-position/

PART II
RECURRING ISSUES

Issue 1 – Frequency

Problem: Across the Chattahoochee-Oconee National Forest, but especially in the Blue Ridge Physiographic Province, the Forest Service burns more frequently than would naturally occur. Continuation of this practice may result in artificially open forests as tree regeneration is repeatedly killed and canopy trees naturally die.[24,31] Frequent fires may also deplete the duff layer and lead to erosion on steep slopes. The duff layer is the organic material layer of the forest floor between the mineral soil (mostly clay, silt, and sandhere) and the loose tree leaves laying on the ground. The duff layer is decomposing organic material, decomposed to the point at which there is no identifiable organic materials (pine straw, leaves, twigs, etc).

Solution: The Forest Service should burn individual units less often. Exactly how often should depend on the climate and topography of the burn unit, but for most dry ridges and slopes, the fire return interval should be at least 12-25 years.[34] Since exact fire regimes cannot be determined, a broader range of fire frequencies should be centered around the best estimate of the historical fire regime, or the fire regime anticipated under a future climate. Somewhat higher fire frequency may be needed initially to counteract the cumulative effect of decades of fire suppression. Still, quantifiable restoration targets should be likely related to duff layer thickness and understory conditions. After those conditions are reached, a natural fire return interval should be implemented. Prescribed burning capacity freed by burning areas less frequently should be put towards burning additional dry areas and harder to burn areas of high ecological value.

Evidence: The excessive fire frequency goals for CONF burn units can be appreciated by analyzing how large or frequent lightning fires would have to be to produce the same frequency. The Chattahoochee National Forest occupies 750,000 acres, and the Forest Service (FS) describes 73% of the forest as "dry-mesic," "dry," or "xeric" forest types6, which include all the forests that would be appropriate for prescribed burning. Unsuppressed wildfires in Great Smoky Mountains National Park average 195 acres.[5] The true average size of wildfires may be greater because infrequent, much more extensive fires, such as the 27,870-acre Rough Ridge Fire, may not occur during the limited record-keeping period. Historic wildfires on the CONF may have also been somewhat larger due to different vegetation and the lack of relatively inflammable spruce-fir forests at high elevations, which could have served as fire breaks.

In this analysis, 1,000 acres will be used as the potential average natural fire size. To achieve a five-year fire return interval would require 109 fires per year (750,000 x 0.73 / 1000 / 5). However, the CONF has historically averaged only 4.7 lightning ignitions per year, including the Oconee Ranger District.[6] Even if only a third of the Chattahoochee National Forest were considered fire-adapted, 50 ignitions would be needed each year to achieve that frequency. If lightning strikes fires average of 1,000 acres, it will need to be more than ten times more common to burn the CONF on a five-year return interval. For the recorded ignitions to burn the CONF on a five-year return interval, they would need to average more than 23,000 acres.

Given the climate and topography of the CONF, a fire return interval of much longer than five years is not surprising. The lack of a dry season in north Georgia makes the region less susceptible to fire than other parts of the Southeast.[35] Lightning may be sufficient to maintain a 1-to-3-year fire return interval in upland longleaf pine forests in the Coastal Plain.[36] Still, the climate of the CONF differs from that region in having more precipitation, lower temperature,

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Recurring issues Georgia ForestWatch has noticed after years of monitoring fire management on our national forests include:

1. The frequency of prescribed fire goals does not seem to mimic natural cycles.
2. Disturbing the forest to keep prescribed fires contained has costs.
3. We need more data on if prescribed fire can protect life and property in moist forests.
4. Let's get some clear goals for the prescribed fire program based on natural fire regimes that are not targeted at a single species.

and more cloud cover. The CONF also lacks the summer dry season found in the Quachitas and Ozarks. The CONF differs from the Coastal Plain and Piedmont in having more dissected topography, reducing fire compartment size (the area where a single ignition would burn before reaching natural barriers to spread).

Conversely, in the fall of 2016 when over 250,000 acres of the Southern Appalachians burned in wildfires, exceptional weather conditions prevailed. "[S]ince 1895, October-November 2016 soil moisture (0-200 cm) in the SE US was likely the second lowest on record, behind 1954" due to "low September-November precipitation and record-high September-November daily maximum temperatures."[37] The extreme dryness also greatly reduced the effectiveness of topographic fire breaks as fire was able to spread through areas that would normally be too wet to burn.

Guyette and others used physical factors to estimate the fire return interval in the north Georgia Blue Ridge mountains at 12-50 years, with most areas being 12-22 years.[34] Explicitly accounting for topography and fire compartment size, Frost estimated the "most fire exposed parts" of the Georgia Blue Ridge to have a "pre-European" fire return interval of 13-25 years.[38] Interestingly, both models estimate the frequency in Georgia Ridge and Valley, which is climatically drier and has fewer topographic fire breaks at 6 or 7 to 12 years. Even these estimates may be too high for lightning fire return interval because the calibration data included the influences of Native American fires and biased site selection (discussed below).

Forest Service position: To support their chosen fire frequency, the FS may cite wildlife and vegetation goals or fire history reconstructions or may arbitrarily decide on a fire return interval without justification. They generally believe that the fire frequencies they use align with Native Americans' historical use of fire and are necessary to achieve vegetation goals. They also believe prescribed fires are safe, typically citing research based on the effects of one or two fires.

Rebuttal: The frequency of historic Native American fires is a problematic basis for modern prescribed fire frequency for two reasons. First, the fire frequency literature for the pre-suppression period, when Native American fires dominated the fire regime, is biased towards higher fire frequency because study sites are selected based on how much evidence there is of historical fires at the sites.[39] Fire history reconstructions need many fire-scar samples to create a fire history reconstruction. Consequently, study sites are not chosen randomly or to be representative of the landscape, but instead on the availability of evidence of fire.[40,41,42] This practice is like going to a bar to survey whether people like beer. It eliminates the possibility

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WELCOME NEW MEMBERS (April – June 2022)

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of certain results while guaranteeing other results. Across the Southern Appalachians, regardless of whether frequent fires were rare, occasional, or common, all fire history studies will choose and report on frequently burned sites because those are the only sites that produce enough samples for the analytical methods.

Studies based on charcoal fragments rather than tree rings sometimes argue that frequent fire has been part of the Southern Appalachians for several millennia. However, the dating methods used in these studies (carbon) lack the temporal resolution to differentiate frequent from infrequent fire regimes. [43,44]

Second, the 20th century was wetter than the preceding centuries. Droughts were longer lasting and more intense during the time covered by fire history reconstructions than they have been since fire suppression became effective.[45] Since climate is a "strong driver" of wildfire patterns with more fire occurring during drought years,[46] fire would be expected to be less prevalent during the fire-suppression period even without active fire suppression. Fire frequency during 1600s, 1700s, and 1800s is not a reasonable expectation for modern fire frequency because it occurred under different conditions.

Issue 2 – Fireline construction leads to erosion and the introduction of invasive species.

Problem: Because they need to be clear of fuels, most fire lines expose the soil to erosion and create a disturbed area that facilitates colonization by invasive species. Some fire lines are not an issue because they are already existing structures, such as roads and streams. However, new burn units often involve constructing new fire lines with bulldozers or hand tools. The bulldozed lines are a much more significant issue because they completely expose the mineral soil, while many handlines leave some or all the duff layer intact. Bulldozed fire lines may be a greater erosion risk than roads because they often follow topographic features and may be steeper than roads.

Solution: Minimizing fire line construction should be a goal in planning any new burn unit. The exception should be where a longer hand line or use of natural features can be substituted for a dozer line. Natural elements such as streams may still need to be avoided if they would have to be disturbed to be used (e.g., clearing out debris jams from a stream) or if they would have to be strengthened by putting fires in areas that would not otherwise burn (i.e., blacklining streams).

Evidence: Fireline construction can increase erosion.[47] In a grassland study, "bulldozed fireline altered primary ecological processes, particularly nutrient cycle and hydrologic functioning, by mechanically removing native plant species, creating exposed bare ground which was susceptible to soil erosion and invasion of competitive non-natives."[48] In the Appalachians, steep fire lines produce several times as much erosion as those with low gradients, and timely rehabilitation of firelines is important to minimizing

Photo credit: Jess Riddle

A fireline erodes on the Chattahoochee National Forest.

erosion.[49] The use of natural fire breaks is recommended to reduce the impacts of fire suppression efforts.[60]

Fire managers recognize that fire equipment can carry invasive species propagules to fire sites.[50] However, little research has been conducted on firelines as invasion sites, especially in the Southeast. More general research on the impacts of fire on nonnative plant invasion finds that invasions depend on the fire regime and the species involved.[51]

Issue 3 – Over-promising wildfire risk reduction

Problem: The FS justifies prescribed fires partly based on their ability to protect property.[6,52] In promoting prescribed fire to the public, the FS portrays wildfires as a major risk and implies that their application of prescribed fire will greatly reduce that risk. However, the evidence does not support the effectiveness of prescribed fires in controlling wildfires in the Southern Appalachians.

This practice leads to prescribing in places or ways that would otherwise not be justified. There is also a risk of creating a false sense of security in the public's mind. Ineffective wildfire prevention can also lead to burns in ecologically inappropriate areas. Ultimately, the credibility of the FS burn program may be damaged, and its ability to conduct needed burns may be compromised.

Solution: The FS needs to analyze where prescribed fire effectively influences wildfires. These primarily consist of areas where dense mountain laurel or dwarf rhododendron could act as a ladder fuel on dry sites, especially where it grows underneath pines, which could carry a crown fire. The FS also needs public communication about fire to be more fact-based, including how much wildfire risk can be reduced by prescribed fire.

Evidence: Overall, little research has been done in moist climates with high fuel production rates about whether prescribed fires prevent wildfires. In probably the best study and the most analogous

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to the Southern Appalachians, researchers analyzed Forest Service prescribed fires in northern Mississippi and concluded that prescribed burning did not reduce the frequency or extent of wildfires.[53] Studies in arid and Mediterranean climates have found that prescribed fires mitigate wildfires.[54] However, that review suggests that the effectiveness relies on disrupting fuel continuity in low -productivity ecosystems. In the Southern Appalachians, high ecosystem productivity allows fuel continuity to recover rapidly (after fall, leaf litter covers the ground).[55] Prescribed fire will disrupt wildfire in the short term.[56] It may be more effective at reducing wildfire intensity by disrupting the vertical fuel continuity created by dense understories of evergreen shrubs, especially mountain laurel. That oak forests can be burned on annually, for at least 17 years, shows that prescribed fires are not very effective at making temperate deciduous forests inflammable.[57,58,59]

While the FS suggests that using fires to consume fuels will render forests less flammable, consuming fuels is not the only way fires affect ecosystem flammability. Increasing fire frequency also affects plant traits and is expected to promote more flammable vegetation.[60,61] Indeed, the FS often explicitly seeks to promote highly flammable grasses,[62] and suppress species that inhibit fire, such as red maple.

Wildfire is not the core of the challenge of protecting life and property; preventing home ignition is.[63] That challenge may be addressed in many ways.[64]

Photo credit: Jess Riddle

Flammable leaf litter blankets the ground one year after a Chattahoochee National Forest prescribed fire.

Issue 4 – Goals for using fire to improve wildlife habitat do not provide meaningful ecological direction

Problem: In addition to vegetation goals and reducing "hazardous" fuels, prescribed fires are used to "improve wildlife habitat." However, what constitutes an improvement is rarely defined. Further, "[fire causes change, which, under any circumstance, is good for some wildlife species and not good for others,"[65] so it is not meaningful to discuss improving wildlife habitat without specifying which species' habitat or what constitutes an improvement. Alternatively, prescribed fire plans may be driven by a single species, particularly the red-cockaded woodpecker, which risks "the potential negative consequences of homogeneous fire applications."[66] Writing about the management of Australian savannahs, Woinarski and Legge summarize that "in the absence of targets set to deliver biodiversity benefits, fire management is likely to be based instead on targets unrelated to, or antithetical to, biodiversity conservation, or it may continue to be based on least-cost operational or current practice, or it may simply be purposeless and anarchic."[67]

Solution: Instead, we recommend that the prescribed fire program have clear goals based on natural fire regimes that are not targeted at a single species. Consistent with ForestWatch's overall position on fire, goals for using fire to manage wildlife habitats should "vary firing techniques, ignition locations, and firing conditions using the historical variance in fire season and frequency as a guide."[68] Managers should also "articulate precise management objectives or outcome assessment to determine their success."[65] Fire and wildlife researchers also recommend better articulation of ecological values (as opposed to wildfire prevention), and greater accountability for poor prescribed-fire management.[67] Finally, a prescribed fire should not be applied to mesic habitats.

These conclusions reflect the body of research on fire-wildlife interactions. Fires can positively or negatively influence bats, reptiles, and other animal groups.[65,69,70] The impacts vary by species.[65,69,70]

Fire affects wildlife directly and indirectly by altering habitat conditions.[65,70,71] Direct effects come from heat, smoke, carbon monoxide, and water chemistry alteration.[70,71] Indirect effects include altering predator and prey populations and changes in habitat that occur as vegetation recovers following fire.[65,72] Indirect effects can alter the "presence, density, reproduction, survival, movements, and home range of wildlife in a particular area."[65] The effects may be greatest on less motile organisms,[71] but can also be of secondary importance to other habitat drivers such as topoedaphic factors.[73]

The direct effects of fire on wildlife are rarely observed.[65] In general, "[a]nimals are most vulnerable to mortality or injury from fire during nesting, brood-rearing, or fawning seasons, and soon after emerging from hibernacula (i.e., some herpetofauna)."[65] However, most species in the southeastern US have behavioral mechanisms that help them escape the direct effects of fire, usually by avoiding fire underground or fleeing the immediate fire area. From an evolutionary perspective, such adaptation is expected since fire is a regular component of the region's ecosystems. Any species that could not cope with occasional fires would be severely disadvantaged.

Researchers have documented a few exceptions. A fire just after timber rattlesnakes emerged from their hibernacula in Arkansas resulted in "a near total loss of snakes at the site because due to the effects of fire".[74] Another study found "[t]wenty percent of box turtles in the burned area exhibited injuries caused

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Fire in the Forest

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by the fire."[75] Even low mortality rates could be significant to box turtle populations because the species has low reproductive rates and long lifespans. Harm in these slow-moving reptiles may specifically be linked to spring fires when they move the slowest and may be at least partially offset by beneficial habitat changes.[65] Fish mortality was also observed in the wake of the 2016 Rough Ridge Fire in the Cohutta Wilderness and has been associated with high-intensity fires in the western US. However, "even in the case of extensive high-severity fires, local extirpation of fishes is patchy, and recolonization is rapid. Lasting detrimental effects on fish populations have been limited to areas where native populations have declined and become increasingly isolated because of anthropogenic activities."[71]

Beyond the direct mortality of mature individuals, fire may also disrupt roosting and reproduction. For instance, tri-colored bats roost in dead leaf clusters with high fidelity, and may be within five meters of the ground.[76] However, many other bat species roost high in trees or underground caverns that are presumably minimally affected by fire.[69] Separate studies recorded 3% of either turkey nests or broods destroyed by growing season fires.[77,78] However, the proportion of nests affected was lower than the proportion of the area burned, and about a third of turkeys re-nested after the loss of a nest. Turkeys re-nested with success rates equal to initial nests.

Many knowledge gaps about the direct effects of fire also exist because interactions with fire are rarely directly observed. For example, "[i]It is unknown how smoke affects bats in these roosts or if different types of roosts reduce or enhance smoke exposure to roosting bats."[69] For bats, "[f]urther study is needed on the interactions of ambient temperature, torpor, arousal times, fire stimuli, and escape behaviors by bats."[69]

The growing season is the period of the year when plants are actively growing and deciduous plants have leaves. In north Georgia, the growing season is roughly mid-April through early November. The actual growing season varies depending on elevation, species, and the weather in any given year.

Fires alter wildlife habits by influencing dominant vegetation and altering the physical structure of ecosystems.[58,79] The impact on wildlife depends on the fire regime.[65]

Researchers have examined fire frequency the most, with frequently burned longleaf pine ecosystems receiving the most attention. In that ecosystem, results on wild turkeys have been contradictory. One study found that "[e]ven at 2–3-year fire frequencies, turkey selection of pine savannas was sensitive to the time since the last prescribed fire. Both hens and gobblers used savannas that had been burned ca. 18 months and began avoiding stands that had not been burned in the past 2 years."[80] However, another study found "[n]either time since burn nor the number of times a site was burned since 1991, regardless of season, were predictors of use intensity,"[81] while in another investigation "[f]emales frequently selected nest sites in areas at the end of their burn rotation."[82] In upland hardwoods, some researchers have recommended a 3-5 year rotation "to enhance and maintain brood cover and increase food availability in upland hardwoods."[83]

White-tailed deer have shown tolerance for even annual burning,[84] though vegetation recovery following fire significantly alters their habitat (see below). Overall biomass of longleaf pine soil arthropods also shows no effect of time since fire.[85] The study examined individual orders and found that spiders, grasshoppers, and crickets required time to recover from fire to their previous abundance. At the same time, beetles, and ants, which accounted for most of the biomass of arthropods, did not.

In reviewing wildlife response to fire in the central hardwood forests, including the Appalachians, researchers recommended managing wildlife with prescribed fire frequencies ranging from 2-4 years to 15-20 years. However, most recommendations involved a maximum interval of eight years or less.[65] These recommendations span many different taxa, including several bird guilds and game species such as bobwhite quail, turkey, and deer. They conclude, "a fire-return interval of 2 yr to 7 yr benefits a wide variety of wildlife species by providing a diverse structure in the understory, increasing browse, forage, and soft mast, and creating snags and cavities."

Cautionary tales of the impact of too-frequent fire come from several frequently burned landscapes. In a North Carolina longleaf pine forest, the consistent application of a 3-year fire return interval resulted in the nearly complete loss of fleshy fruits from the ecosystem, an important food resource for many animals.[66] The Florida sand skink, a rare lizard native to the Lake Wales Ridge of central Florida, shows "increasing abundance with time-since-fire and decreasing abundance with number of fires."[86] In Australia, frequent fires in fire-prone ecosystems are "the major factor responsible for current declines" in diverse bird communities,[67,87] and individual rare bird species.[88] Researchers have raised similar concerns about impacts on bird communities in seasonally-dry tropical savannahs in Brazil.[89]

The contradictory recommendations for more or less frequent fire likely have two causes. Recommendations for greater use of frequent fire are generally made in the context where prescribed fire is currently applied to only a small portion of the landscape. Conversely, where researchers have observed unsettling declines, almost the entire landscape is regularly burned. Caution has also come from landscapes with few topographic barriers to fire, so fires can burn across the entire landscape. These conditions can result in long-unburned areas becoming rare and homogenization of the landscape.[67,68] Currently, the Forest Service burns a minority of the CONF. Within individual Forest Service burn units, topographic features create moister areas that do not burn under the weather conditions that the Forest Service uses for prescribed fires.

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Investigation of how the burning season affects wildlife in southeastern hardwood forests has been "limited."[65] In addition to the concerns discussed above about the effect of early growing-season burns on reptiles, the potential for growing-season fires to disrupt ground-nesting birds, especially turkey, has received attention. As discussed above, impacts in longleaf pine forests appear minor, with no population-level effects.[90] Due to a lack of cover, white-tailed deer may be adversely affected by fire during or shortly before the fawning season.[91]

The effects of fire intensity have received even less attention in this region. In the western US, the black-backed woodpecker, a species precisely adapted to forests killed by intense fires, still relies on patches of low-severity fire.[92] Fledglings disproportionately use areas with live trees because of the greater cover provided by the trees.

Photo credit: Jess Riddle

The open conditions shortly after a fire can both help wildlife forage and make finding adequate cover difficult.

Many researchers and practitioners have promoted pyrodiversity, using a variety of fire regimes across the landscape. Wildlife species may require different habitats produced by different fire histories.[92] Some researchers have cautioned that homogeneous application of fire risks eliminating important wildlife resources from the landscape, such as fleshy fruits.[68] However, research reviews have found the pyrodiversity-biodiversity link to be inconsistent.[93,94,95] In some cases, long unburnt habitats contribute disproportionately to biodiversity and conservation goals.[94,95] In the mostly unburnt and heterogeneous landscape of the CONF, pyrodiversity seems more likely to be beneficial than harmful. That finding, coupled with the region's historical diversity of fire regimes, argues for the Forest Service to use a broader range of return intervals, seasons, and intensities in its prescribed fire program.

Regardless of the fire regime, fires cause habitat changes by damaging intolerant vegetation, and habitats continue to change throughout vegetation recovery. As a result, animal use of burned areas changes over time. Aquatic organisms,[71] salamanders,[96] reptiles,[70] turkeys,[83] and deer[97,98] all show changes in habitat use with the number of seasons since the last fire.[65,99] During the first growing season after fire, habitat effects may be powerful as vegetation regrows, cover increases, and leaf litter accumulates. While many researchers have examined the short-term effects of changing vegetation between fires, few studies have examined the effects of long-term habitat change caused by repeated fires. Processes such as thinning the duff layer allowing increased herbaceous vegetation, canopy gaps in burned forests, and the gradual consumption of coarse woody debris have rarely been examined but could significantly impact wildlife. Some researchers concluded, "[u]nless fire intensity is great enough to kill a portion of the overstory, burning in closed-canopy forests has provided little benefit for most wildlife species in the region because it doesn't result in enough sunlight penetration to elicit understory response."[65] While true, that conclusion fails to account for the difference between short- and long-term impact and the potential for repeated fires to gradually open canopies and thin duff layers.

Burning can change habitat structure by consuming leaf litter and woody debris, felling snags, creating snags, and top-killing vegetation. Litter removal and blackened surfaces can help reptiles thermoregulate.[100] Still, loss of litter and vegetation can lead salamanders, shrews, ovenbird, black and white warbler, and worm-eating warblers to avoid burned areas in the year after a fire.[65] Similarly, downed wood produced by fires can provide valuable basking habitat,[101] but an Australian study found "[p]artially burnt fallen-timber refuges, where the log surface is left charred, are inferior habitat for fauna."[102] Reducing midstory density by fires can benefit flying squirrels, fox squirrels, and bats.[69,73]

Some of fire's most substantial impacts are changes in foraging conditions and cover. Reduced litter, ground vegetation, and midstory vegetation help many species forage. High-intensity fires create foraging habitats for woodpeckers,[92] while open understory conditions facilitate bat foraging.[65,69] Immediately following a fire, coyotes increase the use of burned areas, presumably due to improved sightlines.[99] Litter reduction can help deer mice find seeds[103] and help wild turkeys forage on insects, which contributes to increased use of burn areas in the weeks following fire.[77,80] However, studies in the Southeast have documented that leaf litter consumption can also decrease the populations of insects that live there, which may increase dispersal by predators, such as shrews and lizards.[86,104]

Deer may benefit from fires by an increased volume of forage,[84,105] and increased nutrient concentrations in forage.[106,107,108] Research in African savannahs found that such changes in forage quality drive increased use by herbivores.[109] Increases in herbaceous P, and protein, though, are typically short-term.[107,109] These nutrients are crucial for antler growth.[108]

Multiple factors may prevent deer from realizing an advantage from increased plant nutrient concentrations. Under a closed canopy, fire may produce "negligible" increases in forage availability, though that interpretation focuses on only short-term effects.[65] In much of the white-tailed deer's range, populations are not nutrition limited.[73] Overall, burning effects of forage quality have not been linked to higher deer populations.[73]

The lack of cover may be the most significant factor preventing whitetail deer from taking advantage of improved forage. Female

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Fire in the Forest

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deer "avoided recently burned areas" (less than one year since fire) during the lactation season.[91] Researchers explain "the counterintuitive avoidance of high-quality forage in recently burned areas" by noting that "white-tailed deer were foraging and fawning in fear of a cursorial predator of open range, the coyote."[110] Similar avoidance of recently burned areas has also been observed following wildfire.[99] To what extent "behavioral changes in small mammals during or following fire might cause an increase in vulnerability to predation" is "wholly unknown."[73] Other species likely experience tradeoffs between foraging and cover following a fire because improved foraging has been observed for several predatory species, as noted above.

Vegetation alteration by fires may also affect animals' roosting and dispersal. For instance, "[s]tudies often find bats favor burned areas for roosting," possibly because many bat species use snags for roosting and prefer open midstory conditions around roost sites.[69] Dispersal of both litter-dwelling reptiles and deer have been observed to increase following fire, likely due partly to attempts to find cover.[72,91] However, the turkey did not vary in their "pre-nesting-resource selection" with the number of years since fire.[90]

The overall effect of fires on animal populations varies widely among species and ecosystems. Flying insects have displayed both population increases and declines depending on what taxa are examined.[69] Reptiles have often been resilient to fire or respond positively,[70,72] including Eastern hardwood forest species such as eastern fence lizard, ground skink, and southeastern five-lined skink.[65] Similarly, studies of both prescribed fires and wildfires have shown little impact on small mammal populations,[73] and research in the Georgia Coastal Plain found "growing-season prescribed fire has minimal impact on wild turkey" populations.[82] Researchers in eastern hardwood forests have not found "evidence that fire is leading to population declines for any species, including Endangered Species Act (ESA)-listed species (e.g., Indiana bat [*Myotis sodalis* Mill. Allen] or northern long-eared bat [*M. septentrionalis* Trouess.])."[65]

Studies from other regions have raised some concerns. Fires in Indonesian rainforests "have significantly impacted the butterfly assemblages, reduced species richness and altering community composition ... Many small, restricted range Bornean endemics present in the pre-ENSO [El Nino Southern Oscillation] forest were absent from the whole landscape after the ENSO event, and those endemics that were found tended to be restricted to isolates of primary forest."[111] In Australia's tropical savannahs, evidence indicates "many species of birds (and other vertebrates and plants) are declining across substantial parts of this region and that the current fire regimes are contributing to that decline and in some cases are the major driver of it (Table 1)."[67]

Are such negative effects likely to develop in the southern Appalachians? We cannot say from existing data. The ultimate effects of prescribed fire programs on wildlife populations will depend on long-term ecosystem change, which is unknown. Any ecosystem change will benefit some species and harm others, so positive and negative impacts are inevitable. Likely impacts on vegetation and the habitat at the extant sites that have been burned the most – the Buffalo Range Burn on the west side of the

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Cohuttas and units in the Lake Russell Wildlife Management Area – seem to suggest generally positive changes. Increased herbaceous vegetation could benefit many species. Aquatic systems may be at the greatest risk because mineral soil exposure on steep slopes could significantly increase sedimentation. Gradual nutrient loss reducing productivity could also negatively impact terrestrial habitats.

The evolutionary history of species on the CONF and the landscapes' topography suggest worst-case scenarios are unlikely to occur. Most CONF animals occur in and are adapted to more fire-prone regions. Deer, turkey, many songbirds, box turtles, and others are native to regions farther south that naturally have much more frequent fire, suggesting those species can maintain viable populations in more frequently burned habitats. Species that respond to greater fire frequency through avoidance will have natural refuges on the CONF. The complex topography of mountains creates many natural fire breaks and areas that do not burn even when fire burns surrounding habitats. Consequently, species that require long-unburned habitats or a mix of burned and unburned areas will likely also be near unburned areas. For those natural refuges to benefit wildlife, managers must not force fire into mesic habitats.

Wildlife research indicates even where a fire in and of itself is not a threat, poorly managed fire programs can still produce serious negative consequences. Hence, healthy wildlife populations rely on ecologically appropriate fire management. For many different species, some researchers recommend three to seven-year fire return intervals,[65] including 3-5 years for turkey.[83] However, these recommendations are drawn from short-term research and generally ignore the potential for long-term ecosystem change or degradation. They acknowledge "long-term data are needed to answer most questions," including "[l]ittle data existing on how thinning the duff layer, as opposed to opening the canopy, alters habitats for wildlife."[65] The same researchers also "contend that only fire can provide landscape-level heterogeneity in some landscapes, such as the Appalachians, that otherwise largely would be an unbroken static-aged forest, particularly at present when forest management (i.e., timber harvest) now constitutes a very small proportion of any given area in the region's national forests (Sandeno 2015)."[65] However, that position completely ignores the role of wind as a dominant disturbance throughout the region and a source of forest heterogeneity.[112]

To conserve biodiversity, "[m]anagement faces significant challenges given the inherent variability of natural fires and the long evolutionary histories of the taxa that use fire-dependent habitats."[86] Researchers recommend "avoid[ing] extreme fire regimes,"[72] and many specify that prescriptions should consider "the ecology of the ecosystem"[65] and fire regime in which species evolved.[68,113] For example, even "obligate-seeding species in fire-prone shrublands that may not be resilient to a regime of fire more frequent than that with which they evolved."[113] The "[l]ife-history traits of plants, including time to reproductive maturity and senescence, can be used to estimate lower and upper bounds of fire intervals that support biodiversity."[95] This approach has already been put into practice on Federal land at Fort Bragg, NC, where fire management plans were "derived from climatic patterns of natural ignition sources (Beckage et al., 2005; Slocum et al., 2007, 2010) and historical descriptions of forest structure (Streng et al., 1993; Waldrop et al., 1992), which indicated natural fire season varied regionally but was dominated by growing season (~75% June–August; Fill et al., 2012) with a 3-yr fire-return interval on average (Fig. 2; Cantrell et al., 1995)."

Even with management plans based on natural fire regimes, a lack of heterogeneity can lead to the loss of functional groups, such as fleshy fruits.[114] To avoid such negative effects on wildlife, "fire prescriptions should include variations in frequency, season, application method, and fire weather conditions rather than focusing on an average historical fire regime."[68] Similarly, "management of fire-dependent habitats may require a management strategy that creates fire mosaics, and it may not be possible to manage for the direct benefit of all taxa on the same habitat, especially if the habitats are small and have been fragmented."[86] Fire mosaics are often mentioned in CONF prescribed fire goals, but it is unclear what concrete steps are taken to create true mosaics, and the range of fire frequencies used is generally quite narrow, either 3-5 years or 5-10 years.

While using natural fire regimes provides a great deal of direction for fire management and removes much of the ecological risk, existing fire management often has limited effectiveness due to "failure to articulate precise management objectives or outcome assessment to determine their success. Often, it is unclear whether practitioners are burning for a focal species or group of species (e.g., shrubland songbirds), or whether it is for a target condition or ecosystem function (e.g., table mountain pine [Pinus pungens Lamb.] restoration in montane systems or an oak woodland) … There is a large dichotomy between managing an area so that it will support a certain species versus managing an area for maximum production of that species. This distinction is important, especially for public-lands managers when iconic game species or at-risk species occur, or when conditions desired for other stewardship considerations exist."[65]

Other researchers "caution managers on the development of fire management plans based on the response of few focal flora or fauna in fire-maintained ecosystems because of the potential negative consequences of homogeneous fire applications."[114] Instead, researchers advise "decision makers can achieve desirable outcomes for animal conservation in fire-prone ecosystems by recognizing the importance of context; differentiating among hypotheses; focusing on functional heterogeneity; and applying decision frameworks that consider uncertainty."[95] Woinarski and Legge further caution that a lack of "accountability associated with getting it wrong" has led to poor outcomes, and echo the need for "clear objectives and measurable outcomes."[67] For example, "[f]ire planning must consider the combined effects of prescribed and unplanned fires. Most fire-management plans implicitly assume that unplanned fires will not occur. This myopia underestimates the extent of unplanned burning and has negative consequences for animal conservation."[95] If these recommendations are not headed on the CONF, costs and emotional decisions may drive fire management at the expense of biological conservation.[67]

You can find the entire article with extensive source articles and references at: gafw.org/fire-position/

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