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From Fire Control to Fire Management: An Ecological Basis for Policies

Bruce M. Kilgore
U. S. National Park Service
San Francisco, California

Fire has periodically burned forests and grasslands as long as such flammable vegetation has existed on earth. The Bible records numerous instances of the effect of fire on vegetation, and accounts of the use of fire by American Indians reveal ancient man's knowledge of the potential of fire as both process and tool (Stewart 1956; Mutch 1976). In 18th and 19th century America, fire in the woods was regarded as a common sight. "... whether set by Indians, settlers, loggers, or natural causes, [forest fires] were frequent and often extensive... unless they threatened human life, livestock, or buildings, they were little regarded except as a local nuisance" (Clepper 1975).

Many of our present wildfire problems began when we attempted to ban all fires from the forests. Yet, control of wildfire was essential in the late 19th century as forest resources were being destroyed by careless logging and the catastrophic fires which followed. Two big names in wildfires were Peshtigo in Wisconsin where 1500 people died and 1.2 million acres burned in 1871 and Hinkley in Minnesota where 400 people died and an undetermined acreage burned in 1894. Such large, destructive fires started in logging slash where they gained momentum before moving into uncut forests (Davis 1959). They made the public aware of the potential damage of wildfires and set the stage for development of rigid fire control policies.

Suppression Policies and Early Challenges

Efforts to more effectively control forest fires in America began with the founding of organizations such as the American Forestry Association in 1875. In celebrating AFA's centennial, Clepper (1975) noted that, "The prevalence of forest fire was a major influence in the start of the conservation movement and the rise in public opinion that brought it about."

The policy of suppressing all fires in national parks began in Yellowstone National Park in 1886 and was implicitly incorporated in the National Parks Act of 1916 (Agee 1974). The establishment of the Forest Reserves in 1891 and the Forest Service soon thereafter resulted from public reaction to the continuing destruction of forests by "fire and depredations" (Clepper 1975). It is understandable that members of the new U.S. Forest Service, National Park Service, and other agencies such as the Forestry Branch of the Bureau of Indian Affairs dismissed the historic role of fire in the forest and established policies of total exclusion of fire.

Fire suppression policies were based on claims that fire of any kind: (1) damages mature trees and kills seedlings; (2) destroys the best forage plants and perpetuates undesirable grasses; (3) robs the soil of nature's fertilizer and promotes floods, droughts, and erosion; and (4) destroys the natural breeding places and shelter for birds and animals and often burns up nests, eggs, and young (Komarek 1973).

Some researchers did not feel these statements accurately described the role of controlled fires or low intensity natural fires. Therefore, while no one questioned the attempt to exclude destructive wildfires, some questioned exclusion of all fire. By the late 1920's, research had shed considerable light on the results of low intensity burning. These research findings were almost diametrically opposed to the position being advocated in the South by the "Dixie Crusaders," sponsored by the American Forestry Association. The federal and state land management agencies were so committed to total exclusion of fire, however, that Schiff (1962) reports there was "reluctance to promote research or release results which seemed to jeopardize success" of other agency fire projects.

Support for total suppression was so strong in the late 1920's and early 1930's that a policy of aggressive speed in control was adopted by the Forest Service in 1935. This policy provided that fires must be controlled in the first work period or, if this fails, by 10 a.m. the next day (Baker 1975a). At the same time, strong opposition was expressed toward any "let burn" or "herding" procedures.

Ecological Basis: Research in the South

Early plant ecologists, including Clements, Cowles, Hall, Ramaley, and Cooper recognized the effects of fire on vegetation (Bock 1976). But some of the earliest challenges to the concept that all fires are bad came from a group of fire scientists called by Komarek (1973) the "Dixie Pioneers." These men included a forester, a botanist, an animal husbandman, a wildlife scientist, and several Forest Service scientists from southern experiment stations. These men worked independently, yet they concluded that periodic fire plays an important and beneficial role in the life of many southern pine forests, and particularly that of longleaf pine.

The forester was Dr. H. H. Chapman of Yale University, later president of the Society of American Foresters. Dr. Chapman published more than 20 papers between 1909 and the early 1940's dealing with southern pines and their relationship to fire. His work (Chapman 1912, 1926, 1932, 1944) showed that most winter fires do not kill all longleaf pine seedlings; rather, they help establish pine stands, suppress other pine and hardwood competitors, reduce hazardous fuel accumulations, and control brown-spot disease. Chapman recommended use of fire in longleaf pine every three years. He has recently been termed the "father of controlled burning for silvicultural purposes" in America (Komarek 1973).

In 1913, Dr. Roland M. Harper, botanist for the Florida Geological Survey and later State Botanist for Alabama, published a widely circulated defense of forest fires in *Literary Digest* which spoke of the importance of fire to southern pine in forestalling hardwood succession. Along with Chapman, Harper condemned promiscuous use of fires.

S. W. Greene, an animal husbandman with the Bureau of Animal Industry at the Coastal Plains Experiment Station, McNeill, Mississippi, found that quality and quantity of grasses and legumes on burned lands were much greater than on unburned lands and that cattle grazed on burned pasture made substantialy greater weight gains than animals on unburned pasture. It was Greene's l931 article, "The Forest that Fire Made," that finally reached the public with the message that not all fire was bad. This article was part of what has been referred to as the "dynamite from outside the profession [required] to awaken us," in the words of a Forest Service employee (Schiff 1962).

At the First North American Wildlife Conference, 40 years ago, H.L. Stoddard, wildlife scientist with the U.S. Biological Survey and Director of the Cooperative Quail Study Investigation, reported on his extensive studies of bobwhite quail which showed that carefully controlled, light fire at the proper season and weather conditions can be beneficial to quail habitat (Stoddard 1936). Such fires provide ground cover that is open below but offers protection from predators above. Because quail are weak scratchers, dense tangles of wire grass and broomsedge exclude these birds from their food supply. In addition, heavy ground cover of pine needles, dead grass, and debris smothers the legumes quail require (Stoddard 1931, 1935).

Forest Service scientists from southern experiment stations also gathered data during these early years which helped clarify the role of fire. They did so despite administrative pressure against working on projects or publicizing research conclusions which would be at variance with the fire exclusion policy (Schiff 1962). One significant paper showed that frequent fires did not harm the chemical composition of forest soils in the longleaf pine region (Heyward and Barnette 1934).

In summary, the work of these southern fire scientists showed that controlled burning can be beneficial to longleaf pine, cattle, and quail. In contrast, total fire exclusion in the South soon led to considerable problems, including a tremendous increase in fuels and fire hazard. Not until 1943 did the weight of this evidence bring about adoption of a prescribed burning policy for the southern forests (Schiff 1962).

Ecological Basis: Research in the West

The 1943 shift in Forest Service policy on prescribed burning applied primarily to the South. But soon thereafter, a similar challenge was raised in the West by the combined research and experimental management efforts of two foresters with the Bureau of Indian Affairs (BIA) and a forestry professor at the University of California.

Actually light burning was advocated as early as 1909 in California, but a Society of American Foresters Committee which looked into the controversy concluded in 1923 that light burning was neither more practical nor more economical than fire exclusion (Biswell 1967). The Regional Forester for California and the Director of the California Forest Range Experiment Station during these years believed centuries of repeated fires had caused ”unsatisfactory conditions in the forest” (Show and Kotok 1924). Their attitude exerted tremendous influence on the developing fire protection policies in California. Only in recent years has convincing evidence been published which verifies the ecological roles of fire in western forests (Weaver 1974; Biswell 1967; Hartesveldt 1964; Kilgore 1973b).

The Bureau of Indian Affairs in the Department of the Interior is a relatively little known bureau in forestry matters. Yet the program of forest management developed by two men in that agency has had a major influence on the evolution of fire management policy in the West. In 1943, Harold Weaver published the first of nearly 20 articles on fire and ponderosa pine in Washington, Oregon, and Arizona (Weaver 1943), and in 1950, Harry R. Kallander became actively involved in controlled burning of ponderosa pine in Arizona.

Under the early leadership of these two men, the BIA has control burned nearly 500,000 acres (202,500 ha) of forest lands on the Fort Apache Indian Reservation since 1948, with nearly 100,000 acres (40,500

ha) being reburned once or twice (Kallander, pers. comm.). Additional controlled burning has been done on the San Carlos and Hualapai Reservations in Arizona. In each case, the principal objective was to reduce wildfire hazards (Biswell et al. 1973). There has been more prescribed burning over a longer period of time on these three reservations than on any other forested area in the western United States.

Studies (Weaver 1974, Cooper 1960) have shown that periodic lightning-set fire occurred in ponderosa pine forests at intervals of about 6 to 7 years and maintained low fuel levels. The fires were, therefore, of low intensity, yet pruned back competing woody vegetation, prepared a receptive soil surface for seedfall, and thinned young trees and prevented thickets of reproduction (Biswell et al. 1973).

Ideas from his earlier prescribed burning experience in the Southeast were brought to California by Dr. H,H. Biswell, Professor of Forestry (Ecology) at the University of California, Berkeley. In 1951, he began work on prescribed burning experiments in ponderosa pine forests of the central Sierra Nevada and in the North Coast Range. Biswell concluded from his studies that this vegetation type developed in nature with frequent light fires, that fire exclusion has resulted in extreme fire hazards today, and that prescribed burning by means of light fires can reduce fuels while simulating other ecological impacts of natural burning (Biswell 1967).

In both the South and West, there was considerable resistance on the part of government agencies and private forestry and conservation groups to the acceptance of new facts on the natural role of fire. Even today this acceptance is not total in the West. However, the continued buildup of high-hazard fuels and the increasing expense of associated fire suppression are causing many previously devoted fire-control advocates to question total exclusion policies (Towell 1969; Task Force on California's Wildland Fire Problem 1972; Dodge 1972; Craig 1975).

Ecological Basis: A Brief Synthesis

Since the initial work of these early scientists, an every-increasing number of research reports on the fire ecology of various vegetation types have been published. These have been summarized in recent books, review articles, or annotated bibliographies (Kozlowski and Ahlgren 1974; Wright and Heinselman 1973; Baker 1975b; Heinselman, forthcoming). The Proceedings of the Tall Timbers Fire Ecology Conferences have also provided an important forum for exchange of ecological knowledge between scientists and managers since 1962- Additional symposia have been held in various parts of the country where scientists and managers have discussed the role of fire in the Intermountain West (Intermountain Fire Research Council 1970); the northern environment (Slaughter et al, 1971); the Southwest and West (Southwestern Interagency Fire Council 1971); the Southeast (USDA, Forest Service 1971); North America (USDA, Forest Service 1972); and Southern California (Sierra Club 1974).

These studies and symposia dramatically reveal that fire plays different roles in different geographic areas and vegetation types. Under natural conditions, low intensity surface fires occur frequently in the longleaf pine forests of the Southeast and the ponderosa pine forests of the West. In contrast, the spruce-fir forests of Minnesota and Montana are much less flammable; but on those rare occasions when they do burn, it's often a hot crown fire. Understanding each of these roles is an essential part of the ecological basis for fire policies.

With these great differences in fire intensities and frequencies in various vegetative types, it is reasonable to expect that fire would cause a variety of impacts on such specific ecosystem components as wildlife. In reviewing the results of more than 290 studies, mostly between 1960 and 1972, Bendell (1974) concludes that it is difficult to generalize about the effects of fire on birds and mammals. While a few researchers believe wildfire is extremely destructive of wildlife, many feel direct mortality is negligible. What is far more important is impact on habitat – food, cover, and microclimate. While these species dependent on late stages of forest development may have to relocate following fire, many others are favored by conditions following fire. A surprising conclusion to many people is that most species of mammals and breeding birds simply remain in an area after fire (Bendell 1974). Either they tolerate a wide range of conditions or fires burn so unevenly that some unburned units remain. Certain common wildlife species are apparently not particularly sensitive to the fine details of their environment. Some, like moose, seem adapted to flammable habitat.

In the Sierra Nevada, and in particular the sequoia-mixed conifer forest, the National Park Service currently has a special problem. Early descriptions of the Sierra portray the original forests as open and park-like. They were apparently subject to frequent surface fires which made them practically immune to crown fires. With more effective fire suppression, such crown fire immunity was lost. This poses a special threat to the giant sequoias in national parks. Karly Superintendents at both Sequoia and Yosemite National Parks recognized the problem, and in 1904 some efforts were made to reduce fuel hazards. Anti-fire critics, however, undercut these early prescribed burning attempts, and total fire suppression continued for more than half a century.

The turning point came with a disasterous wildfire in 1955 just west of Kings Canyon. Within a short time, the McGee fire had consumed more than 13,000 acres (5,265 ha) of brush and forest and threatened the Grant Grove of sequoias. Hartesveldt of San Jose State University began the first studies of prescribed burning in Sequoia and Kings Canyon in 1964 (Hartesveldt and Harvey 1967). This work combined with studies by Biswell et al. (1968), Kilgore (1975a), Kilgore and Sando (1975), Forest Service researchers at Missoula, Montana, and Riverside, California, and others led to the conclusion that fire plays seven essential roles in the Sequoia-mixed conifer forests (Kilgore 1973b). Fire (1) prepares a seedbed and favors germination and survival of sequoia seedlings; (2) recycles nutrients; (3) changes the successional pattern; (4) favors wildlife; (5) develops a mosaic of vegetation age classes and types (6) modifies impact of insects and disease; and (7) reduces hazardous fuels.

Reading fire scars on sugar pine stumps adjacent to the sequoia groves reveals that lightning strikes and fires have occurred regularly in the natural sequence of event.s in a sequoia community. Fires probably burned individual trees severely enough to leave a scar about every 10 to 20 years (Kilgore 1973b). In the absence of fire, however, white fir moves in, sequoia seedlings do not become established, and the sequoia forest cannot replace itself. So, recurring fire is a natural force which favors the sequoia. This is true except when too much undergrowth, because of too much fire suppression, leads to too much fire, Because of the present tremendous buildup of fuels, grcat care must now be taken as prescribed fire is first reintroduced into these groves. Only when such abnormally high fuels are gradually reduced can nnrmal surface fires again be allowed to burn without danger of crown fires.

Such ecological evidence of the role of fire does not in itself determine policy. The same ecological evidence can lead to differing policies depending upon the objectives of the agency. Where the objective is to restore natural processes and conditions as in national parks, determinat.ion nf the impacts of those

processes under natural conditions will allow the National Park Service to use fire to approach its objective. Where the object.ive is to grow trees for timber or grass for grazing, as in some segments of the national forests, determination of how fire can be used as a tool to best achieve these objectives wi11 allnw the Forest Service to decide on its fire management policy for that unit of land. Both agencies have wrestled with the problem of how to make use of new scientific evidence on the ecological role of fire when modifying fire management policies.

Recent Changes in Policies

The document of greatest significance to present National Park Service fire policy was the Lcopold Report on wildlife management in national parks, presented for the first time at the North American Wildlife and Natural Resource Conference in 1963. l his report noted that, "... much of the west slope [of the Sierra] is a dog-hair thicket of young pines, white fir, incense-cedar, and mature brush – a direct function of over-protection from natural ground fircs" (Leopold et al. 1963). The report suggested that, "A reasonable illusion of primitive America could be recreated, using the utmost in skill, judgment, and ecologic sensitivity." This report was largely adopted as National Park Service Policy in 1968, bririging about. a major re-orientation in attitudes toward fire suppression.

Present National Park Scrvice fire management policy divides all fires into either management fires or wildfires. It defines management. fires as those of hoth natural origin and prescrihed hurns "which contribute to the attainment of the management objectives of a park through execution of predet.ermined prescriptions defined in detail in a portion of the approved resources management plan." As such, the policy does three things:

> (1) It allows some natural (lightning-caused) fires to burn when they help reach management objectives and when they do not threaten human life or developed properties;
> (2) It recognizes prescribed burning as a proper tool of wiidtand management in ecosystems modified by prolonged exclusion of fire or to reduce fuels along boundaries of management zones;
> (3) It continues fire suppression in developed areas and for all fires now classified as management fires.

The Forest Service has been more cautious in accepting this new philosophy. While they have been prescribed burning in the national forests of the South since 1943, and burned more than 250,000 acres (101,250 ha) in 1974, it was 1970 when the Forest Service in its Northern Region first established a management direction which allows fire to play a more natural role in wilderness (Aldrich and Mutch 1975). In 1971, a major shift in Forest Service policy occurred when exceptions to the 1935 10 a.m. policy were authorized on a preplanned basis when approved by the Regional Forester and the Chief, Forest Service (Baker 1975a).

Present Fire Management Programs

In the late 1950's Everglades became the first national park to use prescribed burning, while in Sequoia and Kings Canyon natural fires were first allowed to burn in back-country areas in 1968 (Kilgore and

Briggs 1972) and an intgrated policy was implemented in 1969. Two or more segments of the integrated fire management program – natural fires, prescribed fires, and suppression – are now in effect in 17 national parks and monuments including Everglades, Yellowstone, Grand Teton, Sequoia, Kings Canyon, and Yosemite (Kilgore 1975, 1976). More than 4 million acres (1.62 million ha) of park wildlands are being managed so that fires play a more natural role in the ecosystems. During the last 8 years, more than 300 natural fires have covered some 40,000 acres (16,200 ha) in eight parks, while another 300 prescribed burns have covered nearly 50,000 acres (20,250 ha) in seven parks.

Natural fires are generally allowed to burn only in fairly large wilderness parks where there is sufficient land area to permit such a policy without danger to human life or property. Prescribed burns to simulate the role of natural fire may be used in carefully selected locations, induding such smaller units as Wind Cave National Park, South Dakota. They are carried out under predetermined conditions of temperature, humidity, wind, and fuel moisture. Suppression continues as the primary action in most developed areas, in zones with high cultural resource value, and in many smaller National Park System areas. Additional integrated fire management programs are expected to begin soon in another dozen National Park System areas, mostly in the West.

Exceptions to the Forest Service 10 a.m. policy are now in effect in parts of the Selway-Bitterroot Wilderness in Idaho, the Gila Wilderness in New Mexico, the Teton Wilderness of Wyoming, and in multiple-use management areas of two national forests in the South whereby some fires are being allowed to burn. Fire management prescriptions have been written for each vegetative management zone of the 100-square mile (259 km') White Cap Fire Management Area in the Selway-Bitterroot Wilderness (Mutch 1974), and guidelines have been developed by the Forest Service for planning and inventory procedures and for developing a fire management plan (Mutch and Aldrich 1973; Aldrich and Mutch 1975). The first major test of the White Cap plan came with the 1200-acre (486 ha) Fritz Creek fire in 1973 (Mutch 1974). All indications are that despite the fact that a fire spotted outside the approved fire management area and had to be suppressed, the initial experiment was successful and is leading the way toward incorporating fire management considerations into broader land use planning (McGuire 1976).

The program known as "DESCON" (Designated Control Burn System) was approved in 1973, in which either man-caused or lightning-caused wildfires may be allowed to burn when they meet preestablished and approved prescriptions and thus accomplish certain desired land management objectives (Devet 1976). Now in use on two national forests in the South, this program is apparently planned for expansion to all Coastal Plain Forests (Mutch 1976). Fire management programs are now also carried out on state and privately owned grasslands, shrublands, forests, and wildlife refuges for a variety of purposes including wildlife benefits (Kayll 1974). More than 300,000 acres (121,500 ha) of private hunting lands in the South have been burned annually since 1930 for quail management (Komarek, personal communication). Such state agencies as the California Departrnent of Parks and Recreation are beginning to usc prescribed fire in managing their forests.

The Future

While many changes have occurred in recent years in National Park Service and Forest Service fire management policies and programs, even greater changes can be expected in the next decade. I see five broad goals if we arc to move ahead with the effective long-range fire management programs:

(1) Better understanding of fire as a process;
(2) Better understanding of fire as a tool;
(3) Greater commitment by managers to use on the land the best of' what we already know;
(4) A well-trained cadre of master prescribed burners;
(5) Greater public understanding of and involvement in developing and approving our management practices.

Fire as a Process

A group of fire scientists and managers agreed on the following five high priority problem areas about which they want further information (Kickert et al. 1976): (1) How do fire frequency and intensity affect accumulation of litter and exchange of nutrients? (2) How does fire intensity affect fuel reduction, soil erosion, microbial food chains, and nutrients? (3) How do frequency and intensity affect plant succession and nutrients? (4) How does fire exclusion affect duff buildup, soil moisture, and primary productivity? and (5) How do hre frequency and intensity affect litter accumulation and soil water repellancy? Answers to parts of these questions may be available in widely dispersed literature sources. So the first step must be to "synthesize what is already known by putting together system simulation models" (Kickert et al. 1976). Through use of such computer models, it may be possible to help the manager predict short-term and long-term ecological effects of various fire management decisions (Agee 1973; Kessell 1975, 1976; van Wagtendonk 1972; and Bonnicksen 1975). In the absence of such models, information being produced may not be the most urgently needed.

A specific area needing further study is the impact of smoke from fire management programs on disease organisms such as *Fomes annosus* and white pine blister rust as well as on visibility at airports, on highways, and at scenic view points. Initial studies by Parmeter and Uhrenholdt (1975) indicate that smoke inhibits many fungi and rusts and may play a greater role in the dynamics of these organisms than previously realized.

A problem related to better understanding of fire as a process is the lag time between information discovered by a researcher and receipt and use of that information by the manager. The FIREBASE program of the Forest Service is attempting to get fire ecology knowledge into accessible form; it is a computerized system which will store and retrieve wildland fire information and put it into hands of fire managers and scientists. By the middle of 1976, it should be ready for limited operational use with 3,500 items involved (Taylor 1976 and personal communication).

Fire as a Tool

Three Forest Service Fire Laboratories and several Experiment Stations, the Petawawa Forest Experiment Station in Ontario, Canada (Van Wagner 1974), and a number of National Park Service scientists (van Wagtendonk 1974) are working on a variety of basic and applied projects which can assist with use of fire as a tool. These projects deal with fire behavior, fire prevention and control, weather, smoke management, prescribed fire, and fire effects on wildland ecosystems (nutrients, streamflow, insects, animals, and birds). Information must be gathered both in controlled laboratory studies and by sophisticated monitoring of experimental burns and wildfires in Wilderness Areas and national parks. Perhaps one of the most practical applied programs is the "Fire and Multiple-Use Management, Research, Development, and Application Program" at Missoula, Montana, in which a team of land

managers are working with scientists to define the role of fire in western forests, to develop methods for blending fire management with land management plans, and to apply and evaluate fire management alternatives on national forests.

Fire process ideas must be translated into answers to such practical questions as: (1) How often should an area be hurned? (2) What prescription is appropriate (what temperature, humidity, wind, and fuel moisture conditions should be used to bring about a given intensity of fire)? (3) How much fuel accumulation indicates the need for another burn? and (4) What management actions can best simulate ”naturalness” in parks and wilderness areas and still minimize smoke contribution to adjacent communities?

Very specific and sophisticated techniques are often needed to use fire as a tool in a particu]ar vegetative type. As a result of long-term sequoia studies, Harvey (Hartesveldt and Harvey 1967 and personal communication) suggests that areas with no sequoia regeneration and with high fuel levels should be given high priority in our sequoia prescribed burning programs and that the base of mature sequoias be protected from heavy burning. He also concurs with Bonnicksen’s (1975) suggestion that representative examples of certain vegetation units, such as patches of reproduction which occur in openings, patches of sugar pine mixed with white fir in the understory of larger trees, and multi-layered vegetation units composed of pure white fir be protected from large-scale broadcast burning in order to more closely simulate the dynamic balance that existed in the primeval sequoia-rnixed conifer forest mosaic. Such specific techniques need to be built into our ever-evolving fire management plans. These plans should take advantage of the planning guidelines and inventory procedures developed by Aldrich and Mutch (1973), a document Moore (1974) called the ”most complete how-to-do-it document available for ecosystem-based fire planning.”

Commitment by Managers

While we will always need more research to confirm our hypotheses, and while new techniques can improve our management programs, simply waiting for more studies to give us the answer before acting is a ”cop-out.” Adequate knowledge is available, for example, to use fire in ponderosa pine; yet millions of acres of this species wait for our management actions. We are getting close to this situation in the sequoia-mixed conifer forest. It gets down to the crucial question, ”Why aren’t we putting into practice what we already know?” Philpot (1976) identified five important reasons: (1) Lack of personal commitment or acceptance of fire’s role in land management; (2) Lack of administrative understanding and strong leadership; (3) Fire ecology knowledge is not in useable form; (4) Lack of expertise and technical know-how; and (5) Absence of fire ecology considerations in the basic land-use planning process. Recent fire management programs in Sequoia-Kings Canyon National Parks, California; Grand Teton National Park, Wyoming; and the Selway-Bitterroot Wilderness of Idaho demonstrate what can be accomplished by committed managers with research backing (McLaughlin 1973; Kilgore 1975; Daniels 1974).

Perhaps one of the most exciting developments in fire management reflecting administrative understanding and leadership is the recently approved large, interagency wilderness fire management program for one-half million acres (202,500 ha) of the Teton Wilderness and 1.7 million acres (688,500 ha) of Yellowstone National Park. This program will be operational in the summer of 1976. It will be the first time that fire on National Park System lands can be allowed to cross the boundary onto National

Forest System lands, by plan, and fires from the Teton Wilderness to cross into Yellowstone. Decision charts are included in an excellent Forest Service plan which take into account such things as public safety, weather, number of other fires burning at the time, spread potential, size of fire, air quality and smoke dispersal, and cooperation with the managers of Yellowstone and Grand Teton National Parks. If all goes well with this program, presumably it will grow with the addition of the Shoshone National Forest and perhaps other interagency cooperative management efforts aimed at better managing the resource and better serving the American public.

Master Prescribed Burners

One of the most important products of the fire management program in the next decade must be trained specialists who will be experts in the use of fire. Lack of technical expertise seems to be a major problem in most areas, with the possible exception of the South and the Fort Apache Indian Reservation in Arizona. As Vogl (1973) points out, in our past emphasis on fire control, we have almost forgotten both the technique of prescribed burning and the legendary rnen who practiced it. We cannot afford to forget the skills of men like Herbert Stoddard, the Komarek brothers (who ”could burn circles around a parked car without blistering the paint”), Harold Biswell, Harold Weaver, Harry Schimke, and Harry Kallander. As these men retire, and several already have, Vogl is concerned that in most parts of the country, few other master prescribed burners are being trained as specialists who really know controlled burning both as an acquired skill and a scientific technique. He fears the know-how that needs to be passed from generation to generation may be lost.

Neither the National Park Service nor the U.S. Forest Service, nor any other responsible land managing agency in the U.S. today can afford this loss. The importance of training was recognized when a complete issue of *Fire Management* was devoted to this subject recently, including the importance of continuing education for fire management professionals and coordination of agency training courses (USDA Forest Service 1974). But we must also find some way to pass along the practical field knowledge and skill from one generation to another.

Perhaps we can establish field training workshops and demonstration sessions whereby young resource management specialists from all agencies, having sound academic backgrounds and fire suppression experience, can also learn the very specialized skills and techniques of fire management – including prescribed burning – from men with extensive practical experience. The Forest Service’s Eastside Prescribed Fire Workshop in Oregon is an example of such a program.

One specific suggestion is a small team of interagency, interdisciplinary fire professionals to give a traveling seminar on a 3-month detail basis to fire management practitioners in all agencies. We must make certain a cadre of specialists learn these skills well, for fire is a powerful force which must be carefully respected at all times (Barrows 1974). I see no area in the country better able to serve as a starting point for these training workshops than the Coastal Plain Region of the South – on the national forests or at the Tall Timbers Research Station in Tallahassee, Florida.

Perhaps as a first example of this type of program, the Pacific Northwest Region of the Forest Service detailed nine of its fire management personnel to the Southern Region this spring to work with Southern personnel on prescribed burns in the South. These men needed to gain expertise in the use of fire for later application in the ponderosa pine forests of the Northwest. The Eastern Region also sent eight men down

on the same training detail. The sophisticated techniques developed in the South over long years of practical application can help train others for their mission, even though the conditions under ponderosa pine or other types will require major modifications of the southern burning techniques.

As another approach, Dr. Harold Biswell conducts occasional field seminars in California which involve demonstrations of appropriate use of fire. There has been only minimal effort, however, to use these as training sessions for agency management personnel. Some courses are developing at universities and colleges to fill this need in part; Jack Barrows' fire science program at Colorado State University is a prime example. But even more emphasis on field experience is essential. Ongoing fire management programs in such park and wilderness areas as Everglades, Florida; Sequoia and Kings Canyon and Yosemite, California; Grand Canyon, Arizona; and the Selway-Bitterroot Wilderness of Idaho, should definitely be worked into the demonstration section of such a program.

Except for fire suppression efforts, the concept of big fire management programs, with lots of equipment and personnel used on each fire, must be changed. The expert burners I have talked with say, "give me relatively few knowledgeable men with hand tools and one drip torch, and I can burn as much in a day as ought to be ignited anyway! You can't afford to be impatient with fire." These experts *d.o not want* large numbers of personnel nor great amounts of sophisticated equipment. During initial applications, they want to burn relatively small areas where carefully planned natural fuelbreaks allow them to have control. If more people are there, they should be observers, and not required back-up. As programs evolve, larger acreages can be handled, once abnormal fuels are reduced, special techniques are developed, and a careful planning job is done.

Not long ago in one of our western park.s, I saw what can happen when too many personnel not trained in prescribed burning are involved. In that case, the idea was to use a prescribed burn as a training exercise for 100 to 125 people from a variety of agencies. Several crews of 8 to 10 men each were assigned different sectors to burn. These people were highly qualified in fire suppression work, but their background in prescribed burning was minimal. Not having been adequately hriefed in the overall purpose of the exercise, some crew leaders became impatient to finish their sector. Thus the particular type of backing fire required under lhe topography, fuel, and weather conditions at that time was not skillfully used. Too much fire was put into the forest, and certain sites burned overly hot and did not achieve the desired objective. We learned from that mistake, and we'll continue to learn if such judgmental errors are used constructively to improve our training programs and to refine our prescriptions.

We cannot afford the luxury of impatience in dealing with so powerful a natural process as fire. To learn the right conditions for burning requires appropriate theoretical training and practical experience. Such experience must provide a working knowledge of fire behavior under the variety of fuel, weather, and topographic parameters in which a resource manager will be operating. And most importantly, he must gain an attitude of deep respect (1) for fire, (2) for the natural resource itself, and (3) for our land management objectives which allow him to use the best judgment and appropriate restraint in making decisions about fire prescriptions and programs.

Public Involvement

We all realize the public relations problem faced by a fire management program, following decades of

effective conditioning that ”all fires are bad.” But there are indications with both National Park Service and Forest Service programs that hard work and skillful communications can get across the new, more complicated message (Kilgore 1972; Stankey 1975). An ”inform and involve plan” is included as part of each Forest Service fire management plan. Agemy public affairs and information-education personnel can be key elements of this effort to involve the public in these important land management decisions.

Conclusion

The transition from total fire control to scientific fire management is a major shift in philosophy and attitude toward the land as well as a change in an action program. It requires subtle ”weaving of a fundamental understanding of flre as an ecosystem process into the day-to-day fabric of resource management” (Mutch 1976). The ecological basis for this change in policies has been developed by fire scientists and managers in the South, the West, and other parts of the country and the world, but the gut-level acceptance of the policy change is still evolving.”Better understanding of fire as both a process and tool is needed (Mutch 1976) along with greater commitment by managers and greater involvement of the public in important land management decisions.

In our enthusiasm for fire management programs, we must avoid any bandwagon approach to the use of fire. While there is some element of risk in reasonable fire management, we will lose both credibility with, and support of, knowledgeable fire contr’ol experts as well as support of the public if we do not use the best possible professional skills and judgment in our use of fire in the forest.

Fire’s role as a process is basic to the operation of many ecosystems in national parks and Wilderness Areas. With this firm knowledge and insight, we can begin to use fire as a tool to best simulate its natural role in these areas. Kventuall, forest and wildlife specialists, livestock interests, and all the American public may agree on appropriate fire management programs which will prove to be best for the natural resources of America, upon which we all depend.

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Discussion

CO-CHAIRMAN BARICK: I feel I can relate to the philosophy that you articulated, Dr. Kilgore, because the agency for which I work has been practicing burning for the past 25 years on game ranges in North Carolina, and I am sure there are other people here who have had similar experiences. Are there any questions from anybody in the audience?

MR. WALTER SHEPPE [University of Akron]: I can understand the burning program that you described but, on the other hand, it is not at all clear to me how you quite define your objectives and choose your techniques, especially when your real objective is maintaining natural conditions in the Park Service area. I would think this is much more difficult. I would like to know whether you have involved any park lands or the Park Service in your burning program.

DR. KILGORE: In answer to your first question, we need to learn more about the relationship between fire and natural conditions and what role fire has played in both parks and wilderness areas. That would help us select the best techniques to achieve near natural conditions. On the other hand, I don't think we can wait until we have a "perfect operation" to start our integrated fire management program. Our managers feel we must move ahead now with the best available

information and the best tools we have. Then we will continue to modify our techniques, in a sense by trial and error, but always handling things conservatively. Insofar as using prescribed fire on park land, the main comment we have received from both conservation groups and knowledgeable park visitors is ”why didn’t you start this long ago?”

MR. KEN WILSON [North Carolina]: I would like to comment further on what my good friend, Frank, said. Most of our burning, while I was supervisor of some management areas in North Carolina, was on the 60,000-acre Sand Hills Wildlife Management Area. As I recall, we burned 10,000 acres a year and we burned them every 3 years. We laid out transects, on which we measured what we hoped would burn and, as we were very much interested in the management of the bobwhite quail, turkey and, of course, deer, we governed our burning on this criteria. Populations of many of these animals, after burning, increased almost 100 percent, at least in some cases. Also the vegetation that came after the burn was more palatable to deer who would often graze it to a much greater degree. There is no doubt in my mind that Frank Barick was the man that pushed this. He did not have a lot of friends who understood it in the first place but he had enough internal fortitude to push it. I must say that conditions in the one area that I mentioned are now acceptable. Also, there are other parts of North Carolina where the Forest Service is operating on the same basis. They are doing their own burning and getting some good results.

DR. KILGORE: One other point that I made in my paper is that we should not look at fire just as a tool but also as a process. In the South, for example, where they have been burning for quail management and a number of other purposes, they are finding a lot of interesting and beneficial side effects. In some areas, for example, where fires have been used for a number of years, populations of wild orchids are developing where they had not been found for years, and certain species of woodpeckers are increasing in numbers.

MR. PAUL LATIM: I was wondering what the consequences of nondegradation is in relation to air quality. You have been talking about activity especially in wilderness areas of the West. We have put together a number of statements in draft form and, to my knowledge, none of them have made it out of our agency as yet. We are trying to address this type management and your talk has encouraged me and others to come to professional meetings and try to explain to others what we see. At present, for example, we have prescribed regulations which can help us designate smoke from wild fires that will damage the resource.

MR. WILLIAM ROGERS [Naval Air Station, Maryland]: In the West, in contrast to the South, you are burning on some very steep slopes. What problems have arisen in the form of erosion and stream sedimentation as a result of your burning?

DR. KILGORE: We have measured this carefully, ourselves, and have also used USGS researchers to monitor this type of problem, both as to water quality and erosion. We have found no particular problem with the light burning we have been using in sequoia-mixed conifer and red fir forests. We have monitored erosion on particular plots of sequoia-mixed conifer forests, and we have found minimal change there after surface fires have burned. Even if you burn most of the surface fuels, you have some litter from the unharmed overstory back on the ground within a matter of weeks or a month later. Therefore, we are not talking about bare soil following a devastating fire.

MR. WILSON: That controlled burning on our areas has saved tens of thousands of acres in the immediate area from burning flat to the ground. It is a case now, however, where people just do not think and it takes a lot of education to make them change.

DR. KILGORE: With reference to erosion, I think it involves a kind of trade-off. Perhaps state and U.S. Forest Service managers and scientists will come up with something else for the Southern California chaparral. But right now my best bet is that chaparral is going to periodically be burning 100,000 years from now (as it does today) regardless of what else we do. While some managers are looking for slow burning plants and grasses to replace chaparral, many people feel the roots of the chaparral are the nuts and bolts that hold the whole thing together, and if you get rid of chaparral, you are going to have more serious erosion problems.

MR. CHESTER McCONNELL [Wildlife Management Institute]: Since the idea of fire and smoke as a pollutant has been brought up, I thought it might be interesting to see what your comments are on the research at Tall Timbers which shows that smoke from the natural burning fires is beneficial to their environment simply because our environment was developed as a result of numerous fires in our past history and they have evidence to prove that smoke from natural fires is actually beneficial to the environment.

DR. KILGORE: I know of various studies being done along that line. However, I am not an expert on that. While we have heard much about the negative impacts of the quantity and quality of smoke found in auto exhaust, there are a number of benefits of wood smoke that are now coming to the forefront. E simply mentioned the work at the University of California with disease organisms and smoke. I would urge researchers to get out in the field and help us determine just what roles wood smoke does play in our forests and other ecosystems.