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USE OF FIRE IN LAND MANAGEMENT[1/]

Richard J. Vogl [2/]

Ecologists are concerned with the relationships existing between organisms and their environment. Studies analyze undisturbed plant and animal communities better to understand balanced relationships established through evolution and time. These studies may serve as the control portions of later research when the information is used to assess disturbed or unbalanced communities.

Fire, from various causes, has been established as a natural part of many pristine environments, or has become a part through the introduction and continued use of fire from the landscapes of the world; an approach most ecologists believe is contrary to established ecological principles. The removal of fire from plant and animal communities previously in equilibrium as a result of recurring fires is tantamount to breaking a strand in an often already sagging web of life in those communities. Eliminating fire creates chain reactions that may be irreversible or costly to rectify. Fire and its use have become controversial as a result of a one-sided compaign that has affected the thinking of at least two generations of both scientists and the general public. A propaganda program initiated to curb the unnecessary, unwarranted, reckless, and often devastating fires of the late 1800's and early 1900's has backlashed so that it is now almost impossible to use or even discuss the use of

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1/ Based on a lecture presented at the Hawaiian Botanical Society meeting of January 8, 1968.

2/ Visiting Associate Professor of Botany, University of Hawaii.

any type of fire anywhere. Ecologists generally agree that fire needs to be reintroduced into the management of many biotic ommmunities as a controlled tool to replace this intricate part of once balanced ecosystems. It is time that fire be converted from its presently predominate role as a bad master to that of a good servant. Ways in which fire can be used in land management are the following:

In forestry, fire in certain types can be used in seedbed preparation, in reducing understory competition, in thinning and pruning, and in insect and disease control. In addition, fire can be employed in the disposal of logging slash, in the completion of some tree species' life cycles, and in fire hazard reduction. Interestingly, major North American lumber species had lives associated with fire before European discovery. These trees survived repeated burning for years and even centuries without the aid of fire protection to give us the famous virgin stands of timber which are only currently being exhausted.

Fire hazard reduction is becoming a mounting problem wherever fire protection has been effective and wherever there are accumulations of inflammable fuels as a result of rapid growth, long growing seasons, and slow decomposition rates. Fire hazard buildups are becoming national problems that are a threat to natural resources, defense, military installations and operations, and evacuation plans during disasters. An advantageous way to reduce this threat is with the controlled use of fire; essentially to use fire to fight fire or to have fires on man's terms and not on nature's terms.

Fire has been used in range management to increase productivity of certain grassland types by increasing vigor, seedstalk production, and palatability. This is accomplished by the removal of choking accumulations of litter and the fertilizing effects of the ash. Fire can be utilized to improve spring flow and retard brush invasion. Thousands of acres have been put out of livestock production by the invasion of these so called "land grabbers". Fire is a feasible way to manage large ranges, and does not leave residues that might be accumulative or recycled in the soils, herbivores, or man as might occur with chemical treatment.

Fire has been used as a wildlife management tool, a field which is rapidly merging into the broader field of recreational management. Most North America wildlife species, as well as wildlife in general, are associated with fire-type vegetations or with forest openings which were or can be created or maintained by fire. Today's public is becoming interested in hunting wildlife year around with cameras, in seeing wildlife from the family car, or in a school-sponsored tour; and is beginning to demand natural vistas, landscapes, and productive habitat. Fire not only controls plant succession but increases productivity by increasing available food, both in quantity and in quality.

A field that is beginning to overshadow most others is watershed management as a result of increased populations and water use. Certain vegetation covers are more effective in conserving water and preventing erosion than others, and complete conversion of entire mountain drainages is being contemplated. Fire may be one effective way to convert some vegetation types and to maintain others without affecting water quality.

In agriculture, burning can be used in weed control, disposal of plant debris resistant to decay, in vermin and disease control, and in land clearing. Burning is suggested because the results of this form of rapid decomposition are usually not

harmful to soils or subsequent crops and may be beneficial and inexpensive.

Burning and bush cutting have been largely replaced in right-of-way management by chemical control. Ecologists still favor the former because of possible residual effects of herbicides, the indiscriminate use of these chemicals, the persistent smells and the unsightly "brown-outs".

Conservationists must begin to think beyond protection and preservation to management. They should become aware of fire as a possible means to retard plant succession. Fire is only recommended as a controlled tool for some communities and not as a blanket rule. The use of fire will only come with public understanding and acceptance and improved burning techniques. When we have learned to use fire to man's advantage we will have learned to control fire and then will have regained the lost art of the aborigine.

FIRE AND OTHER TOOLS IN WILDLAND MANAGEMENT 1/

R. E. Nelson 2/

Fire in the forest means a lot to all of us. Fire has been praised as a universal tool to solve a great array of management problems in forests and other wildlands. But there is little evidence to support wide use of fire in our forest. Proposals to reduce fire prevention and suppression activities should be carefully analyzed.

There has been some dramatizing and emotionalizing in support of widespread burning. Exaggerations are the tools used. Objectives are difficult to isolate.

For example, in a recent newspaper article it was claimed that "two-thirds of the U. S. Forest Service budget is used to fight fires." The facts are quite different.

The U. S. Forest Service manages some 187 million acres of public lands under the principle of multiple-use, and also provides many services to state and private organizations and conducts a broad program of forestry research.

In 1968, U. S. Forest Service appropriations amounted to 359 million dollars. In the last five years, the average annual cost for fighting fires was 21 million dollars or 6 percent of the budget, not two-thirds. The total prevention and suppression bill amounts to about 17% of appropriated funds.

1/ Based on a lecture presented at the Hawaiian Botanical Society meeting of May 6, 1968.

2/ Chief, Forestry Research Center, Hawaii, Pacific Southwest Forest and Range Experiment Station.

We still have too many fires. They destroy too much of our valuable forest resources and developed property too.

It is staggering to realize that suppression costs on a single fire can amount to $2½ million, such as on a fire above Santa Barbara, California in 1964. Follow-up emergency soil stabilization and flood control work cost another $2 million-plus.

Another claim is that "fire knows which are the weak trees and the bad genetic trees." It is obvious that fire has no knowledge. Fire is simply a chemical and physical process of rapid oxidation of a substance--plant materials for instance. Susceptible plants will be damaged or killed by fire. Resistance to fire is not necessarily a measure of the desirability of a plant. Highly desirable plants can be killed even in prescribed burns.

Many studies of the use of fire in forestry have been made and are still under-way. Many problems remain unsolved.

However, there are reports of the successful use of fire for purposes such as tree disease control, control of undesired hardwoods, planting site preparation, wildlife habitat improvement and fuel reduction.

It is often claimed that unprotected forests are subject to frequent natural fires which clean up the forest. It is also claimed that fire protection efforts have prevented these "beneficial" fires and thus caused such a fuel build-up that we now have holocausts.

A compilation of historical forest fires in the United States shows that our worst recorded holocausts occurred in the 1800's, long before fire protection efforts could have caused an "unnatural" fuel build-up in the forests.

Land clearing fires and logging added to the development of these large fires. Lightning was also an important factor. The important point is that in the millions of acres of virgin forest, the fuel conditions were obviously ripe for conflagrations. Man has come in great numbers to set the spark to this fuel, accidentally or otherwise. That is why we have a problem.

In 1966 we had 109,000 fires in the U. S. which burned over 2,230,000 acres. 200 million Americans provide a lot of sparks as over 90 percent of the fires are man caused.

Obviously fire does play a role in affecting the extent and composition of forest and other vegetation in the wildlands. But now let's take a look at the wildlands from another angle.

Biotic factors, climate, and soil, as well as fire, all play a strong role in affecting the composition and extent of vegetation types. However, climate and soils play the strongest role over extensive areas of wildlands. Climate and soil are the basic resources of an area; the medium in which plants grow, with or without the impact of fire; grazing animals, or the plow. There are many examples of the strong influence of soils on vegetation types.

Grassy openings in forests or brush fields are often due to contrasting soils rather than some outside influence. To the contrary, the soil may be the same under grass and brush or forest cover.

In some areas the main differences we find in site conditions are soil depth, surface soil characteristics, and topographic position. Here, fire and erosion may play a strong role in rapid changes of vegetation.

In late spring in California, soil patterns show up where vegetation dries up first on the shallow soils. Herbaceous vegetation may be keyed to soil types.

Soil is one of the most important factors with which we must work in our attempts to make our forests and other wildlands more productive--and less hazardous where fire is concerned.

We must begin this job of forest land management at some logical point. First, we must establish the objective of management. Shall our objective be to find some way to use fire to manage the land? Obviously, this is not a real objective. Usually when fire is mentioned as a tool in wildland management, the management objective is related to vegetation type conversion or manipulation--the land manager wants to alter the vegetation or destroy vegetative matter for one or more purposes.

It is possible that fire can and should be used to obtain the objectives desired. Its effectiveness and its cost must be carefully evaluated, along with any other possible tools or practices. Because fire is an extremely dangerous and difficult tool to handle, its effectiveness and cost is hard to determine. The risk of cost of escaped fires if added to the direct cost of so-called controlled burning would prohibit many prescribed burns. And there are other undesirable effects. For example: Air pollution, soil erosion and siltation, loss of nitrogen and soil organic matter, ugly scars in the landscape, and wildlife killed.

Try to imagine the results if "frequent" burning of all forest lands was the normal practice, as is strongly proposed by a few people. There are 648 million acres of forests in the U. S. If every acre was burned once in a hundred years, this would mean burning of more than 6 million acres each year. This is nearly 3 times the 1966 acreage burned. But every hundred years is not "frequent." Perhaps 10 years is. This would mean burning 64,800,000 acres each year. Imagine the air pollution and other effects of such a program.

Must we conclude that if we can't use fire we can't accomplish the management objective? Remember, fire is just combustion--it rapidly oxidizes and destroys organic matter and killing plants and other organisms.

One management objective that is commonly proposed is to improve habitat for a specific kind of game by type conversion or manipulation. It must be assumed that the land manager knows which are the best food and cover plants and their optimum distribution; that the present vegetation does not meet the requirements; and that the soils and climate will support the desired vegetation. What means does the manager have to make the conversion? Mechanical tools, seed, fertilizer, and herbicides are the tools a farmer uses when he wants to cultivate a crop. These tools, or others, as well as fire, or a combination, should be considered.

When there are suitable soils in the chaparral areas of California, conversion is possible and often practical. Usually this will require a series of tools and operations.

The purpose of the conversion might be to break up the brush field for more effective fire control; to improve game habitat; to improve aesthetics; to develop

a productive timber stand; or some other purpose.

Chaparral can be burned, but without follow-up work will recover the site rapidly.

For permanent conversion the first operation is usually to crush the brush, then burn it. Then the site must be planted to the desired cover. Herbicides must then be used to kill brush sprouts in the spring. It may be necessary to use herbicides more than once to kill the brush competition. This series of treatments, which includes burning as one step to get rid of bulky organic matter, can accomplish the objectives on carefully selected sites.

In Hawaii we have less serious fire problems than on the mainland, but occasionally a fire makes the headlines. The fire above Hanalei on the Island of Kauai in June 1967 is an example. The Division of Forestry has been criticized for not controlling this fire before it burned so much acreage. On the other hand, this fire has been pointed to as a beneficial happening.

The cause of these diverse reactions is lack of knowledge, a substitution of emotion for facts, and an attempt to emphasize narrow values in situations where a broad and complex range of values are involved.

There are complex problems in wildland management, especially where fire is concerned. Fire may play an important role as a management tool in specific limited circumstances. But it is a dangerous tool and can be expensive. It makes little difference whether it is a "natural" fire or an escaped "controlled-burn" which destroys natural resources, capital investments, homes, and other property.

Remember, you and I and 200 million other Americans are creating the spark for over 90 percent of the forest fires in the United States; probably 99 percent of the fires in Hawaii. I think we can and we must be more careful with fire.

BOTANICAL SOCIETY NEWSNOTES

Hawaiian Botanical Society Award: This award, presented to the University senior with the most outstanding record in the plant sciences, was give to STEPHEN A. FERREIRA. Mr. Ferreira, from Hanamaulu, Kauai, completed his B.A. degree in Botany in June. Next year he will undertake graduate work in Plant Pathology at the University of California at Davis.

Sigma XI Award to Dr. Notoatmodjo: The Society of the Sigma XI has announced through the chairman of its Grants-in-Aid of Research Committee, Dr. Harlow Shapley, an award to Dr. Setijati Notoatmodjo of the National Biological Institute of Indonesia.

This award has been made to Dr. Notoatmodjo to assist her in her study of the Indonesian Species of *Curcuma* (Zingiberaceae).

Dr. Shapley, in making this announcement, stated "Sigma XI each year makes a number of grants to the most promising scientists at critical points in their research careers. We recognize that many needs are relatively too small for the large foundations to consider and it is to meet these needs that our research fund is maintained."

Founded in 1886, the Society of the Sigma XI now has 167 charters and more than 170 clubs in the major colleges and universities in the United States and Canada. Sigma XI, with an active membership of 100,000 scientists, sponsors eighteen national lectureships, publishes The American Scientist, and in 1967 made awards in support of research totaling $78,000.

RECENT PACIFIC PUBLICATIONS

KENNER, DIANA D., HANS R. HOHL, & GLADYS E. BAKER. 1968. Preliminary observations on the fine structure of species of Micromonospora (Actinomycetales). Pacific Science 22: 52-55.

LAMOUREUX, CHARLES H. 1968. Review of: Tropical Plant Types by B. G. M. Jamieson & J. F. Reynolds. Quart. Rev. Biol. 43: 202.

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MORRISON, G. C. 1968. A preliminary phytochemical survey in the British Solomon Islands. Pacific Science 22: 184-193.

SIEGEL, SANFORD M. 1967. Effects of metabolic poisons on rice: The comparative sensitivity of aerobic and anaerobic modes of germination. Plant Physiology 42: 1489-1492.

SIEGEL, SANFORD M. 1967. Living relative of the microfossil Kakabekia. Science 156: 1231-1234.

SIEGEL, S. M. 1967. The performance and capabilities of terrestrial organisms in extreme and unusual gaseous and liquid environments. Univ. of Hawaii, Hawaii Botanical Science Paper No. 4: 1-58.

SIEGEL, S. M. 1968. Biochemical processes in macromolecular environments: Plant cell-wall matrix in lignin polymer formation. Amer. Assoc. Adv. Sci., Biology of the Mouth, pp. 111-125.

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SMITH, A. C. 1967. The presence of primitive angiosperms in the Amazon Basin and its significance in indicating migrational routes. Atas do Simposio sobre a Biota Amazonica, Vol. 4 (Botanica): 37-59.

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c/o Department of Botany, University of Hawaii
2450 Campus Road, Honolulu, Hawaii 96822

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THE HAWAIIAN BOTANICAL SOCIETY was founded in 1924 to "advance the science of Botany in all its applications, encourage research in Botany in all its phases," and "promote the welfare of its members and to develop the spirit of good fellowship and cooperation among them." "Any person interested in the plant life of the Hawaiian Islands is eligible for membership in this Society."

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c/o Department of Botany
University of Hawaii
2450 Campus Road
Honolulu, Hawaii 96822

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