Managing Southern Grazing Ecosystems with Fire

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The use of fire to manage the movement of animals undoubtedly predates their domestication. Stewart (1965) has traced the recorded use of fire as a range management tool back to 500 BC in Africa. Across the Atlantic in the Southeastern United States, fire also has a long and varied history. Here, the vast, open longleaf pine forests had long been in dynamic equilibrium with their environment, shaped first by lightning fires and then additionally by Indian fires. Numerous early European explorers documented the Indians' widespread use of fire for such purposes as the stimulation of early-season grass growth to attract game.

Spaniards brought the first cows to Florida in the early 1500's and before long, cattle were found throughout the Deep South. Early settlers in this region were predominantly farmers and herdsmen. Their wealth was measured by their herds and not by land ownership. The southern Coastal Plain was open range—cattle were fenced out, not in. Fire was the primary range management tool and the settlers used it much as they had on their fathers' farms in Great Britain and Spain. These frequent low-intensity fires stimulated a lush growth of grass which was higher in nutrients and more palatable than the coarse grasses of the unburned range (Fig. 1). In fact, ca. 1731 a North Carolina law required the burning of all pastures and rangelands every March (Hardison 1976). Without fire every few years, the grazing resource under the parklike forests of fire-resistant longleaf pine deteriorated.

This somewhat idyllic way of life came to an abrupt end as our country changed from an agricultural to an industrial base and timber became a valuable commodity. Large-scale turpentining and logging of the southern pinery began the decade before the turn of this century and within 30 years the virgin longleaf pine forests were gone. Without the competing overstory, the range resource became even more productive as long as it was frequently burned, which allowed a corresponding increase in livestock numbers.

By the mid-1920's, large cutover tracts were already in the hands of farsighted absentee landowners who wanted to reforest them. Several fire-free years were required to establish a well-stocked stand and fencing was desirable to keep feral hogs from rooting up the seedlings for their tender roots. Some owners attempted complete fire exclusion to maximize timber productivity. These actions were seen by the rural southerner as threats to his very survival! He was not interested in someone else's future profits—he needed the continued use of this land as open range for his livestock. A bitter and often violent struggle ensued but eventually the South's second forest took hold. Fence laws were passed in most states and the ubiquitous practice of burning adjacent land holdings was outlawed. Dense forests of faster growing loblolly pine and slash pine replaced the former open long-

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Fig. 1. *Southern piney woods kept brush-free and relatively open by frequent burning provide ample forage for cattle and wildlife.*

Fig. 2. *Low intensity backfires are used to improve cattle forage, wildlife habitat and timber yields. Regular burning can eliminate fuels that contribute to devastating wildfires.*

leaf stands.

Where do these dramatic changes in the southern grazing scene leave today's range manager? Perhaps not as bad off as one might first envision. Early cattle "management" was little more than survival of the fittest, and only the toughest survived. Hot humid summers, winters with little nutritious forage, and occasional severe drought were particularly hard on calves. Over the years, improved cattle breeds, supplemental feed, improved pastures, and a more scientific approach to cattle management had a very positive impact on cattle production.

Eventually, most forest landowners found complete fire exclusion was neither cost effective nor desirable since the potential fire damage from accumulating fuels increased as the fire-free interval increased. The resistance to the planned use of fire remained strong, especially among State and Federal agencies. Research results were emerging, however, that demonstrated the benefits of intentional fire—now called prescribed burning. Many of the purported damaging effects ascribed to the use of low-intensity prescribed fire were found to be overstated or just not true (Fig. 2). This is not to say prescribed fire is a panacea, but the benefits from the judicious use of fire far outweigh the disadvantages. And just as today's forests are often managed for multiple uses, prescribed fire can often satisfy multiple objectives. In fact, fire can simultaneously enhance range, wildlife, and timber management objectives to the extent that the net economic return from multiple use will be greater than if managed exclusively for a single resource.

Forage Types

The major range ecosystems of the South have been classified according to the forest overstory and/or available forage resource (Fig. 3). Salt-water and fresh-water marsh

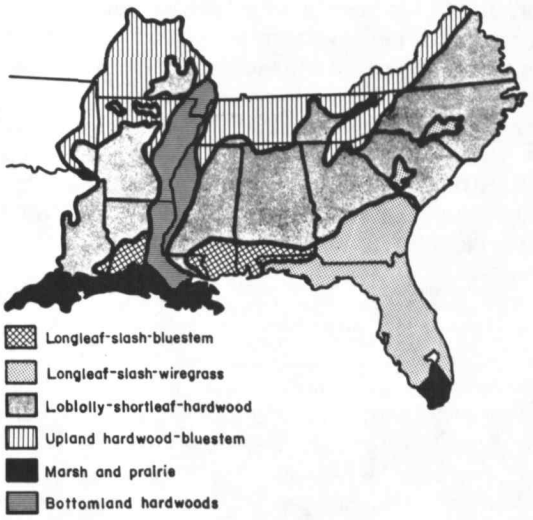

Fig. 3. *Major range types in the southern United States.*

ranges are the most productive per unit area. Since a primary benefit from burning is increased solar energy that reaches the forage-producing stratum, the greatest response to fire occurs in these marsh ranges where the most light-intercepting vegetation accumulates. Salt-water marshes are, however, difficult to effectively graze.

The longleaf-slash pine-bluestem range is also an excellent producer of high-quality forage. The longleaf-slash pine-wiregrass range produces slightly less forage of somewhat lower quality. Although overstory crown canopy can vary from 0–100 percent in any timber type, natural stands of longleaf-slash pine are comparatively open, often because of past management practices. However, central and south Florida are the only locations where extensive sparse stands can still be found. Timber production is the primary objective throughout the remainder of the longleaf-slash pine belt with plantations being the norm. In these stands, grazing is generally limited to the first 8 to 12 years, after which time the tree canopies close and the herbaceous species are shaded

out. Later thinnings may permit a grazable forage resource to again develop.

The loblolly-shortleaf pine-hardwood range (sometimes called the loblolly-shortleaf pine-bluestem range) is the most extensive type in the South. In natural stands, pine overstory and midstory hardwoods are often so dense that little understory vegetation is present and few opportunities exist to increase forage production. If larger hardwoods are not present, however, periodic fire can hold the smaller hardwoods in check and result in moderately abundant forage, especially when used in conjunction with thinning. In plantations, hardwood competition is usually temporarily set back before planting so these stands provide fair grazing until the hardwood sprouts shade out the herbaceous species after 3 to 5 years.

The upland hardwood-bluestem range provides little forage except in open glades because of the usually dense hardwood canopy. Fire is rarely compatible with timber management objectives in these stands because most hardwoods are susceptible to bole damage from even low-intensity fires.

The bottom-land hardwood type that occurs along major river drainages is not considered to be grazable. Prescribed fire has no place in the management of these hardwoods either. Detailed descriptions and primary species in these range types can be found in Lewis et al. (1974).

Plant Growth

Annual forage yields can reach 8,000 pounds per acre (ovendry) in salt- or fresh-water marshes, 3,000 pounds in open longleaf-slash pineland, or practically zero under densely planted pine stands. The effect of fire on promoting and maintaining high forage yields is virtually always positive but differs by range type, plant species, and various fire-related characteristics such as timing and behavior. Accumulations of inedible grass, dead thatch, and pine litter that physically obstruct plant growth can be removed by fire. Burning can also stimulate new growth and seed production of desired forage species and change species composition, while controlling the hardwood and shrub component. Fires need to be repeated every 2 to 4 years or forage production will return to preburn levels. The season of burn can also have a profound effect. After 20 years of various burning treatments, Lewis and Harshbarger (1976) found annual winter fires in loblolly-shortleaf-bluestem range yielded 23 times more forage than unburned control plots (Fig. 4). Since herbage weights were not sampled before the summer burns (about July 1) and the current-year's growth was consumed by the fires, total yields as estimated from October clipping were much higher than indicated.

Summer burns are probably best from a range management perspective but, since most southern pine ecosystems are also managed for timber and wildlife production, the effects of fire on these resources also have to be considered. For example, burning favors legumes which are a major source of seed for several wildlife species including the northern bobwhite; annual or 2-year burning rotations are generally used, with the burns completed before the spring nesting season. Fire improves hunting conditions and hunter success, particularly in respect to quail, by knocking back the understory shrubs and hardwoods to facilitate travel and provide for a clear shot. Prescribed burning increases the

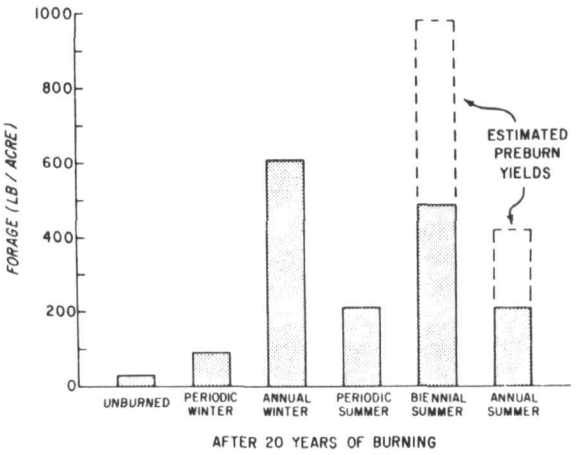

Fig. 4. *Annual yields of forage as influenced by 20 years of seasonal and cyclic burning in South Carolina (adapted from Lewis and Harshbarger 1976).*

density and biomass of arthropods, a major food item in the diet of baby quail, and is thus important in determining chick survival.

Under some situations fire increases the growth of timber trees (Johansen 1975; Villarrubia & Chambers 1978)—perhaps by reducing the competition for water and nutrients and by recycling nutrients locked up in the vegetation. Grelen (1983) found that May burns accelerated longleaf pine height growth, but this is a two-edged sword because faster height-growth means quicker crown closure and thus less sunlight reaching the forage layer. Fortunately longleaf pine maintains a more open crown than other southern pines and thus allows more sunlight penetration. Although summer fires are very effective in controlling understory shrubs and hardwoods, fires under high ambient air temperatures are also more likely to damage overstory pine crowns. Prescribed fires also keep dead fuels from accumulating, thereby reducing the damage from chance wildfires during more critical burning conditions. A combination of grazing and prescribed burning in young southern pine plantations is an excellent method of reducing the wildfire hazard during vulnerable periods when the tree crowns are still part of, or just above, the understory.

Forage Value

Forage quality on southern pine ranges is a major concern because plants growing on the infertile soils characteristic of these forest types are generally deficient in both energy and nutrients required for good animal growth, especially for breeding herds (Campbell et al. 1954, Hilmon and Lewis 1962). Also, many forage plants, especially wiregrass, are low in digestibility. As plants age, their lignin content increases, which depresses digestibility. Burning is widely used to improve the nutrient content and palatability of herbage; but these benefits are short lived, disappearing within a year or so.

Cattle seem to detect the more nutritious plants and thereby maintain a fairly adequate diet by selective grazing. The availability of succulent new growth appears to be the primary factor determining when a particular plant is grazed. Since green forage can develop soon after burning, well-timed fires can be used to provide quality forage during

seasons when there would otherwise be none. Furthermore, nutrients are higher in plants previously grazed than in ungrazed plants, and cattle prefer such regrowth to older herbage.

Because cattle tend to concentrate grazing on fresh burns and on areas recently site prepared and planted to pines, they can overgraze them and do considerable damage if not closely monitored. However, nearby sites can be burned to attract animals away from sensitive areas thereby preventing excess injury and achieving better distribution of livestock over the range. Heavy grazing in young pine plantations can also result in severe tree damage, but injury must be quite severe to greatly affect pine survival and growth (Hughes 1976, Lewis 1980). However, if cattle numbers are kept in balance with forage yields, young pines and cattle are compatible (Pearson et al. 1971).

Cattle Responses

The combined benefit from burning to increase forage quantity, quality, and availability is reflected in cattle weight gains. Halls et al. (1952) found that cattle gains on low-quality pine-wire grass range in Georgia were consistently better on burned range regardless of whether it was all burned annually or if portions were burned every 2 or 3 years (Fig. 5). Kirk et al. (1974) reported similar gains on burned

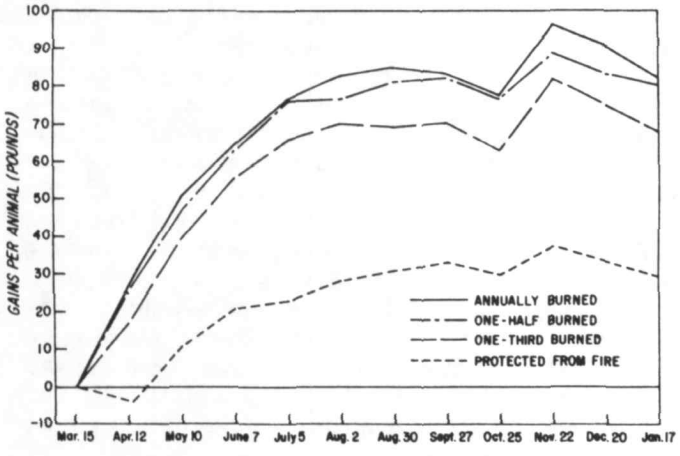

Fig. 5. *Average cumulative seasonal gains over 7 years under different burning programs in south Georgia (from Halls et al. 1952).*

versus unburned native Florida range. On longleaf-slash pine-bluestem range, Wahlenberg (1937) reported that over a period of 11 years, cattle that grazed annually burned range gained almost two-thirds more per season than those on unburned range.

As one might expect, herbage utilization is greatest the first growing season following burning. Utilization then decreases to less than 20 percent after 3 years on longleaf pine-bluestem ranges (Duvall and Whitaker 1964).

A 3-year burning cycle is common on pine-bluestem range, but pine-wiregrass range is burned on 1-, 2-, or 3-year cycles depending on whether the primary interest is quail, cattle, or deer and turkey management. A 2- to 4-year burning cycle is near optimum for timber management needs, such as hazard reduction and control of understory hardwoods; therefore, burning for other resource needs will enhance timber management.

Because integrated resource management is possible does not guarantee that it is financially attractive. Managing for a single resource is easier than trying to mix management objectives and techniques for multiple-use management. Each of the resources must be carefully managed to derive a combined net benefit. Because of the myriad possibilities, economic evaluations are difficult, yet they must be made. Several analyses utilizing combinations of native range, pastures, and timber alternatives have been undertaken (Anderson and Hipp 1974, Lundgren et al. 1983, Haney 1980). All showed positive results under some combinations especially when the forage resource was primarily range. Wildlife benefits have yet to be incorporated into such an analysis; but the results should be favorable, especially in light of the high prices people currently pay for hunting rights on well-managed forest land.

Conclusions

Managing wildland for the simultaneous production of cattle, wildlife, and timber requires a knowledge of the complex interactions involved. Serious conflicts can arise. However, opportunities are there, and the goals of foresters, ranchers, and wildlife biologists can be woven together through the judicious use of prescribed fire to produce increased returns for all three.

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Plant Succession on Prescribed Burn Sites in Chamise Chaparral

Melanie Florence

California chaparral species evolved under a regime of natural (lightning) fire occurring during the hot, dry summer months. As a result, chaparral vegetation is dependent upon fire occurring optimally every 30 to 60 years to rejuvenate itself (Biswell 1979). With wildfire suppression during the twentieth century, this natural fire cycle has been interrupted in many chaparral areas. Large acreages of chaparral now exist with a continuous cover of decadent brush containing large amounts of dead material. A wildfire in one of these areas could burn with high intensity over thousands of acres causing severe environmental damage and site degradation. Prescribed burning is a method which can be used to break up continuous brushfields and reduce unnaturally high accumulations of fuel, to improve wildlife habitat and to improve rangelands.

Prescribed burning is one of the most cost effective and ecologically acceptable solutions to managing California chaparral (Biswell 1980, Koenigs 1980). Its use is becoming more widespread each year with burns during the cool months of the year. Since chaparral species have naturally burned during the hot, dry months, many people have expressed apprehensions about cool-season prescribed burning and its effect on native species.

The response of herbaceous species after cool season fires was studied on several prescribed burn sites at Pinnacles National Monument in the central California coast range. Three chamise chaparral sites on south-facing slopes were burned using a driptorch in 1981 during the winter (February 19, 1981), early spring (April 28, 1981) and late spring (June 2, 1981). The sites were studied for two consecutive spring seasons to compare species composition and successional trends. Also, data obtained from a nearby July, 1978, wildfire site adjacent to the Monument on Bureau of

Location of Pinnacles National Monument.