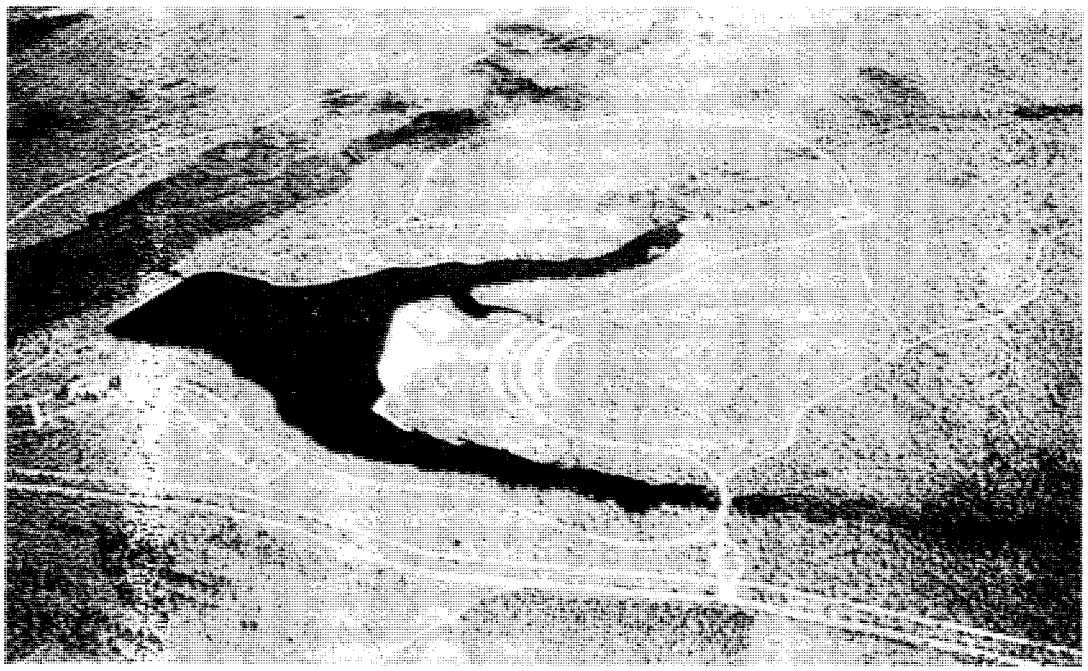

FIG. 1. The Bass River Recreation complex, leveled by wildfire in 1930 is now completely protected by prescribed burning.

FIG. 2. In areas of high fire frequency, fuel modification may be the only practical method of protecting the esthetic environment.

Prescribed Burning on Recreation Areas in New Jersey: History, Objectives, Influence, and Technique

JAMES A. CUMMING*

According to Day, (1953) the Lenape Indians, residents of New Jersey for approximately 10,000 years, burned the woods deliberately in the spring and fall and accidentally at other times. This was done purportedly, to drive game, improve visibility, facilitate travel, drive away insects and reptiles, increase the supply of grass seeds and berries, and for offense and defense in war. The dominance of pine in the early history of Southern New Jersey has been attributed to these fires (Lutz, 1934; Pinchot, 1899). By 1801, the Indians were moved to western reservations and during the next 50 years forest exploitation reduced Southern New Jersey to levels of vegetative poverty from which it has never recovered.

John Gifford, founder of "American Forests" magazine, was born in Mays Landing, the heart of New Jersey's wildfire region, in 1861.

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He had the good fortune to meet Gifford Pinchot some 15 years later in Cape May at a meeting of the National Forestry Congress which boasted an attendance of three, including Pinchot's father (Widner, 1968). Mr. Gifford, was Professor of Forestry at Cornell when Pinchot and Graves were engaged by the State of New Jersey in 1895 as forest consultants. His exhaustive investigations of the critical forest fire problem were included in Pinchot's report to the State Geologist in 1899. This study recommended the establishment of a Forest Service and emphasized the need for fire control.

In 1905, the legislature passed the first statute providing for a "Forest Park Reservation Commission" with powers to acquire, manage, and protect forest lands in the state. Under this legislation, Alfred Gaskill, one of Pinchot's earliest associates, was granted leave by the U.S. Forest Service to report on organizational progress in New Jersey. In 1907 he accepted an appointment as our first State Forester and 2 years later wrote that drought and fire frequency joined to confirm the Commission's belief that forestry in New Jersey was impractical until the forest fire situation was brought under control.

Under his leadership the Forest Fire Service developed rapidly and, in 1909, the legislature passed a unique "Railroad Fire Line Law" to cope with the state's most devestating causal agency. This statute required all railroads to construct and maintain fire breaks 110 feet wide on each side of the tracks where they ran through woodlands. While broadcast burning was utilized as a protection measure by cranberry growers sometime after 1850, it can be said that burning on railroad rights-of-way provided official recognition and support for the use of fire as a hazard reduction tool by the State of New Jersey. Although the law was declared unconstitutional in 1913, the railroads still pursue an abbreviated program.

Little, Allen, and Moore (1948) state that the practice of controlled burning has been utilized for protection on the state forests since 1928. It was pioneered on safety strips from 25–200 feet in width along roads, primarily for the purpose of backfiring, and following the destructive fires of 1930 applied to entire tracts.

Research, engineered to investigate the potential of New Jersey's

1,300,000 acre Pine Region and the part fire might play in achieving practical goals, was encouraged by C. P. Wilber, Gaskill's first technically trained assistant, who held the reigns as State Firewarden, State Forester, and Director of the New Jersey Department of Conservation. As an outgrowth of talks with Firewarden Albert Le Duc, he was invited to observe the results of protective burning in an exceptional pine stand Le Duc had been treating since the early 1900's.

The first study of controlled burning in the state was subsequently established on the Lebanon State Forest in 1936, by O. M. Wood and S. Little, Northeastern Forest Experiment Station, and E. B. Moore, Chief, Forest Management Section, New Jersey Department of Conservation and Economic Development. All of these men had, interestingly enough, been former students of Professor H. H. Chapman at Yale. Meanwhile, Wilber concentrated on the completion of a comprehensive $11,000,000 dollar 400,000 acre plan for forest recreation in New Jersey which he published in 1937. To Moore and Little went the responsibility for leading the fight for prescribed burning. This task was pursued with an enthusiasm that seemed to provide both with satisfaction in quantity capable of challenging and overcoming all opposition.

They concluded that removal of accumulated litter favored the germination of pine, a tree far more suitable to the infertile sands of the region, and that the application of additional cultural treatments could alter stand composition dramatically. Data assembled included information on overstory mortality and injury, the effects on fuels, shrubs, and soil; its use as a protection measure, seasonal limitations, and costs. In 1948, Little, Allen, and Moore (1948) introduced the practice of controlled burning to the general public after 12 years of investigation and analysis. The Atlantic City Racing Association, in 1949, was the first private recreation facility to take advantage of this program and the burning plan for their property remains in effect to this day. Over the years operations have been expanded to include lake developments, private camps, game preserves, country clubs, nudist colonies, city parks, religious conference centers, and various institutions.

FIG. 3. Recreation areas of intensive use are generally subdivided by a labyrinth of forest paths and trails which lend themselves readily to firing.

OBJECTIVES OF PRESCRIBED BURNING ON RECREATION AREAS

The primary objective of prescribed burning on forest recreation areas in New Jersey is to reduce the probability of their destruction by wildfire. Investigation has shown that when uncontrolled fires enter treated areas they do much less damage and suppression work is made easier and more effective (Cumming, 1964).

A second purpose is to favor wildlife, as well as hunting, by developing an interspersion of different food and cover conditions. On recreation areas where there is a mixture of different size classes of trees, some on burned and others on unburned land, a variety of conditions and an abundance of "edges" separating them is produced. This is much more favorable to wildlife than an area maintained as a "monotype." Plowed lines provide excellent access for

FIG. 4. Wildfire in fuel accumulations of this weight and continuity would be virtually impossible to control under severe burning conditions.

sportsmen and improved visibility increases chances for hunter success. Vegetative stimulation, as the result of surface blackening and increased soil temperature, may also be regarded as beneficial, especially from the wildlife standpoint, even though this effect is relatively short-lived.

In addition to increasing productivity, an improvement in stand character and composition reinforces esthetic values. This is achieved by increasing the percentage of pine so that a more balanced distribution of species is brought about. Litter which accumulates and smothers desirable plants is consumed and the thinning of dense shrub growth results in improved view angle, depth, color contrast, and comparative form which serves to display recreation areas to their best advantage. Openings, roadsides, dikes and dams are easily maintained and the rejuvenation of laurel, blueberry, huckleberry,

FIG. 5. Roadside rest and picnic areas are maintained readily in the New Jersey Pine Region by prescribed fire.

bracken fern and other attractive fire species provides practical opportunities for vegetative manipulation. Fire acts as a sterilizing agent against undesirable plant diseases, such as tar spot (*Rhytisima andromedae*) on laurel, and through natural pruning, promotes increased flowering and yields of nutritious fruit.

FOREST TYPES

From the investigations of fire and its effect on the ecosystem it has become evident that it can be used in the forest to great advantage. Common characteristics of species favored by fire include seed production at an early age, thick bark, generally the ability to sprout, often the production of closed cones, readily transported seed, and relative intolerance of shade. Recreation areas supporting this combination of biological adaptability lend themselves most readily to treatment.

Studies to date indicate that no less than 18 forest types are wholly

or partially dependent on fire for their existence (LeBarron, 1957; Little and Moore, 1949; Weaver, 1955). This list includes: Douglas-fir, paper birch, western white pine, lodgepole pine, longleaf-loblolly pine, pitch-shortleaf pine, ponderosa pine, jack pine, aspen, western larch, black spruce, red spruce, sand pine, scrub oak, Atlantic white-cedar, longleaf pine, eastern white pine, and red pine.

Mechanical treatment, combined with lopping, ripping, disking, and broadcast burning in New Jersey, has also been used to establish stands which are esthetically pleasing and highly productive (Little and Moore, 1952). Although cost, variability of seed crops, and a wide variety of response has detained progress in this field, the development of more efficient machinery, high quality seed, and rapid methods of aerial application hold forth considerable promise. The comparatively high cost of these methods, however, can only be justified if stands so created are protected, from the time of their establishment, by prescribed fire.

EFFECT OF FIRE ON FOREST SOILS AND UNDERSTORY VEGETATION

Research on prescribed fire has continued in New Jersey over the years with many valuable contributions provided by independent study. P. Y. Burns (1952) published a doctoral thesis describing the effects of prescribed burns on the soils of the New Jersey Pine Region in 1952. Data was collected on plots of the two Lebanon Forest studies. His report on the chemical properties investigated included the effects on exchangeable calcium, potassium, nitrogen, pH, phosphorous, and organic content. Physical properties analyzed were volume weight, field capacity, pore volume, air capacity, and infiltration. The study concluded that moderate burning treatments benefit the mineral soil chemically and have little or no influence on its physical properties. Because of flat topography and porous sandy soils, with the ability to accept more than 6.3″ of water per hour (Rhodehamel, 1966), neither erosion nor compaction presents a problem.

In 1953, Dr. Murray Buell and John Cantlon (1950) financed by the Cranberry and Blueberry Research Branch of the New Jersey

Experiment Station, Rutgers University, published the results of a survey analyzing the effects of prescribed burning on ground cover. This study, superimposed on the original Lebanon plots, indicated that the shrub layer, under a closed canopy, was reduced in direct proportion to the number and frequency of burns. As one would suspect, fire species like pine and scrub oak became more important constituents while species like huckleberry and wintergreen became less important. The greatest difference, with regard to plant cover, was found following the cessation of burning between cut and uncut plots. On that portion of the plots harvested, oak sprouts increased from 2 to 16 percent, pine from 1 to 9 percent, blueberry from 9 to 20 percent, huckleberry from 2 to 4 percent, herbs from 2 to 16 percent, moss and lichens from 30 to 44 percent. Heavy browsing by deer of the numerous young shoots indicated that the stage of development, immediately after cutting, was very favorable for game. In areas of intensive use where sprouting may be considered objectionable, chemicals and mowing have been used as a supplement to burning.

EFFECT ON WATER YIELDS

Since transpiration and evaporation combine to provide the greatest transfer of water as vapor from the Pine Barrens Region (Rhodehamel, 1966), there has been general supposition that periodic burning would increase water yields through a reduction of evapotranspiration rates. Litter in this area is capable of retaining 260 percent of its oven-dry weight following precipitation and evaporation losses are directly proportional to its thickness. Preliminary work by Cantlon (1951) strenghthened the hypothesis that significant additions to ground water might accrue through prescribed reduction of the absorptive layer. A cooperative 40-year study, designed to investigate this possibility, was initiated on two separate watersheds of the Lebanon State Forest in 1951 (Buell, 1951). Unfortunately, this project, following an 8 year calibration period, was destroyed by a severe wildfire in 1963. Although the work has been abandoned, efforts are still being made to recoup such preliminary data as may be available. These data will be published in the near future.

EFFECT ON WILDLIFE AND HUNTING

Most destructive wildfires occur during the spring when the young of wildlife species are most vulnerable. This has led some uninformed persons to question the use of controlled burning, which they are apt to confuse with wildfire. It should be noted, however, that burning for silvicultural, protection, or wildlife purposes is not conducted during this period. Lutz (1934) has emphasized that the use of fire in game management is similar in many respects to that of fire in forest management. In both fields, fire may be utilized for sanitation, control of both plant and animal species composition, and various other purposes. In neither forest nor wildlife management is the use of wildfire permissible.

An estimate of the spring deer population in the Pine Region, computed by roadside track count, has been reported at an average of 5.6 deer per square mile in 1966 (Moore *et al.*, 1966).

During 3 consecutive years, prior to and including 1940, an interesting and intensive wildlife census was conducted by the Bureau of Forestry on 16 blocks of the Lebanon State Forest in late October (Moore *et al.*, 1940). Large numbers of CCC crewmen made it possible to drive and count all sample areas simultaneously. Deer concentrations on the 3500 acres inventoried varied from 2.7 animals per square mile in an upland stand to 106.5 per square mile in a lowland area. The average population on the forest, which is truly representative of the region as a whole, was 37.7 deer per square mile. Approximately 91 percent of the area sampled had been subjected to cultural measures in the form of cutting, brushing, or burning within the 5 year period preceding the census.

Lowlands, which comprise approximately 25 percent of the South Jersey range, are called upon to provide a disproportionate share of the diet for a deer population which, on these sites, may average from 20–50 animals per square mile during winter. This concentration pattern simulates winter yarding by deer in the northern states and Canada where heavy snows restrict their travel and induce disease and starvation. All available data and observations confirm the preference of deer for lowland areas in New Jersey for both food and cover. Atlantic white-cedar, an excellent indicator of population

pressure, is the favorite browse in the southern part of the state and from chemical analysis would appear to be the only food which, alone, contains the nutritional capability of carrying deer through the winter (Moorhead and Somes, 1958).

Local studies emphasize the necessity of applying control measures designed to perpetuate white-cedar as a deer food and prevent deterioration of the range. Under present pressure, fencing of areas harvested for cedar, an expensive and difficult undertaking, appears to be the only sure way of achieving satisfactory regeneration of this type over a major part of the lowland range in South Jersey. Hot fires applied to lowland hardwoods may be an effective means of alleviating some of this pressure. Observation following wildfires on these sites reveal intensive utilization of hardwood sprouts.

Studies by Little, Moorhead, and Somes (1958) indicate that upland shrubs furnish little winter food for deer in the New Jersey Pine Region, much less, in fact, than does tree reproduction. Local evidence indicates that herbaceous material, available following burning and cutting, can contribute substantially to the annual diet. Herbage yields, generally speaking, are inversely proportional to crown density and experiments have shown that recreation area managers interested in attracting this animal should thin their stands below 50 percent crown cover to obtain large increases in the herbaceous plant community.

The effect of prescribed fire on the availability of bear oak mast has also been a subject of serious concern. Burning in this sporadic acorn producer, however, is not only desirable but essential. Bear oak, currently occupying an estimated 350,000 acres of upland in the Pine Region, is one of the fire species which would, through competition, gradually be eliminated without the benefit of repeated hot, killing fires. Unfortunately, while the acorns of these oaks are highly palatable to deer and are instrumental in contributing to fatty deposits which help the animals through winter, yields are irregular and variable.

A scrub oak survey (Moore *et al.*, 1954), conducted by the Bureau of Forestry in 1954, a heavy seed year in South Jersey, revealed that acorn yields averaged 217 pounds per acre on September 22. At the beginning of the critical feeding period, December 4, over 73 percent

of the crop was rendered defective and practically useless as deer food due to the work of weevils and rodents. And, by December 16, availability had been reduced to 11 pounds per acre. During poor seed years, little or none is available. Meticulous burning schedules in scrub oak can be instrumental in maintaining this type for wildlife use and stimulating mast production.

Tree oaks in this region produce few acorns until they reach 50–60 years of age. These species, protected by prescribed fire, are allowed to become older, larger, and more productive of mast.[1]

The best foods, from a wildlife manager's viewpoint, exhibit stability through annual abundance. While general and simultaneous crop failures in all of the oak species is unlikely, local investigations have shown that their presence should be considered a bonus rather than a dependable staple.

Since systematic cutting on the uplands can result in conditions capable of supporting higher deer populations per square mile, this necessary supplement to controlled burning must be expanded in zones of extensive recreation on all State Forests. This is especially necessary on areas like the Belleplain State Forest where tall unbroken canopies have developed. On lands administered by the Division of Fish and Game, in addition to the present cutting operations, an active program of prescribed burning for wildlife on uplands and lowlands should be initiated to help provide stability for animal populations which seem to fluctuate in unison with the number and severity of fires. The record deer harvest in South Jersey, for example, immediately followed the severe 1963 wildfire season. The precise influence of cutting and burning on herd size, allocation, and maintenance must be determined through accurate census techniques and evaluations of the herd as well as our southern range. Much additional study is needed. Skeletal development, body weight, reproduction ratios, age classes, and foods utilized testify to the evils of overpopulation and the poverty in which many of the South Jersey deer currently exist.

Webb (1968) states that quantity, rather than quality, has always

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[1]Personal communication S. Little, N.E. Forest Experiment Station, New Lisbon, New Jersey.

been the primary consideration in wildlife management as the result of pressures from hunters. Quality, which finds itself in the same category as esthetics, must be emphasized to avoid the development of wildlife ghettos and preserve hunting, as a necessary management tool, in a state where uniformed parties periodically pressure the legislature for its discontinuance.

A review of the studies and observation on the efficacy of fire as a tool in game management throughout the hemisphere, along with local analysis of its effect on mast, browse, and cover provides much support for the hypothesis that deer, elk, quail, turkey, sharptailed grouse, geese, muskrat, woodcock, rabbits, and doves, to name a few, benefit to a much greater extent than they are disadvantaged.

THE EFFECT OF PRESCRIBED BURNING ON GROWTH AND THE OVERSTORY

In January 1946, Little, Moore, Moorhead, and Smith (Somes and Moorhead, 1952) established four ¼ acre plots in an old field pine stand in the Salem County Barrens. All of the plots received a low thinning and two were burned. Three treatments were applied between installation date and 1953.

Measurements revealed that prescribed burning favored the net growth of all pines, especially the largest. During the 8-year study interval, growth of all stems totaled one cord per acre more in the burned than in the comparable unburned plots. Diameter on the 75 largest pines was 0.1 inch more on the burned than on the unburned samples. While additional studies are needed in this area it would appear that fire not only creates favorable seedbeds for the germination of seedlings most adaptable to the site, but promotes their later development. The stumpage value accrued on the increased growth during the period was more than sufficient to support the total cost of burning.

Crown and cambial damage, sustained following heat intensities which exceed recommendations, produce significant reductions in height and diameter growth. Losses can range from a single year's growth to stagnation or complete mortality. In addition to upsetting

the efficiency of the physiological process associated with crown damage, headfires, consuming heavy fuels, can cause undesirable changes in stand character, structure, and quality which result in a diminution of the esthetic environment. In contrast, the effects of controlled burns, properly applied, are indistinguishable to the vast majority of forest visitors 3 months after treatment.

EFFECTIVENESS AS A PROTECTION MEASURE

The number and severity of fires occurring on any area relate directly to weather, fuels, risk, and the effectiveness of the presuppression and suppression program (Chandler, 1961). In the New Jersey Pine Region, without the use of prescribed burning, there is a steady build-up of fuels on the forest floor. On the sandy upland sites earthworms are seldom found, and so the litter does not become incorporated with the mineral soil (Little *et al.*, 1948). This constitutes an increasingly dangerous fire hazard which periodically results in a holocaust, such as those of 1930, 1936, 1941, and 1963. Explosive fuels, urbanization and forest utilization are creating egregious risk.

The driest spring on record in New Jersey culminated for fire protection personnel on the weekend of April 20–21, 1963, when a series of wildfires burned over 183,000 acres of woodland, consumed 186 homes, 197 outbuildings, and was responsible for the loss of seven lives. Thousands were forced to flee, and entire communities were evacuated. The estimated financial loss incurred as the result of weekend forest fires exceeded 8.5 million dollars (Cumming, 1964).

The fastest spreading fire, burning in fuels averaging 28 tons per acre, started near New Lisbon and covered nearly 76,000 acres in the 71 hours required to gain control. Its forward progress during the first 6 hours was 1.5 mph, nearly double that for normal spring fires, and the consumption of 1066 acres per hour was far in excess of any previously recorded.

The fire frustrated early attempts at control with discouraging ease and burned over 12,000 acres of the Lebanon State Forest. While several portions of the Forest had been subject to periodic prescribed burns, many tracts, including more than 3000 acres in two experi-

mental watersheds, had not been treated within the last 10 years. The periodic increment of 7 to 10 tons of leaf litter per acre, accumulated during this interval, obliterated fuel reduction benefits of previous treatments.

Six months after this destructive fire, a damage survey was made on 510 acres of upland oak-pine stands in the northwestern portion of the State Forest and in 300 acres of similar stands on contiguous private lands. Forest types, soils, tree size, and diurnal variables existing at the time of the fire were comparable. The two blocks differed only in their prescribed burning history; the State Forest had received 0–5 burns in the last 10 years, the private area none.

Because of prior fuel reductions, areas prescribe-burned within the last 10 years supported 28 percent less fire of head intensity than the untreated areas and 18 percent of the treated portion did not burn at all. Damage in the untreated stands was far greater with 97 percent of the oaks and 79 percent of the pines killed or severely damaged, compared to 46 percent and 17 percent respectively in previously treated tracts. None of the untreated area escaped the flames.

Statistics for the 100,000 acre Wharton State Forest indicate that wildfire damage, on 35,000 acres since acquisition in 1955, not only held inventory and growth levels constant for the past 10 years but has restricted development (Cumming, 1966). Forty year averages show that timber stands on the Wharton face the probability of being killed back by fire once every 15 years. A destruction interval of such short duration is intolerable to anyone comtemplating the development or expansion of recreation facilities. The confiscatory penalties of carelessness can postpone recreational development on most pine region sites for 30–50 years.

Threats to recreation areas and historic sites were clearly illustrated during a 12,000 acre wildfire on Wharton in 1960. Effective control measures narrowly saved historic Batsto Village, two-thirds of which was previously consumed by a forest fire in 1874.

Forest management plans in New Jersey provide for highest priority in protection to the recreational and headquarters complex followed by mature timber stands, immature stands, and finally areas occupied by regeneration. Prescribed burning at 3–10 year intervals is recommended for extensive recreation areas with 1–2 year inter-

vals in areas of intensive use and high value. Cost, prorated over a 3 year burning rotation, average between .18¢ and .50¢ per acre. Most of the 10 to 15 thousand acres treated annually are burned on 15 to 20 days between Thanksgiving and mid-March. Treatments of approximately 80,000 acres annually on a 4 year rotation has long been the established goal of the Bureau. Current plans guide activity on 200,000 acres of state and private land. The advantages of prescribed burning as a protection measure are readily understood and accepted by landowners of the Pine Region and it is, on this basis, most easily sold. Its contribution to the experience of forest fire personnel has made it an invaluable training aid in fire behavior.

BURNING TECHNIQUE WITHIN THE RECREATIONAL COMPLEX

The utilization of fire in areas subjected to intensive use involves not only the risk of damage, mortality, and escape, but an emotional response to esthetic vandalism which can destroy public confidence and severely restrict managerial options. Therefore, precautions cannot be overemphasized; mistakes must be minimized.

The first step is the identification and installation of clean fire breaks, safe in their continuity. Work initiated too early in the fall renders lines useless through the accumulation of wind-blown leaf litter. Frozen soil plagues those who delay. Large extensively managed areas are subdivided by plowing parallel north-south lines at 660 foot intervals which are extended to 1320 feet when conditions permit. This procedure satisfies the demands of prevailing westerly winds which are most dependable for winter burning in New Jersey. Approximately, 500 acres can be ignited easily by a 4-man crew well before noon allowing 6 to 10 hours for fires, 1–2 ft in height, to back across the strips. Normally, all ignition should be terminated by 1 PM on an everage day or earlier on days of high danger. Recreation areas should be avoided on marginal days and always entrusted to the most knowledgeable and conscientious personnel. Complete weather information is obligatory prior to firing. On all recreation areas, where there is a demand for maximum quality, lines judiciously located at 330 foot intervals are recommended with

buffer, beautification, or isolation strips preempting areas of significant biological, esthetic, or recreation value. In both plowing and burning the destruction or marring of bridle, hiking, or hunting trails, woods roads, campsites, picnic areas, or esthetic assets must be avoided.

Burning should be started as soon as possible in the morning and completed by dark if practicable. Winds are steadiest during this time and the possibility of men becoming lost or injured in the darkness is eliminated. During periods of high fire danger, night burning is often applied advantageously but requires exceptional timing, careful consideration of fuels, overstory, topography, climatic conditions, fire breaks and land use.

Tie-in procedures usually begin for daytime operations between 3 and 9 PM depending upon season and humidity. A perfect performance will be evident by the absence of crown scorch on pine and char heights on hardwood stems that are not readily discernible.

In addition to the use of backfire, mandatory in recreation areas on first and second burns, head, flank, and spot fires, notorious for high temperature profiles, can be used to advantage by the most experienced personnel on areas where the vertical and horizontal continuity of fuels has been broken. Unless these techniques are applied carefully, the time they are designed to save may be offset by losses due to crowning, spotting, and excessive damage. In the 20 years this program has been in effect only one fire, with extinction costs of $65.00, was lost by an assigned crew. This record has been zealously guarded. However, in an effort to protect private landowners from this contingency, the New Jersey Farm Bureau created a non profit corporation which makes adequate liability and accident insurance available to its members. Financial encouragement, 50 percent of the cost not to exceed .70¢ per acre, is also available through the federal Agricultural Stabilization and Conservation Service which regularly approves funds for this purpose.

MINIMIZING CONTRIBUTIONS TO AIR POLLUTION

While there is no conflict between the prescribed burning program and state air pollution laws the Bureau has been cognizant of

its responsibility in this field for many years. Although complaints have been few, educational programs expressing a sense of public urgency will undoubtedly stimulate general sensitivity to the creation of gaseous wastes.

South Jersey, however, due to topography and atmospheric instability enjoys a comparatively low air pollution potential. Atmospheric stagnation in this section occurs primarily as the result of temperature inversions which normally reduce the dispersion of contaminants. These inversions are the consequence of stagnant anticyclones which produce "Indian Summers" in rural areas but serious pollution problems in highly populated and industrialized regions.

A recent study by the Department of Meteorology at Rutgers University (Havens, 1963) included a tabulation of all stagnating anticyclones occurring in New Jersey for the past 64 years. During this interval, only 119 stagnations of 4 days or more, were recorded. Only one period in the study exceeded 5 days. The most striking result of the investigation was the revelation that 68 percent of the inversions occurred in September, October, and November. January and February, accounted for only 4 percent of the total and March, had none at all. December accounted for a more substantial 8 percent. Since the bulk of the burning is generally completed in December, January, February, and March in close liaison with the U.S. Weather Bureau, contributions made to the air pollution index must be regarded as inconsequential.

The overall insignificance of smoke from prescribed fire as a contaminant is emphasized in a report by the U.S. Public Health Service which holds that motor vehicles, power and industry, and space heating are responsible for 96.5 percent of the contaminant problem (Patterson, 1968). Great strides by the automotive industry in the air pollution field, hopefully, will reduce the climate of panic and crisis that has been necessary to initiate progress in this area. Bureau policy recognizes the potential for local contamination by forbidding the use of prescribed fire during forecast temperature inversions and directs that roadsides be treated in alternate sections in order to reduce the possibility of accidents as the result of reduced visibility. Meanwhile we anxiously await the results of investigations

on the chemical composition of wood smoke, the activity of its pollutants and their dissipation.

New Jersey, the most urbanized state in the nation with an average population density of 900 people per square mile, beamed fulfillment on Charles Wilber's recreational foresight by approving a $60 million dollar "Green Acres" bond issue for the acquisition of recreation areas in 1964. Dovetailing with the contributions of Moore and Little on the use of prescribed fire these dynamic programs are joined in harmonious support of the state's open space policy. They enhance its character and preserve its value.

ACKNOWLEDGEMENTS

The author wishes to express his sincere gratitude to Mr. George R. Moorhead, State Forester, Dr. Silas Little Jr., Principal Silviculturist, Northeast Forest Experiment Station and Mr. Gordon T. Bamford, Chief, Forest Management Section, for their critical reviews, helpful suggestions, and comments. A special note of appreciation goes to Mr. Elwood B. Moore, former Chief of the Forest Management Section, for the extensive assistance he, in characteristic generosity, provided.

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