Prescribed Fire and Wildlife

- In upland hardwood forests, fire effects on wildlife are most closely associated with changes to habitats and microhabitats. Low-intensity burns generally do not kill trees in the short term (although delayed mortality can occur), and shrub or leaf litter recovery is generally rapid. In contrast, hot fires that kill numerous trees effect snag density, light levels, leaf litter, and microclimates that can affect wildlife.
- Direct mortality of individual animals is thought to be relatively rare, but may depend on the species' behavior, fire behavior, and season of burn.
- Prescribed fire may be beneficial to bats in the long term by promoting higher insect abundance and reducing forest 'clutter,' facilitating bat foraging. Bat roosting habitat can also be improved by prescribed fire, perhaps due to increased sunlight on roost trees.
- Both low- or high-severity burns appear to have negligible effect on terrestrial salamander abundance. In contrast, high-severity burns that kill numerous trees may benefit lizards that use these warmer, lighter environments for thermoregulation, foraging, and egg-laying.
- More research is needed to determine effects of repeated burning and growing season burns on amphibians, and how site factors such as moisture and site quality can mediate prescribed fire effects.
- Low-severity, dormant-season burning has few detectable effects on breeding birds.
- High-severity burning with heavy tree-kill results in more birds and bird species. In general, many forest and generalist species are not affected, whereas species associated with open habitats, such as indigo buntings and eastern bluebirds, increase in number.

References: Greenberg and Loeb (In press), Greenberg and others (2013), and Moorman and others (2011).

All photos by USDA Forest Service
USDA is an equal opportunity provider and employer.

References

Arthur, M.A.; Alexander, H.D.; Dey, D.C. [and others]. 2012. Refining the fire-oak hypothesis for management of oak-dominated forests of the Eastern United States. Journal of Forestry. 110: 257-266.

Barrioz, S.; Keyser, P.; Buckley, D. [and others]. 2013. Vegetation and avian response to oak savanna restoration in the mid-south USA. The American Midland Naturalist. 169:194-213.

Brose, P.H. 2013. Post-harvest prescribed burning of oak stands: an alternative to the shelterwood-burn technique? In: Miller, G.W.; Schuler, T.M.; Gottschalk, K.W. [and others], eds. Proceedings of the 18th Central Hardwoods Forest Conference. Gen. Tech. Rep. NRS-P-117. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 352-364.

Brose, P.H.; van Lear, D.H.; Keyser, P.D. 1999. A shelterwood-burn technique for regenerating productive upland oak sites in the Piedmont region. Southern Journal of Applied Forestry. 16: 158-163.

Elliott, K.J.; Hendrick, R.L.; Major, A.E. [and others]. 1999. Vegetation dynamics after a prescribed fire in the southern Appalachians. Forest Ecology and Management. 114:199-213.

Greenberg, C.H.; Waldrop, T.A.; Tomcho, J. [and others]. 2013. Bird response to fire severity and repeated burning in upland hardwood forest. Forest Ecology and Management. 304:80-88.

Greenberg, C.H.; Loeb, S. [In press]. What are the effects of fire on nongame species in the southern Appalachians? In: Rankin, W.T.; Herbert, N., eds. Restoration in the southern Appalachians: a dialogue among scientists, planners, and land managers. Gen. Tech. Rep. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station.

Greenberg, C.H.; Keyser, T.L.; Zarnoch, S.J. [and others]. 2012. Acorn viability following prescribed fire in upland hardwood forests. Forest Ecology and Management. 275: 79-86.

Guyette, R.P.; Stambaugh, M.C.; Stevenson, A.; Muzika, R. 2008. Prescribed fire effects on the wood quality of oak (*Quercus* species) and shortleaf pine (*Pinus echinata*). Final report to the Missouri Department of Conservation. 115 pp.

Loftis, D.L. 1990. A shelterwood method for regenerating red oak in the southern Appalachians. Forest Science. 36: 917-929.

Marschall, J.M. 2013. Timber product value loss due to prescribed fire caused injuries in red oak trees. M.S. Thesis, University of Missouri-Columbia. 60 p.

Moorman, C.E.; Russell, K.R.; Greenberg, C.H. 2011. Reptile and amphibian response to hardwood forest management and early successional habitats. In: Greenberg, C.H.; Collins, B.; Thompson, F.R., III, eds. Sustaining Young Forest Communities: Ecology and Management of Early Successional Habitats in the Central Hardwood Region, USA. Managing Forest Ecosystems, 2011, Vol. 21: 191-208.

Spetich, M.A.; Perry, R.W.; Harper, C.A.; Clark, S.L. 2011. Fire in eastern hardwood forests through 14,000 years. In: Greenberg, C.H.; Collins, B.; Thompson, F.R., III, eds. Sustaining Young Forest Communities: Ecology and Management of Early Successional Habitats in the Central Hardwood Region, USA. Managing Forest Ecosystems, 2011, Vol. 21: 41-58.

Stevenson, A.P.; Muzika, R.; Guyette, R.P. 2008. Fire scars and tree vigor following prescribed fires in Missouri Ozark upland forests. In: Jacobs, D.F.; Michler, C.H., eds. Proceedings, 16th central hardwood forest conference. Gen. Tech. Rep. NRS-P-24. Newtown Square, PA: U.S. Department of Agriculture Forest Service, Northern Research Station. 525-534.

Stottlemyer, A.D.; Shelburne, V.B.; Waldrop, T.A. [and others]. 2006. Preliminary fuel characterization of the Chauga Ridges region of the southern Appalachian Mountains. In: Connor, K.F., ed. 2006. Proceedings of the 13th biennial southern silvicultural research conference. Gen. Tech. Rep. SRS-92. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 510-513.

Van Lear, D.H.; Waldrop, T.A. 1989. History, uses, and effects of fire in the Appalachians. Gen. Tech. Rep. SE-54. Asheville, NC: U.S. Department of Agriculture Forest Service, Southeastern Forest Experiment Station. 20 p.

Waldrop, T.A.; Brudnak, L.; Rideout-Hanzak, S. 2007. Fuels of disturbed and undisturbed sites in the southern Appalachian Mountains, USA. Canadian Journal of Forest Research. 37: 1134-1141.

Waldrop, T.; Phillips, R.A.; Simon. D.A. 2010. Fuels and predicted fire behavior in the southern Appalachian Mountains after fire and fire surrogate treatments. Forest Science. 56: 32-45.

Waldrop, T.A.; Yaussy, D.A.; Phillips, R.J. [and others]. 2008. Fuel reduction treatments affect stand structure of hardwood forests in Western North Carolina and Southern Ohio, USA. Forest Ecology and Management. 255: 3117-3129.

Wang, G.G.; Van Lear, D.H.; Bauerle, W.L. 2005. Effects of prescribed fires on first-year establishment of white oak (*Quercus alba* L.) seedlings in the Upper Piedmont of South Carolina, USA. Forest Ecology and Management. 213(1-3): 328-337.

Yaussy, D.A.; Waldrop, T.A. 2010. Delayed mortality of eastern hardwoods after prescribed fire. In: Stanturf, J.A., ed. Proceedings of the 14th biennial southern silvicultural research conference. Gen. Tech. Rep. SRS-121. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station: 609-612.

PAMPHLET PREPARED BY: **Tara L. Keyser, Cathryn H. Greenberg, and Henry McNab**

SPRING 2014

USDA
United States Department of Agriculture

Prescribed FIRE in Upland Hardwood Forests

Forest Service
Research & Development
Southern Research Station
Science Update-99

Upland Hardwood Ecology and Management
Bent Creek Experimental Forest
1577 Brevard Road Asheville, NC 28806
(828) 667-5261
www.srs.fs.usda.gov/uplandhardwood

In upland hardwood forests of the Southeastern U.S., prescribed fire is increasingly used by land managers citing objectives that include hazardous fuels reduction, wildlife habitat improvement, promoting oak regeneration, or restoring forest composition or structure to an historic condition. Research suggests that prescribed fire effects on hardwood forests and associated wildlife vary depending on numerous factors, including heat and duration, forest type, patchiness of fuel, past burning, topography, weather, and season. The appropriate use of prescribed fire as a silvicultural treatment in upland hardwood forests depends on the landowners' goals and objectives, and skill in its application.

Prescribed Fire and Fuel Loadings

- Prescribed fire can temporarily reduce accumulated forest fuels that could otherwise increase the risk and intensity of wildfire.
- Fuel levels recover to preburn levels rapidly (< 3 years) due to aboveground mortality and sprouting of shrubs and small trees, and leaf-fall in autumn.
- High-severity prescribed burns may further increase fuel loadings due to overstory tree mortality.
- Repeated prescribed burning—perhaps every 2-3 years—may be required to maintain lower fuel loadings and reduce wildfire risk.
- Loadings of dead coarse and fine fuels in undisturbed forest stands are generally similar across all topographic positions, but coarse fuel loadings may be higher in stands recently disturbed by wind or harvest.
- Dense ericaceous shrubs, such as mountain laurel, function as additional fuels.
- Crown fires generally are not a threat in upland hardwood forests.
- Prescribed fire may be difficult to implement uniformly on mountainous landscapes where complex topography can result in heterogeneous fire behavior and patchy fuels and fuel loads.

References: Stottlemyer and others (2006), Van Lear and Waldrop (1989), and Waldrop and others (2007, 2010).

Prescribed Fire and Hardwood Timber Quality

- Prescribed fire can result in loss of sawlog and pulpwood volume through immediate and delayed tree mortality. Volume loss will vary with fire intensity and duration, and tree size and species.
- Fire scars to the tree bole and can be entry points for decay agents.
- Volume loss due to fire-caused defects may also reduce value. Value loss depends on location, markets, and the targeted product.
- Value loss is generally negligible in trees with fire scars below 20 inches and covering less than 20% of the bole circumference, or if trees are harvested within 5 years of fire damage.
- Burning should be avoided while merchantable tree species are pole-sized if high-quality hardwood sawtimber production is an objective, as this size class appears most susceptible to future product value loss.

References: Guyette and others (2008), Marschall (2013), Stevenson and others (2008), and Yaussy and Waldrop (2010).

Prescribed Fire and Ecosystem Restoration

- Historically, fire-maintained ecosystems such as oak savannas and shortleaf pine forests occurred locally, likely created and maintained by Native Americans, and later by European settlers.
- In the Appalachian Mountains, Table Mountain pine forests occurred naturally on dry slopes and ridgetops where wildfire was frequent and of low intensity.
- Overstory reduction and prescribed fire may increase light and promote a grass-forb understory for oak savannas. Prescribed fire can also create suitable seedbed conditions for shortleaf pine germination, or promote seedfall and germination for the serotinous Table Mountain pine.
- Preliminary research suggests that growing-season burns and repeated burning may help to reduce sprouting of woody stems.
- Results of oak savanna restoration studies are preliminary, and are being conducted on low-quality sites dominated by scarlet, black, southern red, and white oak and shortleaf and Virginia pine.

References: Barrioz and others (2013), Elliott and others (1999), Spetich and others (2011), and Waldop and others (2008).

Prescribed Fire and Oak Regeneration

- Oak regeneration is problematic on high-quality sites, where competition from faster-growing species (such as yellow-poplar) is fierce after overstory removal. It is generally not a problem on dry, low-quality sites where competition is lower.
- Prescribed fire may influence oak regeneration by: (1) promoting acorn germination and seedling establishment; (2) increasing light levels at the forest floor by top-killing shrubs and small trees, thereby promoting the growth of oak seedlings; and (3) controlling competition from other tree species in the years prior to or following a regeneration harvest.
- Fall burns may kill acorns on the leaf litter surface, potentially affecting oak regeneration for many years.
- Frequent burning that compromises litter or duff depth could limit the availability of 'safe sites' where acorns are insulated from high fire temperatures.
- Prescribed fire or other pre-harvest methods to promote oak regeneration will not result in oak recruitment to the forest canopy unless the overstory is removed or substantially reduced after oak regeneration becomes large (about 4 feet in height).
- Using prescribed fire following shelterwood regeneration harvests has proven effective at regenerating oak stands on moderate quality sites, but remains untested in moist, productive stands.
- Using prescribed fire to promote oak regeneration through competition control is not always successful and often depends on fire severity, fire behavior, site quality, and species composition. In general, multiple fires will be required to promote oak species and change species composition on productive sites.
- In some situations prescribed fire may reduce the survival of newly established oak seedlings.
- Alternative competition control methods, including targeted herbicide application, may be a more appropriate method to control competition and promote oak regeneration.
- Landowner objectives, weather conditions, air quality standards, local burn policies, cost, liability issues, and availability of qualified fire management personnel all influence when and how a burn is conducted, and thereby, influence oak regeneration success.

References: Arthur and others (2012), Brose (2013), Brose and others (1999), Greenberg and others (2012), Loftis (1990), and Wang and others (2005).