

The Historical Foundations of Prescribed Burning for Wildlife: a Southeastern Perspective

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Abstract.—Controlled burning has deep historical roots in the South, where the practice was quickly adopted from the Indians by early European settlers. It became used widely, primarily to improve forage conditions for free-ranging cattle and to improve visibility and access. Likewise, hunting is deeply imbedded in southern culture and was an attraction to visitors throughout the 19th Century. This was especially true of quail (*Colinus virginianus*) hunting, and after the Civil War wealthy northerners began to buy large plantations for hunting retreats. In the 1920's Herbert L. Stoddard documented the necessity of prescribed burning to maintain bobwhite quail habitat on these plantations. Opposition to the practice among foresters and public agencies was fierce, and Stoddard became an outspoken advocate of light winter burning in longleaf pine (*Pinus palustris*) and, later, certain other forest types. Use of prescribed fire in forestry and game management was gradually accepted. But, although some naturalists such as Stoddard were interested in the effects of fire on native flora and nongame wildlife, private landowners and public agencies generally showed little interest in managing specifically for non-game wildlife until the 1970's. By then, there was in the southern states a background of 50 years of research and many more years of practical experience in the use of fire that could be applied to this new goal. Soon, any biologists and managers recognized that prescribed burning would play a nearly essential role in managing certain nongame species. And, as new management goals evolved, fire regimes other than light winter burning also came under scrutiny for potential use in restoration and maintenance of certain natural communities

Introduction

Woods burning has a long unbroken history in parts of the South, and much of the early scientific work on prescribed burning was done there. In the keynote address to attendees of a prescribed burning symposium, E. M. Bacon (1971) of the U.S. Forest Service said "Prescribed burning seemingly had its origin in the South, it has certainly been an accepted management tool for a longer period of time in this region than anywhere else in the country." In his book "Fire in America," Pyne (1982) noted that when the need for prescribed burning became evident, the skills were in the hands of local woods burners, "a resource that had to be managed." He concluded that "Its

peculiar fire heritage helped the South to train the rest of the nation in the art of prescribed burning."

There is too much literature on the subject to review in detail. The history of the controversy surrounding controlled burning and the forestry profession has been dealt with in detail by others. There are at least two important books dealing with the subject (Pyne 1982; Schiff 1962). Our objective is to provide a historical overview of the southern roots of prescribed burning in forestry and, especially, wildlife management. We will mostly limit our discussion to the application of prescribed burning in management and will not review research on habitat and wildlife responses to fire. The term prescribed burning originated among foresters and came into use in the 1940's. The term controlled burning was used by the local people and, until recently, by wildlife managers. Although the two terms have somewhat different definitions, we will use them interchangeably, as appropriate in the context of the discussion.

Prehistoric Fires

Fire is more common and more important in the environment of the South than in most other areas of the United States (Christensen 1978). This is especially true in the Coastal Plain, but even in the Appalachians fire has been frequent enough to cause the development of fire-dependent species and influence the composition of forests over large areas (Van Lear and Waldrop 1989). The frequency, seasonality and intensity of its occurrence are determined in part by local climate, topography, soils, and vegetation. Plants adapted to specific sets of conditions are sorted into communities that may have characteristics that facilitate or deter fire, or influence the type of fire regime. Periodic fire is especially an important part of the environment of all the southern (yellow) pines (*Pinus* spp.) except spruce pine (*P. glabra*), which typically grows in mixed stands with hardwoods. Landers (1991) stated "the pine genus has long been recognized as having special traits adaptive to fire and fire-prone sites," and he provided a detailed analysis of these traits and their relationship to fire periodicity and intensity for each of nine southern pine species. Today, nearly half of the total forest area in the southern states and nearly two-thirds of that in the Coastal Plain and Piedmont is occupied by pine or pine-hardwood types, (estimated from data in Rudis 1998).

But pine forests are not the only fire-adapted communities. Other community types that are dependent upon periodic fires for their regeneration or

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maintenance include shrub bogs, Atlantic white-cedar (*Chamaecyparis thyoides*) swamp forests, bay forests, cypress (*Taxodium ascendens*) domes, and grass-sedge bogs in the Coastal Plain (Christensen 1978, 1988; Garren 1943; Komarek 1974), heath thickets and grassy meadows at high elevations in the Southern Appalachians (Christensen 1978; Garren 1943), and canebrakes along stream bottoms in all provinces (Hughes 1966; Komarek 1974; Platt and Brantley 1997).

Lightning is assumed to have been the primary agent that caused fires in North America before humans became a major factor (Komarek 1964, 1966; Pyne 1982). Until recent centuries there were few natural barriers to the spread of such fires after ignition, and fires probably swept unimpeded over vast areas. However, some (e.g., Stewart 1956) have questioned whether lightning played the primary role in shaping pine forests in much of the South. They have noted that lightning in the South is usually accompanied by rain, and lightning-caused fires in the region today are usually spotty and small in size compared to man-caused fires (Barden and Woods 1976).

Anthropologists and geographers tend to emphasize man as the main source of prehistoric fire (Denevan 1992; Stewart 1956). Paleoecological studies (Delcourt and Delcourt 1985; Delcourt et al. 1993; Whitehead and Sheehan 1985) indicate there was a rapid expansion of southern pine forests 3,000-6,000 years ago. This occurred concurrently with the expansion of American Indian populations and may have been at least partly due to their actions. But, it is impossible to sort out the effects of climatic changes that were occurring during that time. Many writers have documented deliberate use of broadcast burning by the Indians (DeVivo 1990; Hammett 1992; Maxwell 1910; Robbins and Myers 1992; Rostlund 1957; Silver 1990; Stewart 1956; Van Lear and Waldrop 1989). Spanish explorers and, later, other travelers consistently described an open landscape and gave eyewitness accounts of Indians using fire in clearing land for agriculture, driving game, and other purposes. Rostlund (1957) reviewed many of the early narratives and concluded that Indians were burning the landscape and creating savannas and prairies at an accelerating rate until European contact in the 16th Century. Increasing amounts of charcoal in deposits laid down over the last 1,000 years (Delcourt and Delcourt 1985, 1997) support Rostlund's conclusion.

After contact with Europeans, Indian populations were severely decimated by disease and other factors—possibly being reduced by as much as 90 percent (Lovell 1992). The prairies and savannas returned to forest, and the extensive pine forests described by so many travelers in the 18th and 19th centuries (Johnson 1987) probably developed after the influence of the Indians was greatly diminished, or removed entirely. Regardless of the relative importance of man versus lightning as a pyrogenic agent shaping vegetation, it is evident that for

several thousand years, fires set by Indians were significantly affecting the landscape (Delcourt and Delcourt 1997).

The Tradition of Woods Burning in the South

As European settlers moved in, fire was used to clear land for farms and communities; and, nearly everywhere on the frontier, fire was used carelessly at first. But, controlled burning did not become a common practice in the Northeast. Much of the region was mesic hardwood forest (Kingsley 1985), not a fire type, and there were fire control laws in all of the Northeast by the time of the Revolution (Pyne 1982). Commercial logging in the region began early, and timber interests encouraged fire suppression (Pyne 1982). Also, the Northeast was settled mainly by people from the southeastern lowlands of England (Fischer 1989), and, later, from parts of continental Europe where forests were predominantly fire-sensitive hardwoods or spruce (*Picea* spp.). Immigrants from these areas had little experience with controlled burning (Pyne 1982). They came from some of the most heavily urbanized areas of the time; few of them had lived on farms (Fischer 1989), and most that had lived on farms came from areas where row crops and fenced pastures were the dominant pattern of agriculture (Fischer 1989; McWhiney 1988; Pyne 1982). They developed agricultural patterns in America similar to those with which they were familiar (Fischer 1989).

But, in the South, woods burning was a widespread practice from the outset, especially in the Coastal Plain. As previously shown, much of the region supported fire type forests. Settlement was primarily by immigrants from the uplands of rural western England, and later from Scotland and Ireland (McWhiney 1988, Fischer 1989), where open range herding was customary (McDonald and McWhiney 1975; McWhiney 1988; McWhiney and McDonald 1985). Many of the settlers probably were already familiar with the practice of controlled burning to improve grazing conditions. The forests in the highlands of England, Scotland and Ireland had been converted to heathlands by centuries of burning for grazing by cattle and, later, sheep and red grouse (Gimingham 1970; Kayll 1966). In much of the South people called "crackers" (sometimes disparagingly) practiced a frontier lifestyle centering around free-ranging livestock (cattle and hogs), patch farming, dipping turpentine, and hunting and fishing (McWhiney 1988; Owsley 1949). Pyne (1982) noted that "for many of the Scotch-Irish immigrants who settled the regions, the socio-economic environment was not unlike that of Scotland, which had helped to perpetuate a herding and hunting economy that routinely used broadcast fire." McWhiney and McDonald (1985) observed "The custom of range burning. . . seems to have been another adaptation in

America of a Celtic tradition—one that meshed with an American Indian practice.” McWhiney (1988) stated that open range herding of livestock was “a continuation in the Old South of traditions practiced for centuries by Celtic peoples.” In Florida and the Southwest, there was a similar Spanish influence.

As settlement continued, the better lands, especially in the Upper Coastal Plain, Piedmont and Valley provinces, were increasingly occupied by descendants of English Cavaliers who had moved inland from coastal Virginia and the Carolinas. They were mainly farmers and planters, who cleared the forests, cultivated the land and developed permanent lifestyles (Owsley 1949). Here, the plantation culture was best developed and, because most of the land was cleared for row crops and improved pasture, in many places the tradition of burning the woods was broken. Those who were feeling crowded and unwilling to change their ways and become farmers, moved to less productive lands (Owsley 1949) or on to the West (Jordan 1981). They were able to pursue their traditional ways in the extensive pinewoods of the Coastal Plain, the Southern Appalachians, and scattered areas throughout (Owsley 1949). In these areas woodlands were treated as a commons for hunting and grazing.

Popular interest in the Old South has focused mainly on the large cotton and rice plantations, while, until recently, the other livestock producers have gone unrecognized except by professional historians. Unlike the plantation owners, small farmers and others who lived off the land left little in the way of written records. McWhiney (1988) cited data showing that for 15 years before the Civil War the average number of livestock driven to market from the South each year was many times the annual numbers in the famous Texas cattle drives during their heyday for 15 years after the war. Just before the Civil War, the cash value of southern livestock equaled the cash value of cotton and all other crops combined (McWhiney 1988). Much (but not all) of the livestock was produced on open range. Fencing of one’s property was illegal in some southern states until the middle 1800’s (McDonald and McWhiney 1975); and, in most states of the Deep South, unrestricted ranging of livestock was allowed under local option laws until after World War II. It was up to the landowner to fence livestock out, and motorists were liable for damages in accidents involving livestock on roads and highways.

Many of the herdsman tended large herds of cattle and hogs but owned little or no land. Some were cowboys hired by absentee livestock owners. In the pinewoods large herds were tended from horseback, and controlled burning opened up the landscape, allowing better access and visibility. Other reasons for burning included reducing the hazard of wild fire to turpentine woods, reducing the risk of rattlesnake (*Crotalus* spp.) bite, and

controlling ticks. Often no attempt was made to confine fires within property boundaries, nor was there a desire on the part of most landowners to exclude fire from their property. Controlled burning was often a community affair.

Fire also was used as a tool in hunting, however, did not find any references documenting prescribed burning specifically to improve game habitat. Nonetheless, hunting was an integral part of Southern culture among all social and economic classes (Elliott 1846; Gohdes 1967; Marks 1991; Opper and Meisel 1987). Skilled hunters would have known which habitat conditions provided best hunting success and what practices resulted in those conditions. And they almost certainly would have used these practices to increase hunting success—especially on the plantations, where sportsmen from the northern states and Europe were entertained throughout the nineteenth century.

The Quail Plantations and Controlled Burning

Hunting in the South, especially for bobwhite quail (*Colinus virginianus*) hunting, became increasingly attractive to northern visitors after the Civil War. As land became available during the economically difficult times following the Reconstruction era, wealthy northerners began to buy plantations for hunting retreats in South Carolina, Florida, southwestern Georgia, and, later, in other areas of the Southeast (Brueckheimer 1979; Paisley 1968). One of these owners, Henry L. Beadel, told of how he and other new owners brought northern attitudes about fire with them and were appalled at the extensive burning (Beadel 1962). They put a stop to it on their properties, and as a woody understory developed, quail populations declined.

But, these plantation owners were educated and influential. In 1923 they began discussions with the U. S. Bureau of Biological Survey (forerunner of the Fish and Wildlife Service) that led to a cooperative study of the bobwhite quail and the reasons for its decline. Herbert L. Stoddard was employed by the Bureau to head the project, which was financed by the plantation owners. The final report on the study was published in book form and remains a classic in wildlife literature (Stoddard 1931). In it, Stoddard identified lack of fire as a cause of quail decline. He became an outspoken advocate for the use of light winter fires in game management and forestry, especially in the longleaf pine (*P. palustris*) type. After completion of the original quail investigation., Stoddard continued to promote prescribed burning as director of the privately funded Cooperative Quail Study Association from 1931 to 1943 and, after that, as a forestry and wildlife consultant, and still later, as one of the founders of Tall Timbers Research Station near Tallahassee, Florida.

The Controlled Burning Controversy

For years a conflict had been developing between timber interests and local livestock interests over range burning and free-ranging livestock, especially hogs. While economic interests of lumber companies, foresters, and some absentee landowners focused on timber, the economic interests of the local people were centered on the understory grasses for cattle grazing and, in the pinelands, on turpentine production. As early as 1850, the state geologist of Mississippi reportedly stated "The beautiful park-like slopes of the pine hills are being converted into a smoking desert of pine trunks on whose blackened soil the cattle seek more vainly every year the few scattered sickly blades of grass whose roots the fire has not killed" (Dunston 1913). A U. S. Forest Service examiner (Dunston 1913) reported three-fourths of the woodlands in Mississippi were burned over every year and many localities were burned twice or more. He called for a vigorous education campaign, stating "The enormous loss caused by the boll weevil is not greater than that from forest fires, nor is the extermination of the cotton pest of more vital importance to the future wealth of Mississippi than the prevention of such fires."

Similar conditions and concerns were reported for pinelands elsewhere. W. W. Ashe (1894) made a survey of forest conditions in eastern North Carolina for the North Carolina Geological Survey and reported a chief consideration in the regrowth of longleaf pine in North Carolina to be "entire prevention of all fires among the pines." In another report on forest conditions in North Carolina, Gifford Pinchot and Ashe (1897), stated "The first and absolute prerequisite before any attempt can be made to improve the condition of the long leaf pine forests is entire exclusion of cattle and hogs and complete protection from fire."

The hardwood areas of the mountains were similarly burned and grazed. Regarding forest conditions in the mountain region of North Carolina at the turn of the century, Holmes (1911) reported unrestricted grazing despite local stock control laws in some counties. He reported 20 to 50 percent of the forest land in each county was burned annually "with the false idea that (fires) improve the range."

Throughout much of the South, Coastal Plain and mountains, large lumber companies began extensive commercial harvest of timber in the late 1800's. The wasteful and destructive logging pattern, typical of the time, left behind vast amounts of slash and logging debris. Annual burning of the cutover lands continued, intensified by the heavy fuel loads.

From the foresters' perspective, there was reason to be concerned. Foresters correctly perceived that uninterrupted annual burning did not allow forests to regenerate. However, many of their other ideas proved to be wrong—for example, claims that fire should be

totally excluded from longleaf pine forests (Ashe 1894, Pinchot and Ashe 1897), that it resulted in "soil impoverishment" (Dunston 1913), that it resulted in short-bodied, limby, knotty longleaf pine trees of low value (Ashe 1894), and that burning actually harmed the grazing resource rather than improving it as the woods-burners contended (Dunston 1913; Holmes 1911).

In this political environment it is not surprising that Stoddard's articulate advocacy of controlled burning was fiercely opposed, especially by foresters. The U. S. Forest Service maintained a firm policy against burning (chronicled by Schiff 1962). Federal funds available for state forestry agencies under the Clarke-McNary Act of 1924 were withheld from states if they tolerated controlled burning. The American Forestry Association sponsored a massive propaganda campaign, the Southern Forestry Education Project, from 1927 to 1930. Teams of men, known as the "Dixie Crusaders" were sent into the rural South with trucks equipped with generators, movie projectors, films, radio broadcasts, posters, and pamphlets. According to Schiff (1962), "the crusaders traversed 300,000 miles, disseminating 2 million pieces of literature along the way. More than 5,200 motion picture programs and lectures were presented to 3 million people...." Damage to wildlife was emphasized in the campaign.

Also, beginning in the 1930's, the Forest Service employed sociologists and psychologists to study the woods-burners and continued to support research on the subject for more than 40 years. In mostly unpublished reports to the Forest Service (summarized by Pyne 1982), the researchers concluded that underlying reasons and motives for woods burning included social isolation, boredom, ritualistic tradition ("our pappies burned the woods," Shea 1940), frustration of a culturally and economically disadvantaged group, alienation, and creation of jobs in fire suppression.

The developing pulp and paper industry added its influence to the anti-fire effort. In the 1940's the National Advertising Council, the U. S. Forest Service and state forestry agencies created what has been called the most effective advertising campaign in history: the Smoky Bear program. And, in an appeal to the strong religious convictions held by most rural southerners, compilations of Bible passages deemed to be anti-fire were printed in pamphlets and widely distributed (e.g. U. S. Department of Agriculture 1955) and at least one poster showed Smoky Bear praying for people to be careful with fire.

At the time of his original study of bobwhite quail, Stoddard was an employee of the Bureau of Biological Survey in the U. S. Department of Agriculture, and publications by employees had to go through review by

other agencies in the Department that might be affected. Stoddard had great difficulty in getting the chapter on controlled burning in his bobwhite quail book past reviewers in the U. S. Forest Service and had to revise it several times (Stoddard 1969).

In his memoirs, Stoddard (1969) wrote that the anti-fire campaign was "the most intensive—and ludicrous—educational campaign that ever insulted the intelligence of American audiences. It was carried on by well-meaning but utterly misinformed persons." Stoddard wrote:

"One of the main arguments against the custom of burning off the longleaf forests was the alleged disastrous effect on game and wildlife in general. . . . Motion pictures of deer with hair and hooves burned off in disastrous crown fires (in the west or the Lake States) were regularly shown on southeastern screens. . . . Dead fish, killed by the ash from explosive mountain fires, were shown rotting in the sun as examples of what would happen if the Florida cattlemen did not stop firing the flatwoods."

Stoddard complained that, as forestry agencies gradually withdrew their unalterable opposition to the use of fire "in a gesture that might be termed face-saving, they substituted the expression 'prescribed burning' for 'controlled burning,' and insisted that experts must 'prescribe' the practice."

In their own defense, foresters noted that burning was not easily confined within property boundaries, and they contended that advocating prescribed burning while conducting a program to persuade people to reduce the occurrence of wildfire would send a mixed message and weaken fire control programs. Also, they noted that advocates of prescribed burning did not have the responsibility of controlling destructive fires as did foresters. (Reibold 1971).

Acceptance of Prescribed Burning by Public Agencies

U. S. Forest Service policies toward prescribed burning were especially important to wildlife management during the first half of the century because the Forest Service at that time controlled most public land important to wildlife in the South, including most wildlife management areas, which were under cooperative agreements with state wildlife agencies. It also greatly influenced state and private actions through funding programs and cooperative work with state forestry agencies and educational programs.

Reibold (1971), in reviewing the history of prescribed burning from the perspective of the Forest Service, explained that a major reason that forestry agencies were slow to put prescribed burning into practice was

inadequate budgets and professional staff, coupled with the need to address other priorities. In the 1930's, when large-scale acquisition of national forests was undertaken with little professional staff and inadequate budgets, priority had to be given to hundreds of transactions involved in land acquisition, mapping, development of work programs for Civilian Conservation Corps camps, reforestation, and fire control. Also, Reibold contended that proper execution of prescribed burning was not possible until tractor plows became generally available, which was not until after World War II.

But Reibold (1971) acknowledged that there was much resistance among foresters to prescribed burning. Nearly all of the early foresters in the South were from the North and the West. A strong German protectionist influence in the forestry schools was greatly reinforced by experiences with the extremely destructive wildfires that followed logging in the northern states, burning millions of acres and, in several cases causing hundreds of human deaths. Reibold said "some (foresters), having spent a lifetime in working to prevent fires or in fighting them, were emotionally opposed to what seemed to them to be an abandonment of all they had worked for."

Early in the Twentieth Century, some scientists and professional foresters had begun to recognize the role of fire in maintaining longleaf pine forests. The contributions of a few individual botanists, foresters and animal husbandrymen, who bucked the tide, are detailed by Harper (1962), Pyne (1982) and Schiff (1962). Although administrators reportedly suppressed and delayed publication of research on controlled burning (Pyne 1982; Schiff 1962), some research personnel in the U. S. Forest Service were reporting on the effects of burning and its possible use in silviculture. A listing and abstracting of publications of the Southern and Southeastern Forest Experiment Stations from 1921 to 1955 (Bruce and Nelson 1957) shows publications dealing with the benefits of prescribed burning in forage production, pine regeneration, fire hazard reduction, control of brown spot needle rust, and hardwood control appearing as early as 1932 and becoming numerous in the 1940's. There were proposals and directives for limited prescribed burning on federal lands in the 1930's (Reibold 1971). But, with a few exceptions, research findings and policy directives were not implemented, and prescribed burning for the most part was restricted to private lands. There was little use on public lands until the 1960's, and even the forest industries were reluctant to do much prescribed burning.

It was not until after World War II, when equipment and manpower became available that the national forests began to undertake burning, mostly for fuel reduction. In 1947 prescribed burning was initiated on the Francis

Marion National Forest, including some growing season fires for hardwood control and periodic winter fires to improve habitat for wild turkeys (*Meleagris gallopavo*) (Devet and Hopkins 1967; Holbrook 1952). This was one of the earliest cases of prescribed burning on a national forest with wildlife habitat improvement as an objective. By the decade of the 1950's, prescribed burning on the national forests averaged about 250,000 acres per year (Reibold 1971). During the 1960's, the U. S. Forest Service cautiously began expanding prescribed burning on forests outside the longleaf pine region.

In 1971 the U. S. Forest Service sponsored a symposium on prescribed burning. In the foreword to the proceedings (USDA 1971) symposium chairman Stephen Boyce stated that among the 450 scientists, land managers, and environmentalists attending, "consensus was essentially unanimous that prescribed fire, when properly used in the South, is an almost indispensable management device having generally beneficial effects, certainly lacking in sustained deleterious effects on the crop trees, on the soils on which they grow, or on the flora and fauna of the area burned." Symposium participants, however, did recognize a lack of knowledge about the effects of prescribed burning on air quality—a matter of growing concern.

Prescribed burning had not been as big an issue with other federal agencies because they controlled few areas with upland forests in the South. There were only four national wildlife refuges with large areas of upland forest. There was some prescribed burning on the refuges in the 1940's, but generally for uplands there was a fire exclusion policy from 1949 until even-aged forest management was adopted in 1962 (Czuhai 1981; Givens 1962). Prescribed burning in waterfowl marshes (Lynch 1941) had been accepted much more readily than on forestland (Givens 1962).

The National Park Service had a strong anti-fire policy from the time of its establishment in 1916 until 1958 when a policy change was made specifically for the Everglades National Park and the first prescribed burn in a national park was conducted that year. The antifire policy of the National Park Service was reversed in 1967 (Hendrickson 1972; Kilgore 1974; Taylor 1981) to allow prescribed burning where necessary for community restoration and maintenance.

At the state level, most wildlife management areas were not owned by the states but were operated under cooperative agreements with landowners, who approved or disapproved habitat management measures. Before about 1960, most management areas in the Southeast were on national forests, many of them in the mountains. Thus, state wildlife agencies had little opportunity to carry on prescribed burning.

Attitudes Toward Prescribed Burning Within the Wildlife Management Profession

Primarily because of Stoddard's influence, backed by his rigorous studies of bobwhite quail, wildlife biologists in the South had accepted prescribed burning, at least in principle, before other resource management professionals. The basic techniques of controlled burning for game management were well established by the mid-1930's. The optimum season, frequency, and conditions for burning for various game species and important food plants were recognized. And special techniques, such as spot-burning at night to create a mosaic of vegetation, were in use (Stoddard 1935b). Prescribed burning on an annual or biennial rotation was a standard practice in the management of bobwhite quail. In 1932 Stoddard reported "occasional controlled burning of overly 'rough' cover" was among "measures practiced on scores of Southeastern preserves. . ." for wild turkeys (Stoddard 1932); he recommended specific burning techniques on a 2- to 4-year rotation (Stoddard 1935a; 1939). And, although restoration of white-tailed deer (*Odocoileus virginianus*) populations in the South was just beginning, controlled burning was used to improve browse conditions in areas of the Coastal Plain. As previously noted, burning of marshes to improve habitat for waterfowl and muskrats (*Ondatra zibethica*) was in practice in the 1930's or earlier (Lynch 1941).

Outside the South, wildlife biologists were skeptical or more cautious. Despite research showing improved habitat conditions for many species following experimental and wild fires, prescribed burning was not commonly employed for the management of wildlife. With few exceptions, books on wildlife management before 1960 treated prescribed burning as a practice peculiar to the South. From 1930 through the 1950's there were seven important textbooks on wildlife management. With one exception, all of them emphasized protection from fire and treated prescribed burning as a practice limited in application to the southern coastal plain.

In his classic textbook "Game Management," Aldo Leopold (1933), who was well acquainted with Stoddard's work, made only passing mention, in a scattered half dozen sentences, of controlled burning. He referred to spot burning of heather for red grouse (*Lagopus lagopus*) and to Stoddard's use of fire in bobwhite quail management to control nesting cover. He mentioned Stoddard's suggestion that controlled burning may reduce ectoparasites and might prove useful as a means of range sanitation, but then wrote "Use of fire without sound evidence of its effects, or on lands primarily devoted to other crops, is of course to be deplored."

In "The Land and Wildlife" Edward H. Graham (1947) briefly acknowledged the use of fire in management of

Gulf Coast marshes for muskrats and snow geese (*Chen caerulescens*). Regarding use of prescribed burning on forest lands, he wrote only two sentences: "It has been used in longleaf pine forests of Georgia to check growth of hardwoods and increase wild legumes, a device for improving habitat for bobwhite quail" and "although fire is a tool sometimes employed by both foresters and wildlife managers, its use is specialized and does not negate the general rule of protection from burning."

Reuben Trippensee (1948), in his widely used textbook, referred to controlled burning as "a management technique peculiar to the Southeast, where certain vegetative cover types not only permit the use of fire in this manner but apparently require it if quail range is to be kept productive." Citing Stoddard (1931, 1939), he devoted nearly two pages to controlled burning, but only for quail management in longleaf pine. Regarding wild turkeys, he stated "in all regions except the Southern Coastal Plain, lack of forest-fire control means exclusion of the turkey."

Wallace Grange's book "The Way to Game Abundance" (1949) provided the one notable exception in its treatment of fire as a habitat management tool. Grange considered animal cycles in the North to be largely a result of plant succession linked to a cycle of drought and associated fires. An entire chapter was devoted to controlled burning for accomplishing a variety of objectives in the management of various species. Grange stated "with the possible exception of the desert, all other North American game habitats have been, from time to time, improved by the agency of naturally occurring fire, and may be benefited through the application of controlled fire."

Leonard Wing's textbook "Practice of Wildlife Conservation" (1951) dealt similarly with the subject. Wing made the statement that "The value of controlled burning is becoming recognized, but a clear distinction should be made between *controlled* and *uncontrolled* burning." He then devoted about a page to the practice of controlled burning in the Southeast. He gave no examples from other areas but did suggest that controlled burning might be useful in the management of some other game birds and specifically mentioned songbird and non-game conservation.

As late as 1959 Ira Gabrielson, first director of the U.S. Fish and Wildlife Service and long-time president of the Wildlife Management Institute, in his textbook "Wildlife Conservation" mentioned prescribed burning in a paragraph devoted to Stoddard's work with quail, then added "Generally speaking, however, on the basis of present knowledge, fire is so great an enemy of both wildlife and forests that there is an increasing amount of fire control, both on public and on private lands. This should in the long run be exceedingly beneficial to wildlife" (Gabrielson 1959).

Into the 1980's most textbooks and references on wildlife management continued to reflect little awareness of or interest in prescribed burning.

Roy Komarek (1966) criticized wildlife professionals for neglecting habitat management in general and prescribed burning in particular. He noted that the index to the first 29 volumes of the Journal of Wildlife Management had no entries for "controlled burning" or "prescribed burning", and only seven entries to "burning" or "fire." He found the subject similarly lacking in the other publications of the Wildlife Society. Writing that the wildlife profession was lagging in the use of fire, he called for more experimentation with season, frequency, and size of prescribed fires for different objectives and different species, including non-game species and wild flowers. Previously a strong critic of the conservative attitude of foresters toward controlled burning, he noted that by this time foresters had perfected techniques by which they were burning hundreds of thousands of acres. He wrote "Despite the fact that Stoddard pioneered the use of controlled burning on game lands more than thirty years ago, the field of wildlife management, except in a few cases, has contributed little to the advancement of the art and in many cases depends upon techniques developed by the foresters."

Continuing Stoddard's promotion of the study of fire ecology and the controlled use of fire in land management, the Tall Timbers Research Station was formed in 1958, and through its research, demonstration plots, and especially its annual fire ecology conferences and published proceedings, contributed greatly to the study, understanding and use of fire. Stoddard, brothers E. V. and Roy Komarek, and others at Tall Timbers deserve much credit for the acceptance of prescribed burning outside the Deep South. At the first North American Wildlife Conference, Stoddard (1936) had urged experimentation with prescribed burning in other regions. And, from the beginning, the fire conferences were worldwide in scope, bringing in speakers from all continents to address the ecology and use of fire in many vegetation types and parts of the world, emphasizing that the usefulness of prescribed burning was not limited to management of longleaf pine.

Prescribed Burning in Nongame Wildlife Management

Although management of nongame wildlife is a relatively new emphasis, recognition of the value of fire as a potential tool for nongame wildlife management is not. Most prescribed burning has multiple objectives, and just because prescribed burning was not conducted specifically for nongame objectives does not necessarily mean that managers were unaware of the effects on nongame species and did not take them into

consideration when burning. In his early writings, Stoddard, who was an esteemed ornithologist, made frequent references to effects of fire on species other than game, forage, and commercially important timber. In one of his early publications (Stoddard 1936) he wrote that "multitudes of small birds" use the burns in late winter and early spring and "such burns (are) important to their welfare also." In one of his reports to cooperators, he included a section titled "burning to maintain floral beauty of pinelands" (Stoddard 1939). Stoddard's recommendations for burning in quail management included discussion of fire's effects on rodent and predator populations and its role in reducing predation on quail. E. V. Komarek, working with Stoddard, elaborated on the effects of controlled burning on mammals in a paper for the *Journal of Mammalogy* (Komarek 1939). Komarek's later writings included frequent references to the benefits of fire to wildflowers, earthworms, butterflies, and birds (Komarek 1969, 1971).

But, until the 1970's there was little emphasis in the South or elsewhere in managing specifically for nongame wildlife (Landers and Johnson 1980), so nongame species were only rarely a specific objective of prescribed burning. Interest in managing habitats for species other than game animals greatly increased in the 1970's. This was evident in the surge in conferences, symposia and special sessions at technical meetings devoted to nongame species (DeGraaf 1978; Odom and Guthrie 1981; Odom and Landers 1978; Thompson 1971). Although most effort in nongame and endangered species management at that time was devoted to determining the status of these species, prescribed burning was considered in papers making recommendations for habitat management for various reptiles and amphibians (Herman 1981; Landers and Speake 1980; Means and Campbell 1981; Means and Moler 1978), nongame birds (Edwards 1978; Meyers and Johnson 1978; several papers in Thompson 1971; Wood and Niles 1978) and mammals (Hilliard 1979; Lustig and Flyger 1975; Winchester et al. 1978).

Also, it was recognized that prescribed burning for forestry or game management objectives maintained a biotic community with a distinct suite of plant and animal species (Komarek 1971; Landers and Speake 1980), and prescribed burning received increasing attention for community restoration and maintenance in parks and natural areas (Hendrickson 1972).

We end this historical review with a symposium on prescribed fire and wildlife in southern forests held at Myrtle Beach, South Carolina in 1981 (Wood 1981). The symposium included papers on the status of prescribed burning programs on state, federal, and private lands and a series of papers reviewing the database on the effects of prescribed fire on many individual species or groups of vertebrates. The presentations demonstrated that, although there was generally strong conceptual

understanding of fire ecology and its relation to habitat needs of various wildlife and there was a good database for some game species, with a few exceptions, data on fire and non-game species were seriously inadequate.

Implications

The most obvious lesson of the controlled burning controversy in the first half of the Twentieth Century should be a reminder that all knowledge does not reside with professionals or government agencies. In 1981 E. V. Komarek noted that private hunting preserves of the Southeast for more than 50 years had burned between 750,000 and 900,000 acres annually, leading the way in spite of intense discouragement by government agencies and many resource management professionals (Komarek 1981).

Secondly, this review shows that conditions are always changing. Fire has been a significant environmental factor throughout much of North America for thousands of years. But its role has been a dynamic one—determined by climatic shifts and for several thousand years by the ever-changing human factor. There is much interest now in managing for natural landscapes. But, it is not possible to define what was *the* natural condition, except by defining the exact place and time—and accepting human influences as natural. Managers could set a goal of re-creating conditions of the sixteenth century when the Spanish explorers passed through the South. But, early descriptions of the landscape are spotty and probably biased; and, even if early conditions were known, they might not be what is desired today. Early accounts indicate that Indians used fire excessively in many areas, and the landscape they created in some areas may have excluded forest cover that would be valued today. Furthermore, in most places it would not be possible to re-create prehistoric conditions because soils have been drastically changed, important species have been lost, and exotics have become established. Therefore, we think prescribed burning strategies should be based on objectives that are better defined than vague notions of what is natural.

Third, land managers must be able to adapt to continuing change. With increasing human populations and urban-suburban encroachment on rural areas, there will be increasing concerns about public health, automobile accidents, and liability resulting from problems with air quality and smoke produced by prescribed burning. These concerns may result in serious limitations on the use of prescribed burning in the future. And, if, as many scientists contend, the climate is becoming warmer and drier, this may drastically alter the use of fire—for example, making hazard reduction a more important objective and more seriously restricting the season of burning. Also, history shows that priorities in resource management are controlled by economic and political conditions. Controlled burning conducted by herdsman 100 years ago was well suited to their

objective; but with different economic conditions (i.e., development of the forest industry), changes were needed. Today, much prescribed burning has multiple objectives, even in wildlife management. Current interest in management for game and nongame wildlife and natural areas may wane if economic prosperity declines or there is an urgent need for other forest products. Therefore, development of techniques for a diversity of approaches to fire management is needed to allow compromise and adaptability in meeting future needs. Research also must continue on alternative methods of vegetation control because the use of prescribed burning will almost certainly become restricted in some areas.

Finally, fire research is still needed. Managers have been able to draw on 300 years of burning experience and more than 50 years of fire research in the South. But, since the 1981 symposium on prescribed fire and wildlife, prescribed burning has been applied to an increasing variety of situations where new objectives are in place. Management objectives include an increasing variety of plant and animal species and communities. Prescribed burning is no longer considered to be out of bounds of consideration in the management of any habitat type. It is being used, at least in a limited way, in the mountains for site preparation, hazard reduction, oak regeneration, maintenance of bog turtle (*Clemmys muhlenbergi*) habitat, maintenance of grassy balds as habitat for small mammals and raptors, and management of plants of special interest. Growing season fires are being used increasingly for hardwood control, promotion of flowering of grasses and other forbs, and to produce diversified patterns of plant growth. Infrequent high intensity fires are being used to restore or regenerate communities, and new technology for igniting and controlling fires is being developed by foresters. With more diverse objectives and increased use of prescribed burning in habitats other than southern pine forests, the need for research is greater than ever, and the research database may be weaker in relation to needs than it was in 1981, when the prescribed fire and wildlife conference was held. Roy Komarek's criticisms of the wildlife profession in 1966 remain valid today. We think this is especially true outside the South.

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