Forest Fire and Big Game in the Pacific Northwest

JACK R. NELSON, *Professor*
Washington State University
Pullman, Washington

To the average citizen, a forest fire (Fig. 1) is a catastrophe, causing wholesale destruction of homes, timber, watershed, wildlife, and scenic environment for recreation. But to those who study it, fire is as natural as rain. But, like rain, when too much comes at the wrong time or wrong place, it can bring with it economic and esthetic loss. It is necessary for the general public to look upon fire as objectively as it does rain. For, certainly, a forest fire is not always an ecological disaster.

Wildfire (Fig. 2) has been a significant ecological factor in the Pacific Northwest for thousands of years (Weaver, 1943; Daubenmire, 1968). Wildfires in this region were both large and frequent, especially east of the Cascade Mountains. Few forested areas could have survived for long in climax condition. Barrows (1951) calculated that fires, burning at the rate recorded prior to 1947, could consume 50 percent of the forests in eastern Oregon and Washington, northern Idaho, and adjacent western Montana every 100 years, with 3.7 million acres being burned two and three times. Surface fires (Fig. 3) of light intensity probably occurred every 7 to 15 years in the life of a ponderosa pine stand, consuming litter and other debris, and rendering the stand less susceptible to serious fire damage later (Weaver, 1947).

Such frequent wildfires through the centuries have undoubtedly had a profound influence upon evolution of both plants and animals in the Northwest. Reproductive and other mechanisms conducive to

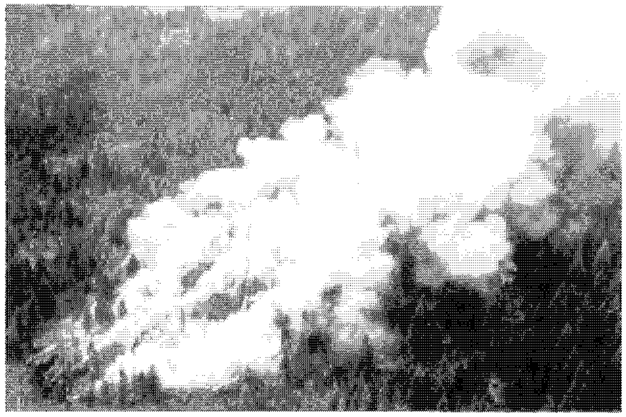

Fig. 1. Forest fires in the Pacifi Northwest are a natural ecologic: phenomenon (W. L. Stewart, USFS)

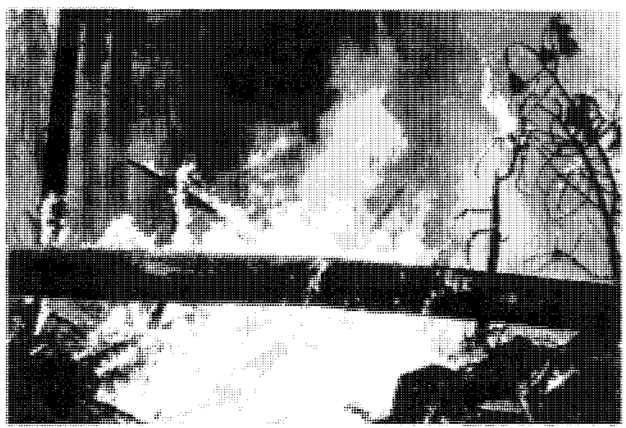

Fig. 2. Prior to the present fir suppression era, few forested area in the Pacific Northwest could hav survived for long in climax cond tion, due to the high frequency c wildfires (W. L. Stewart, USFS).

Fig. 3. Surface fires were commo in more open forest types (W. I Stewart, USFS).

surviving periodic fires are common among plants of the region, including thick bark, underground rhizomes, root sprouting (McLean, 1969), epicormic sprouting, wind-born seeds, serotinous cones, and seeds which require high temperature, pre-germination treatment, such as *Ceanothus* spp. (Fig. 4) (Galzebrook, 1941; Cronemiller, 1959). Perhaps, as Mutch (1970) suggests, many of these plants have evolved higher flammability which would enhance the possibilities of fire and, thereby, favor perpetuation of fire type vegetation.

Most game animals in the region are, in one way or another, closely associated with secondary succession habitats. Although black bear and all deer species (Fig. 5-8) of the region (white-tailed, black-tailed, mule deer, elk, and moose) are found in limited numbers in climax and near-climax forest habitat, their populations are greatest in areas which have been modified by fire or logging (Parsell, 1938; Taber and Dasmann, 1958; Patton and McGinnes, 1964; Spencer and Hakala, 1964). Mountain sheep (Fig. 9) on the other hand, seem

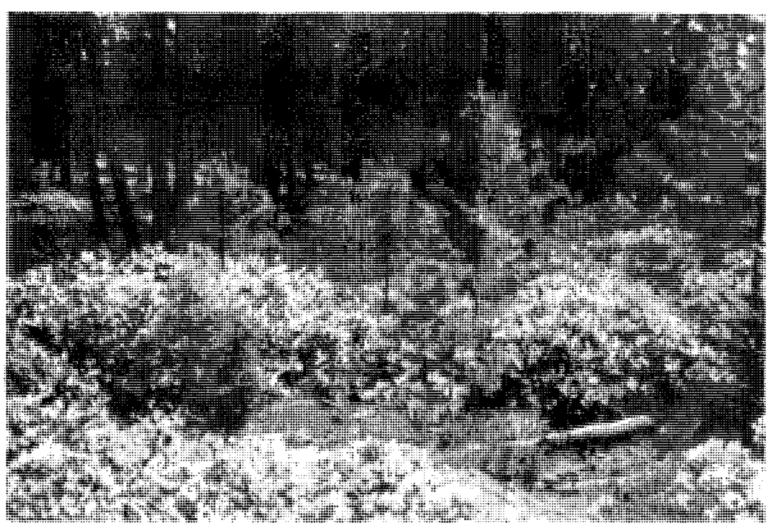

Fig. 4. Evergreen ceanothus (*Ceanothus velutinus)*, like other ceanothus, requires fire for optimum germination.

the largest of the four compartments, not only digest cellulose and other complex carbohydrates, but synthesize most vitamins and all essential amino acids needed by the host ruminant. Of course, the raw materials for synthesis must be present in the ruminant diet, including crude protein (nearly any form of nitrogen will do), essential minerals, vitamins D and E, carotene for vitamin A synthesis, and an energy source, such as cellulose. When these raw materials are lacking in the diet for very long, the deficiency is manifested in a variety of ways, including (1) reduced reproduction (Fig. 10), (2) increased incidence of disease and parasitism, (3) higher predation losses, and (4) starvation, to name a few (Dasmann, 1971; Robinette et al., 1952).

Big game animals in the Northwest maintain themselves on a high nutritional plane for most of the year. During spring and early summer, green and succulent herbs provide forage, with nutrients in quantities well-above levels needed for optimum growth and reproduction. As the growing season progresses and forage nutritive values decrease, the animals merely move to higher elevations, cooler aspects, or more shaded habitats to find vegetation in delayed stages of phenological development (Laycock and Price, 1970). Preliminary results of our elk and mule deer food habits study on

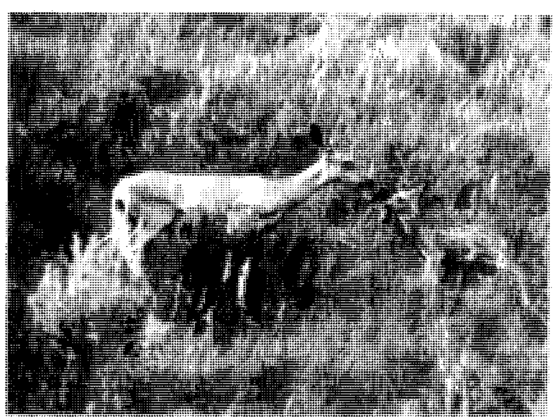

Fig. 10. Rocky Mountain mule deer doe with fawn. Females of all mammal species have very high nutritional needs during the latter stages of pregnancy and during lactation (Ed Bry).

Colockum Game Range in central Washington indicate that crude protein content of diets may range from 15 to 30 percent from March through early August (McArthur, 1974). This is considerably above the 13 to 16 percent crude protein level needed for optimum deer growth and reproduction, and especially above the 6 to 7 percent needed for maintenance (Halls, 1970b)

By late summer and fall, most herbaceous species have matured and their palatability and nutritive values to big game are minimal. It is at this time that big game animals in many areas turn more heavily to browse for sustenance (Murie, 1951; Hill, 1956; Allen, 1968; Martinka, 1968; Korphage, 1974). Among these herds, browse remains important through winter until spring green-up. Browse generally is not as digestible nor as nutritious as green herbage; but, in fall and winter on many ranges, it comprises the most nutritious food available. Browse commonly varies from 6 to 10 percent crude protein in winter (Murie, 1951; Hill, 1956; Smith, 1957; Brown, 1961; Short et al., 1966; Leege, 1969), varying with species and parts of plant eaten and is an important source of phosphorus and carotene.

On heavily browsed winter range, crude protein content of the diet may drop below maintenance level, and herd losses result. This is a particularly difficult time for young animals, which were unable to acquire much fat the previous summer, because of rapid growth and high nutritional requirements. Resorption, abortion, and stillbirth are common occurrences among pregnant does and cows, when forced to winter at sub-optimal nutritional levels.

EFFECTS OF FIRE ON BIG GAME AND BIG GAME HABITAT

Relatively few fires in the Northwest are of the raging, conflagration type which consumes not only thousands of acres of vegetation, but also soil surface horizons and some wildlife. Approximately 98 percent of all forest fires in the region have been less than 100 acres in size (Div. Coop. For. Fire Control, U.S.F.S., 1970). In fact, 94 percent burn less than 10 acres. These fires are generally light to moderate in intensity, otherwise they would not have been contained by suppression crews so quickly. Damage to soils is light.

Perhaps soil fertility and even structure are improved (Vlamis et al., 1955; Tarrant, 1956).

With the exception of a few early fires which occur during bird nesting season (Stoddard, 1963) and large conflagrations, loss of wildlife during fires is largely discounted (Howard et al., 1959; Handley, 1969; Komarek, 1969). In fact, much to the dismay of foresters intent on reforestation following fire, post-fire vegetation attracts small rodents in unwanted numbers (Ahlgren, 1966).

The ecological significance of fire is relative to the organisms under consideration (Moen, 1973). A large forest fire may be detrimental to the woodland caribou and, for reasons given earlier (Geist, 1971), mountain sheep; but, to other big game in the region, the fire means the beginning of easy living.

Fire Benefits

Response of vegetation following fire depends upon the size of the fire, intensity, and composition prior to fire (Ahlgren and Ahlgren, 1960; Daubenmire, 1968). Plant succession on large, intensively burned areas may move slowly, because of remoteness of unburned seed sources and low survival of plants within the area burned. Usually, however, within 2 or 3 years, much vegetation has become reestablished and more luxuriant than it was under forest canopy (Fig. 11).

The most obvious change in vegetation to the casual observer is the greatly increased understory production, particularly if an artificial seeding has been made for erosion control purposes (Fig. 12). Stewart (1973) studied effectiveness of 12 seeded forage species in stabilizing wildfire burns in mixed-conifer forest in north-central Washington. Yields ranged from 1,637 to 2,889 lbs/acre the first season following the fire. This seeded burn could conservatively carry 5 deer-months per acre. Unseeded controls averaged 179 lbs/acre the first year. The second year, unseeded controls averaged 425 lbs/acre, twice that of adjacent unburned areas. Heavy mule deer use of the seeded area was observed, particularly on orchard grass (*Dactylus glomerata*).

The attractiveness of new growth to grazing animals, following

Fig. 11. Luxuriant understory growth a few years following fire can greatly increase big game carrying capacity.

Fig. 12. Aerial broadcast seeding following wildfire is commonly practiced to protect the watershed. Such practices are of considerable benefit to big game, as well.

fire, is well known and documented (Daubenmire, 1968; Lay, 1967). Biswell (1961) reported that black-tailed deer numbers in burned chamise brushlands was 131 per sq. mile 2 years following fire, compared to adjacent unburned areas with densities of approximately 30. Burned areas were used more intensively than unburned areas for at least 6 years.

Possibly of more significance to big game habitat management than to the game animals themselves is the improvement in palatability, caused by fire, of normally unpalatable species. Leege (1969) found that elk utilization of syringa (*Philadelphus lewisii*) sprouts following a prescribed burn increased from 1.3 to 36.3 percent, and oceanspray (*Holodiscus discolor*) use increased from 0.7 to 23.1 percent the first year. The second year, utilization of syringa remained high, while oceanspray use dropped to 6.9 percent. Gibbens and Schultz (1963) reported similar findings in manzanita burns.

There is some controversy as to whether or not new growth following fire is more nutritious. Most researchers, however, report increased protein, phosphorus, and calcium for 1 to 2 years following fire (Daubenmire, 1968). DeWitt and Derby (1955), studying nutritive values of shrubs on burned and unburned sites in Maryland, concluded that increased protein effects lasted 4 years. Comparing early June samples of red maple (*Acer rubrum*) and flowering dogwood (*Cornus florida*), they found 11.6 and 12.5 percent crude protein in these two species, respectively, on burned sites, compared with 9.5 and 9.9 percent on unburned sites.

Still another beneficial effect of burning is a tendency for plants in recently burned areas to be earlier phenologically than the same species on adjacent, unburned sites. This effect has not been well-documented for game ranges, although it has been observed repeatedly by range and pasture researchers (Daubenmire, 1968).

The above examples demonstrate that, not only does fire often increase big game carrying capacity several-fold, particularly on heavily forest land (Fig. 13), but also forage is more nutritious and available sooner than on unburned sites. Increased nutritive value and earlier phenology of new growth on burned areas may be of considerable value on big game ranges in spring. Following a severe winter, particularly on poor range, the fate of the calf or fawn crop

Fig. 13. In the eastern Cascade Mountains, natural plant succession, following wildfire and (here) salvage logging, often leads to a long-enduring grass-sedge cover which is much used by big game in summer.

could depend upon an early source of highly nutritious forage.

I would be remiss in my discussion of effects of fire on big game if no mention were made of habitat and species diversity. Most recovered burned areas are very diverse in plant species composition and structure. Due to variations in burning intensity, habitat and species diversity is the rule, rather than the exception (Fig. 14). Habitat diversity is important to animals seeking food and cover, because it offers habitat stability (Lay, 1969; Goodrum and Reid, 1958; Larson, 1967). Lyon (1971), for example, reporting results of a prescribed burn on second growth, mistletoe infested Douglas-fir in south-central Idaho, found that the number of plant species increased from 51 to 99. Most of this increase was due to invading herbaceous species, although five new shrubs were encountered. Gibbens and Schultz (1963) recommend that habitat manipulation should be conducted in such a way as to favor as many plant species as possible, because plants vary so greatly in phenology, palatability, and nutritive value. Fire helps to accomplish this naturally.

Fig. 14. Wildfire usually leads to habitat diversity. Post-fire succession here has led to a shrub-dominated ridgetop, with dense secondary growth of mixed-conifer habitat on the slopes.

FIRE AS A TOOL IN BIG GAME HABITAT MANAGEMENT

In the Pacific Northwest and neighboring areas, fire has been used as a habitat management tool primarily in brush manipulation. The major portion of management and, consequently, research effort has centered in California. From 100 to 150 thousand acres of chaparral are control burned annually in California to reduce fire hazard and to enhance livestock and wildlife benefits (Cornelius, 1966). Although mechanical crushing, fertilizer, and herbicide treatments are applied to enhance the final result, clearings in the brush, burning is the principal treatment.

Fire helps to provide a favorable seedbed for grasses, which are commonly seeded to help maintain the clearings, by (1) removing cover, (2) reducing competition, and (3) increasing soil nutrients. The ash helps to cover the seed when broadcast seedings are made (Bentley, 1967). Hardingrass (*Phalaris tuberosa*), perennial ryegrass (*Lolium perenne*), and tall fescue (*Festuca arundinacea*) are commonly seeded.

Biswell (1961) recommended that, for optimum deer production, this burning program be maintained until 75 percent of the chaparral has been cleared, using small, 5 to 10-acre, clearings to create maximum edge.

Both spring and fall burning have been practiced, depending upon desired results. For example, fall burns are more subject to erosion; however, for optimum germination of many shrub seeds, the fire must be followed by a long cool, moist period (winter). Spring burning is favored in areas where manzanita control is desired (Gibbens and Schultz, 1963).

The benefits of chaparral burning to big game have been reflected in increased numbers of deer using cleared areas. Biswell (1961) observed more than four times as many deer using cleared areas during the second year following treatment. Since it is difficult to accurately assess animal movements between treatment areas, this figure may be misleading. Supported by a study of ovulation rates of does using the two treatment areas, a stronger case was made in favor of burning. Does collected in the treated areas tested 175 percent (of single ovulation), compared with 82 percent in control areas. Taber and Murphy (1971), citing Murphy (1963), observed similar effects of brush burning on black-tailed deer ovulation rates.

Similar habitat manipulation efforts have been carried out on elk winter range in northern Idaho (Leege, 1968, 1969; Leege and Hickey, 1971; Leege and Fultz, 1972). In that area, key elk winter ranges, seral brush communities created by wildfires in the early 1900's, have developed beyond successional stages which are optimum for elk browse production. Certain browse species, notably mountain maple (*Acer glabrum*) and willows (*Salix* spp.) have grown too tall (Fig. 15) to be much available to elk. In addition, tree regeneration has claimed large areas.

Burning not only kills the tops of large shrubs, causing most to resprout lavishly, but stimulates germination of redstem ceanothus (*Ceanothus sanguineus*). Redstem, the most valuable browse species in the area, produces as many as 240,000 seedlings per acre on fall burns (Leege, 1968). Spring burning, a less hazardous approach from a fire control point of view, produces fewer seedlings which are subject to high drought mortality.

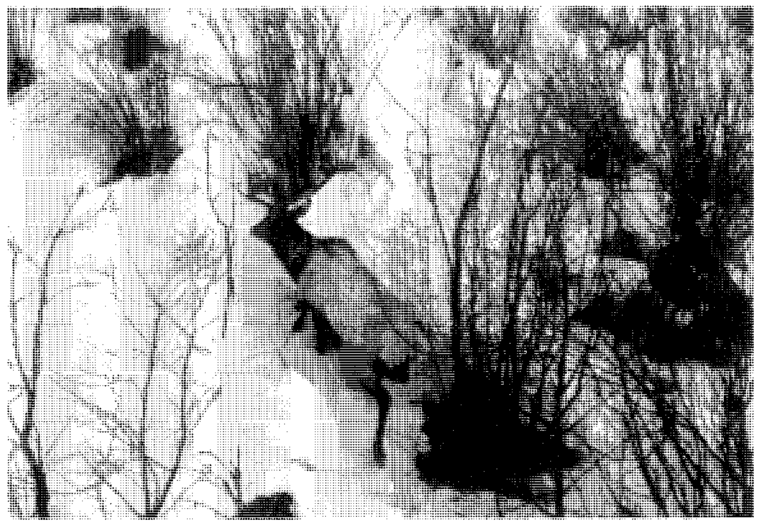

Fig. 15. Bull elk on browse winter range in northern Idaho. Prescribed burning will kill this tall brush back to levels more available for elk use (Idaho Fish and Game photo).

Other than the above mentioned brush burning, nearly all benefits derived by big game from prescribed burning are incidental to forest management. But considering how extensively burning is employed for timber management purposes in this region, benefits to big game are great, indeed.

Clearcut logging is widely practiced in the Northwest, particularly on industrial timber lands west of the Cascades. Cuts are small, typically ranging from 30 to 60 acres, but are occasionally larger, usually called for by some physical feature of topography or vegetation (Hooven, 1973). Logging residue is generally burned to prepare the site for natural or artificial stocking, as well as for fire prevention (Fahnestock, 1973). Understory and, consequently, big game responses to clearcut and burn logging are very similar to those following wildfire (Hooven, 1973). Other timber harvesting practices, particularly when followed by residue burning, are also looked upon as beneficial to deer and elk.

There exists, particularly in east-side forests where timber values are not nearly so high, a great opportunity for integrative management of forest, wildlife, and range. Weaver (1943, 1947) described the practice of using fire as a natural thinning agent in ponderosa pine. Such periodic surface fires would create reduced-fuel breaks between the highly flammable range lands below and the more valuable timber land above. In addition, understory vegetation would become more productive (McConnel and Smith, 1970; Thompson and Gartner, 1971) for domestic stock and big game. McConnel and Smith, reporting results of ponderosa pine thinning experiments in the Methow Valley, Washington, found that understory production increased nearly six-fold, 8 years after trees were thinned from 2,800 to 67 per acre. Such high tree densities are not uncommon in east-side ponderosa pine. The U. S. Forest Service and Washington State University are currently researching the feasibilities of this approach.

SUMMARY

Fire, whether wild or controlled, has been shown to benefit big game in a variety of ways. Following fire, understory vegetation usually reestablishes more luxuriant than before, often increasing carrying capacity for big game several-fold. In addition, new growth following fire is more palatable and nutritious than on unburned areas and is often phenologically earlier. Brush field burning not only provides these benefits, but also (1) increases accessibility of game into dense brush areas, (2) further increases browse availability by killing back brush that has grown too tall for game to efficiently utilize, and (3) rejuvenates decadent shrubs. And finally, loose ash following fire provides an ideal seedbed for broadcast seeding herbaceous forage species. All told, burning promotes healthier and more productive big game herds.

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