

Is Prescribed Burning Compatible with Environmental Quality?

A PANEL DISCUSSION

Moderator: Walter J. Fillmore, Staff Director for
State and Private Forestry
USDA Forest Service, Northern Region
Missoula, Montana

Panelists: I. Donald Aldrich
Executive Secretary
Montana Wildlife Federation
Missoula, Montana

Jack S. Barrows
Lecturer in Fire Science and Technology
College of Forestry and Natural Resources
Colorado State University
Fort Collins, Colorado

R. Bruce Perry
Land Management Specialist
U.S. Environmental Protection Agency
Region VIII
Denver, Colorado

Benjamin F. Wake, Administrator
Environmental Sciences Division
Montana Department of Health and
Environmental Sciences
Helena, Montana

Mr. Fillmore:— A prescribed burn is not a lightning fire or a fire set by an arsonist or by a careless act. A prescribed fire is set to accomplish a specific objective, whether it be to reduce fuels, control a disease, or to encourage the productivity of wildlife feed.

Weather conditions and timing are factors that are critical to objective accomplishments.

A prescribed fire has to be well thought out and well planned.

A prescribed fire is not a new tool to the forest land manager. Whether or not it has always been properly used may be a matter for evaluating its compatibility.

During our industrial revolution, which evidently is still in progress, environmental quality has often been ignored or downgraded for greater production of goods and services. Once an environment is downgraded, it may be impossible to reestablish its original quality.

During World War II, I spent several weeks cruising on the Great Lakes. The water of the lake was so pure that we scooped our drinking water and boiler water directly from the lake and used it without any treatment. Drinking water was not real critical, but boiler feed water had to be perfectly pure.

Thirty years later the water in the lakes has been contaminated by industrial wastes and municipal sewage. It took less than 30 years to destroy the environmental quality of the Great Lakes. Your guess is as good as anyone's as to how many dollars and how many years it will take to restore that quality.

Our panel members are a distinguished group of experts in fire management and environmental quality, and I am anxious to learn their views on how compatible prescribed burning is with the environment. Environmental quality is difficult to define. "Quality" is like "beauty;" its real definition lies in the eye of the beholder.

Mr. Aldrich:— I am pleased that I did not ask the question, "Is prescribed burning compatible with environmental quality?" The question, at least to me, is symbolic of man's arrogance, his firm belief that the world was made for him, and should accommodate his every wish.

In searching material on fire management I was elated to find the

statement, "Fire accomplishes such vital functions in the regeneration period as: (1) reducing vegetation that competes with seedlings for light and moisture; (2) removing debris which sometimes obstructs seed germination; (3) reducing the organic soil mantle to provide the new seedlings quicker access to mineral soil; (4) releasing bound-up nutrients for better initial growth of new seedlings; and, (5) providing heat to open serotinous cones"¹

These conclusions appear in many other publications with slight changes in emphasis, but always in agreement that fire is a natural function, that it has always been present, that it provides change, perpetuates diversity, and is beneficial to the ecosystem and the ecosystem components.

Rather than question the acceptability of fire, we should seek an alternative that benefits the forest community in as many ways and does not have a more serious effect on the quality of the environment.

In the past replacing natural functions with management that only better serves man's desire to exact wealth more cheaply has not been in the best interest of sustained environmental quality.

Years of fire control falls in this category. Fuel accumulations during this period have created the real fire hazard. We are now faced with the problem of managing forest fuels to prevent the type of fire that causes soil deterioration, retards reproduction, and adversely affects water production and quality. In many cases prescribed fire is the logical method to reduce fuels. It certainly is more acceptable, environmentally, economically, and ecologically than sitting on a powder keg and waiting for some one or something to set it off.

For some reason the conservatives, the level boat advocates, prefer to wait for more studies, new technology, and panaceas. They find more comfort in continuing past programs than in implementing the natural method which successfully created and perpetuated the vegetative community that has been so generous.

NEPA has provided all interests with basic resource and environ-

¹"Fire and Forestry", Missoula Chapter, Northern Rocky Mountain Section, Society of American Foresters.

mental information, a set of options, and the opportunity to participate in the planning process. Conservationists find themselves evaluating alternatives: we find clearcutting an acceptable alternative when properly used as a management tool, we find fire in the same category. If all segments of the forest management controversy will be as realistic, we will eventually give the landowners and managers the full complement of tools they need to retain the diversity of our life support system, our environment.

Since the species of flora and fauna represented today have evolved characteristics to make them compatible with a fire environment and, since fire is a part of their ecology, like solar radiation and precipitation, it would have to be my conclusions that prescribed burning is not only environmentally acceptable, it is ecologically irreplaceable at the present state of the art.

I have already listed what seem to be some of the scientifically determined functions of fire that are essential or at least beneficial to the biotic community. Speakers the past 3 days have further confirmed the need for fire in forested lands.

Those who still feel that smoke is environmentally unacceptable or that prescribed burning is a threat to the forest economy must answer the questions, "What alternatives do we have?" and "What are the trade-offs ecologically?" With the time frame of ecological processes we can often get by without paying the cost in our life spans. Are we willing to add to the coming generation's ecological debts?

A. B. Mount in his article, "An Australian's Impression of North American Attitude to Fire,"² had this to say, "We go to great lengths to replace fire with machines or chemicals without really understanding what fire does. Our unnatural alternatives aggravate soil erosion and cause pollution of land, water and air far in excess of the most destructive wildfires.

"Although a few experts know the difference, we have failed to educate the public to discriminate between geological erosion and man-aggravated erosion; between woodsmoke and gasoline exhaust fumes; between wood ash and the chlorinated hydro-carbons. In

²Tall Timber Fire Ecology Conference, April 10-11, 1969.

these cases our frames of reference are too narrow, they recognize erosion and pollution but fail to separate the man-made from the natural.”

Several studies indicate that except for the particulate contributions to air pollution, woodsmoke is quite benign and primarily a nuisance. Some evidence has been presented that woodsmoke particulate has furnished condensation nuclei for precipitation through geologic time. Is it still a necessary function?

On the economic side, Richard Vogl said, “In some vegetation types, the monetary loss to timber and watershed and the cost of fire suppression are directly related to the number of years an area has been protected beyond the natural fire sequence. Once burning is postponed beyond the time an area would blaze under natural conditions, the creeping light surface fires that normally would have occurred and reduced fuels to fertilizing ash are inevitably replaced by killing crown fires.”

I’ve already been redundant, I was only asked if prescribed burning is environmentally acceptable. My obvious answer is “yes”, but I would like to close by quoting William H. Hendrickson, Office of the Chief Scientists, National Park Service. “[Fire] is a resource, that structures the kinds and numbers of species present just as does the water resource, the climate and the soil.

“Prescribed burning is a compromised accommodation of the fire resource. It is akin to irrigating the everglades and to killing elk with bullets where we will not allow predation, disease, winter-kill and scavengers to take and use the herd.”

ADDENDUM

The U.S. Department of Health, Education and Welfare (1968) and the Clean Air Act of Montana (1967) defines air pollution as:

“The presence in the outdoor atmosphere of one or more air contaminants in such quantities and duration as is, or tends to be, injurious to human health or welfare, animal or plant life, or property, or would unreasonably interfere with enjoyment of life or property, or conduct of business.”

“The combustion products (smoke) from forest fires or prescribed

PANEL DISCUSSION

burns are often considered on a par with any other emissions that might affect air quality. But enough is known about smoke from woody fuels to indicate that its importance is limited almost entirely to visibility obstruction, an effect that can be minimized by proper timing and preparation for burning. Much of the organic matter in smoke from forest fuels is similar to material normally entering the atmosphere from vegetative life or from the decomposition of vegetative matter. Fire compresses these processes into a shorter time. The environmental effects of prescribed burning are far more than compensated by great reduction in danger of disastrous forest conflagrations.³

Pollutant From Forest Fires	Total Emission in Millions of Tons Per Year	Percent of National Total
Carbon monoxide	7.2	7.2
Particulates	6.7	23.7
Sulfur dioxide	negligible	-----
Hydrocarbons	2.2	6.9
Nitrogen oxides	1.2	5.8

“Fire could be used to re-establish the primeval distribution of forest age classed and vegetation stages.” —Miron L. Heinselman, “The Natural Role of Fire in Northern Conifer Forests.”

Fire was a natural part of forest and rangeland development before man interfered and plant species “evolved, adapted and flourished” with fires. “Prescribed” or controlled burning of some range land can boost forage production up to 500 percent. —Dr. Carl Wambolt, Extension Service Range specialist, Montana State University.

“... it is clear from these studies that the forest floor accumulates a large quantity of minerals, and further, the forest ecosystem contains a limited and estimable mineral nutrient capital which is highly

³ The abstract from “Forest Fuels, Prescribed Fire and Air Quality”, J. Alfred Hall, Pacific Northwest Forest and Range Experiment Station, F. S. Portland, 1972.

subject to depletion.”—Mark J. Behan, “The Cycle of Minerals in Forest Ecosystems.” Symposium—The Role of Fire in the Intermountain West, Oct. 1970.

Nitrogen and potassium limit productivity in coniferous forests.

Fixed nitrogen is of biological origin. In coniferous forests alder and ceanothus have symbiotic nitrogen fixing micro-organisms within their root systems.

Accumulation of nitrogen in litter is a drain on the soil’s nitrogen reservoir.

To avoid misunderstanding, I have used the following Society of American Foresters’ definition of prescribed burning:

“Skillful application of fire to natural fuels under conditions of weather, fuel moisture, soil moisture, etc., that will allow confinement of the fire to a predetermined area and at the same time will produce the intensity of heat and rate of spread required to accomplish certain planned benefits to one or more objectives of silviculture, wildlife management, grazing, hazard reduction, etc.”

For additional clarification, the environment of an organism can be defined as everything that is not that organism, and ecology refers to the relationship between organisms and their environments.

Mr. Barrows:—This panel of the Fire and Land Management Symposium has been charged with presenting answers to a provocative and timely question—“Is prescribed burning compatible with environmental quality?”

Without any attempt to dodge a clear and meaningful response to the question, I must state that the answer may be either *yes* or *no*. To make sure that you do not think that I am dodging the question the following remarks will explain my reasons for answering *yes* in some prescribed fire situations and *no* in others.

Obviously an answer to the question addressed to this panel requires a clear understanding of the term—*environmental quality*. In this application of the term I make the following assumptions: First, that we are focusing on environmental quality in forest, range, brush and wildland areas; second, that we recognize the impacts of fire, not only on the areas where fire is applied, but also on other

PANEL DISCUSSION

areas that may be affected; and third, that we are guided in our definition of environmental quality by the language of specific laws including the organic acts for national forests, parks, the public domain and other federal areas; the Wilderness Act; the National Environmental Policy Act; and the various federal and state clean air and water acts.

It would be presumptuous for me to assume that all concerned public agencies and individuals will fully agree, at this time, on a specific definition of environmental quality. This is a very complex matter. Clear interpretations probably will not be achieved until there have been extensive decisions by the courts on various aspects of environmental quality. However, in the absence of these decisions, I suggest that the following description of environmental quality in section 101(a) of the National Environmental Policy Act provides an adequate definition for our discussions today:

- (1) "fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
- (2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;
- (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;
- (4) preserve important historic, cultural and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice;
- (5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
- (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

In answering the question we must also define a "prescribed fire." The material presented in this symposium clearly indicates that we must consider environmental quality for two types of prescribed fires:

- (1) The fire deliberately ignited and controlled by a fire management organization under clearly specified conditions to achieve specific resource management objectives.

- (2) The wildfire, usually but not exclusively ignited by lightning, all or portions of which will be allowed to burn under clearly specified conditions to achieve specific resource management objectives.

Under the foregoing definitions I believe that the answer to our panel question is *Yes* under the following conditions:

For Prescribed Fire Type 1 (deliberately ignited)

- (1) In advance of the burning operation a plan is prepared that specified the area to be treated, weather conditions required, firing patterns, acceptable fire behavior, control measures and the timing and duration of the burn.
- (2) The burning operation results in net benefits to environmental quality. These benefits may include: fuel reduction to minimize the chance for a future damaging wildfire; site preparation for the regeneration and improved growth of a forest; improvement of wildlife habitat; insect and disease control; and recycling of nutrients to the soil.
- (3) The burning operation is carried out under standard and approved practices of smoke management. This means that the weather conditions selected and the burning techniques will quickly disperse the smoke to the upper atmosphere and will keep smoke away from highways, airports, campgrounds, important scenic vistas and centers of population.
- (4) The burning operation will not degrade watersheds, damage property or social and economic values, or threaten public safety.

For Prescribed Fire Type 2 (wildfire)

It would seem logical to advocate that the wildfire deliberately allowed to burn for specific resource management purposes should fit the same specifications established for prescribed fire type 1. However, there are few situations when all of these specifications can be met for the entire life of a wildfire. Nevertheless I believe that prudent action and highly professional fire management operations can make carefully selected wildfires compatible with environmental quality. I suggest that the following specifications should govern the use of wildfires for resource management purposes:

- (1) The area selected for treatment should be located so that re-

PANEL DISCUSSION

source, social and economic values in adjacent areas will not be damaged.

- (2) Wildfires in specifically designated areas will meet the requirements of a fire management plan. This plan will specify the acceptable ignition areas, fire boundaries, weather factors, fire behavior, fire danger rating, time of year, public safety factors and suppression preparedness.
- (3) The fire will be carefully observed throughout its life including observation of effects on adjacent areas.
- (4) If the fire behaves in a manner that violates the specifications of the fire management plan, all or portions of it will be suppressed as necessary.

Obviously, my answer to the panel question is *NO* for prescribed fires that do not meet the requirements that I have listed. The carelessly planned or managed prescribed fire has a high potential for damaging environmental quality. In this connection I want to emphasize two very important factors:

- (1) *Air Quality*. Forest fire agencies in the U. S. have aggressively developed smoke management procedures for prescribed fires. The effectiveness of these procedures has been widely demonstrated. Had the actions on smoke management not been taken the continued use of prescribed fire would have been seriously threatened. We must continue to strengthen the smoke management program. Now that wildfires also are being used in resource management we must be sure that prudent actions are taken to safeguard the gains already made in smoke management and the attendant protection of environmental quality.
- (2) *Fire Safety and Quality of Life*. In using wildfires for resource management purposes we must be fully aware of the inherent dangers. We can minimize these dangers by very careful selection of wildfire conditions. However, a massive outbreak of lightning fires, such as occurs frequently in some parts of the West, will almost always require aggressive action on many of the fires. Otherwise we invite consequences that will be damaging to the fire management program and environmental quality. Similarly, a single lightning fire burning under high fire danger conditions can threaten public safety and affect environmental

quality. There are not any national parks or wilderness areas large enough or void enough of people to permit a disregard for fire safety factors. Highly professional and experienced fire management with astute ability to evaluate ecological, social and public safety factors is an essential requirement in prescribed burning. I believe that such an organization can use fire in protecting and enhancing environmental quality.

Mr. Perry:—The Environmental Protection Agency has regulatory responsibility for environmental quality in two resource areas that should be under consideration here today. These being water quality and air quality. The question of a project whether it be prescribed burning or any other activity, being compatible with environmental quality must be addressed from the standpoint of quality standards. It is well established that prescribed burning does have an impact on both air and water quality. The degree and acceptability of that impact is what I interpret to be the question at hand.

I have been repeatedly told by many involved with prescribed burning, that wood smoke is a natural phenomenon and, in fact, should not be considered a pollutant and certainly not worthy of the great amount of concern expressed by the EPA. However, wood smoke, natural or man caused, contains large amounts of particulate matter. The EPA has found it to be necessary for reasons of health and welfare to establish primary and secondary quality standards for particulates found in the air around us. The basis for such standards are outlined in the Air Quality Criteria Documents prepared by the EPA. Briefly, two standards for particulates have been established:

1. Primary standards—based on health effects. Annual average 75 micrograms/meter³ 24 hour average 260 micrograms/meter³
2. Secondary Standards—based on esthetics. Annual average 60 micrograms/meter³ 24 hour average 150 micrograms/meter³

If air quality measurements determine that these standards have been exceeded then that activity or activities, whether man caused or natural, cannot be said to be compatible with what man has established as environmental quality.

Basically, the same arguments can be used when considering

PANEL DISCUSSION

water quality. When established standards have been violated the activity is not compatible with environmental quality.

The land manager, is not the only one involved in using the atmosphere to carry away unneeded or unwanted products. There is competition from smelters, automobiles, power plants and the farmer who burns his ditches every year. You cannot and must not consider the effects and impacts from prescribed burning in a vacuum.

It is my observation that there is a serious imbalance in the activities of scientists and researchers who are concerned with measurement of prescribed burning effects. A great deal of time is spent measuring impacts on soil, nutrients, vegetation, etc. And certainly such measurements are necessary. However, efforts measuring effects on the atmosphere are small by comparison. In EPA Region VIII there is not one air quality monitoring system in existence that has been specifically designed to measure impacts of prescribed burning. There seems to have been a shrugging off of the responsibility of measuring the impacts on the atmosphere by the agencies and industries responsible for the majority of prescribed burning. Is it any wonder then that the land manager is reluctant to use a valuable tool such as fire. The manager is constantly open to question and sometimes criticism from those responsible for maintaining air quality standards because he cannot, in fact, quantify his impact on the environment.

The EPA recognizes that healthy, productive forests are an important part of environmental quality and that ecologically natural and diverse national parks and wilderness areas are also an important contribution to that concept. However, the achievement of productive and ecologically sound forest lands must and can be achieved within the limits of other environmental quality standards.

The question before the panel cannot be answered with a "yes" or a "no." The fact is that no one really knows. Day to day activities are not being monitored intensively enough to determine the answer. As long as the monitoring aspects are ignored, the use of valuable tools will be constantly questioned and subject to such accusations as the National Park Services' "Scorched Earth Policy" as recently reported in the Denver Post.

Achieving the answers will not be easy. The commitment to de-

fine, quantify, and predict the impacts on air and water quality, cannot be delayed.

Mr. Wake:—I appreciate having been asked to participate on this panel discussion—Is Prescribed Burning Compatible With Environmental Quality? I had thought when I first received the program that the subject of air quality was, perhaps, an afterthought of those who had made up the program since the direction of most of the discussion has been to that of increased creation of smoke. I hope that the few moments I have in dealing with this subject of air quality is not merely a sop to the conscience of those participating or a carrot, as it were, to be tossed to the environmental control agency in charge of air pollution control, but that there is a genuine concern for the degradation in air quality that always occurs when any burning takes place and more specifically when slash burning or forest fuels disposal is done. Having reviewed all of the titles on the program and having listened for most of the day, there sticks in my mind the inescapable conclusion that air pollution occurs from the use of fire and that the objectives of the Clean Air Act of Montana and the objectives of the Federal Clean Air Act are not enhanced by deliberate fire starting or the use of fire in most instances. This is particularly true concerning slash burning or similar forest practices.

We recognize and appreciate the cooperation of the U. S. Forest Service and several forest industries in the reduction of smoke from slash burning and other fires and the attention given to creation of fires mainly during those times of best ventilation. This cooperation has been good and we greatly appreciate it. Nevertheless, during times of fires for disposal of slash, deterioration in air quality is profound and widespread.

It is for this reason that we must be opposed to burning which does not meet the criteria for smoke emissions which all others must meet. Slash burning has been permitted only because of the lack of information, at this time, to preclude such burning entirely. We are convinced that the smoke from burning of slash, as an example, creates an additional burden that the human body must endure from all causes by the generation of particulate matter, not to mention

PANEL DISCUSSION

certain distillation products of wood and carbon monoxide which may be of even greater significance. The formation of aromatic hydrocarbons of carcinogenic potential has been identified in air samples collected in certain areas of Montana where wood smoke from tepee burner operations was the major source of the particulate.

Particulate matter is of considerable concern. Effects on health is readily shown in the literature, not only from individual smoke particles or other individual type particulates but from the synergistic effects which may take place when other materials are present, which they almost always are.

Considerable data have been presented on a number of air pollution episodes in London and in New York City. Excess deaths and considerable increase in illness have been observed in London and New York at various concentrations of smoke in combination with sulfur oxides. While one may assume that smoke generation on a mountain side in Libby may be of no significance in Helena, Montana or in Anaconda, we cannot concur. We have observed on several occasions the whole western part of the states will be covered by smoke during times of heavy slash burning which mixes with other gases such as sulfur dioxide being generated in large quantities at Anaconda and East Helena. Analysis of numerous epidemiological studies clearly indicate an association between air pollution as measured by particulate matter accompanied by sulfur dioxide and health effects of varying severity. It should also be remembered that there are probably no communities which do not contain individuals with impaired health who are particularly susceptible to the adverse effects of elevated levels of particulate matter and sulfur oxides and other gaseous materials which may be present. Epidemiological studies concerned with increased mortality also show increased morbidity.

An asthma attack is terrible for a child and even worse for his parents. Triggered by an allergic irritation, the tiny passageways of the lungs close up, making it impossible for the youngster to catch his breath. Panic makes breathing even more difficult. A parent can never predict an attack or even be certain that the medications on hand will be effective. For many, the sound of a gasping youngster signals frantic rush to the hospital.

In one Ohio town, 79 cases of asthma attacks and other breathing problems occurred during a 2-month period in the Fall of 1972. A local doctor attributed more than half of these attacks directly to the open burning of leaves. It was determined that more than \$30,000 worth of oxygen was required for the treatment of local patients during that time period.

How can leaf burning cause breathing difficulties? Many asthmatic youngsters are allergic to mold spores, millions of which are harbored in leaves. These substances are released into the air by the burning process. In addition to mold and spores, other gases are released by open burning that can be harmful to people suffering from emphysema, chronic bronchitis, or other respiratory problems. A person struggling for every breath cannot tolerate the airborne waste that open burning releases into the air.

Particulate matter suspended in the air also scatters and absorbs sunlight reducing the amount of solar energy reaching the earth producing hazes and reducing visibility. Suspended particulate matter plays a significant role in bringing about precipitation, and there is some evidence that rainfall in cities has been increased as the cities have developed industrially. That world-wide particulates have been increasing, is evidenced by the fact that in the United States and other countries turbidity produced by the back scattering of sunlight by particles in the air has increased significantly over the last several decades.

Particles suspended in the air reduce visibility or visual range by scattering and absorbing light coming from both an object and its background, thereby reducing the contrast between them. Moreover, suspended particles scatter light in the line of sight illuminating the air between to further degrade the contrast between an object and its background. Many people report a depressing effect with increasing lack of visibility.

Particulate air pollution causes a wide range of damage to materials. Particulate matter may chemically attack materials due to its own corrosiveness or to corrosiveness of substances absorbed or adsorbed on it. Merely by soiling materials, and thereby causing their more frequent cleaning, particulates can accelerate deterioration. Laboratory and field studies underscore the importance of the

PANEL DISCUSSION

combination of particulate matter and corrosive gases in the deterioration of materials. Particulate air pollution damages electrical equipment of all kinds. Oily or tary particles such as many of the distillation products of wood commonly produced in inefficient burning such as slash burning contribute to the corrosion and failure of electrical contacts and connectors. Dust can interfere with contact closure and can break contact surfaces. The soiling of textiles by the deposition of dust and soot on fabric fibers not only makes them unattractive and thereby diminishes their use but result in abrasive wear of the fabric when it is cleaned.

Several studies indicate that there is a relationship between the level of particulate pollution, used in index of air pollution, and levels of public concern over the problem. A study conducted in St. Louis metropolitan region found a direct relationship between the fraction of a communities population who said air pollution was a nuisance and the annual mean of concentration of particulate air pollution in the community. We have received many complaints from people about the vast amount of smoke created by slash burning and other fires which indicates their disenchantment to smoke (produced by someone else).

Up to this point, I have considered only the toxic and aggravating characteristics of particulate matter. Yet there are other emissions from burning or the use of fire in forests where substantial quantities of gases such as carbon monoxide are released into the air. Carbon monoxide has a relatively high toxicity compared with other pollutant gases. While lethal levels of carbonoxyhemoglobin are not subjects of controversy, lower level effects or mental impairment resulting from continuous low level exposures are under much study. Investigations have shown that oxygen transport is significantly effected at a level of 10 percent of carbonoxyhemoglobin. Other studies have reported that impairment of the central nervous system can occur at levels as low as 2 to 5 percent carbonoxyhemoglobin with consistent impairment in cognitive and psychomotor performance occurring at 5 percent. These elements are well understood, but an even greater influence produced by carbon monoxide is its relationship to heart disease. The human body reacts to the reduced oxygen transport to the tissues in correlation with the type of carbon

monoxide exposure. If the exposure is to high concentrations for short periods, the heart pumps faster to increase the flow rate of blood to the lungs for aeration. In this way, the demand for oxygen carrying hemoglobin molecules increases. It is clear that this increased flow rate is the source of strain on the heart.

If the exposure is to low concentration over a longer period of time, the body tends to adapt by stimulating production of hemoglobin in red blood cells. If the exposure is prolonged, an increased number of red blood cells in the blood stream will tend to balance the anemic condition caused by the carbonoxyhemoglobin; however, increasing the density of the blood with red blood cells leads to a morbid condition known as plethora, making the blood much more sticky thence much harder for the heart to pump. Again, a strain on the heart is the result. Therefore, whether the carbon monoxide exposure is brief and high or prolonged and low the end result is a severe strain on the heart. The available evidence suggests daily average carbon monoxide level in the excess of 10 ppm may be associated with increase mortality in hospitalized patients with heart disease.

I believe that the state Department of Health and Environmental Sciences has carried on an aggressive, but reasonable, attack on air pollution in Montana and that we have achieved notable success in many areas. Just recently, three large pollution sources have agreed to a substantial control program, costing many millions of dollars for which we and the other people in Montana are grateful. It is of recurring concern, however, each fall, that slash burning completely nullifies these important gains. There has been a determined effort made by millions to reduce air pollution. Why should the acceleration of emissions from "prescribed" fires in forests go unchallenged? It is particularly difficult to explain to persons who may have a small fire in their backyard burning leaves, trash or limbs or perhaps a little garbage and a tennis shoe or an old tire why this should not be done when they can see a vast column of smoke rising into the air and settling into their valley from slash burning performed some place else perhaps many, many miles away. It is equally difficult to understand the enchantment of Federal and State forest managers with the increased use of fire in the face of executive order 11752

PANEL DISCUSSION

published in the Federal Register December 19, 1972 which says, in part, . . . “the Federal Government . . . should provide leadership in the nationwide effort to protect and enhance the quality of our air. . . .”

While I indicated in the beginning that we are grateful for some good work done by the United States Forest Service in attempting to minimize smoke from slash burning and other fires and in spite of all of the fine presentations at this meeting (which was held for the promotion of the use of fire and smoke) I must protest the use of fire in any instance except for the protection of life and property which may be in imminent danger, and then only if no other means of protection are available. In my opinion, all forest operations of any government agency or private company should be actively engaged in determining means to limit burning to an absolute minimum, if not altogether. I predict that there will be a time in the not too distant future, because of the increasing amount of air pollution being produced worldwide, that there will be a demand for the complete ban of prescribed burning in the forests regardless of whether certain types of trees must be sacrificed in the process. Ultimately, people are more important than a given species of tree.

To summarize, millions of dollars have been spent by many organizations supported by millions of people to reduce or eliminate air pollution. I would hope to see a redirection in the thinking of forest managers promoting fire and a substantial effort made in the review of alternatives. It would seem to me that many foresters and forest use managers are modern Rip Van Winkles when it comes to air pollution control. Foresters and forest managers should become aware of and support and protect that most fundamental element of the human life support system, the lung. They should also support the proposition that air is for breathing and any activities that adversely affects the vital function of human beings should at least be minimized, not enhanced, and eliminated, if possible.