INFLUENCE OF FOREST FIRES AND FIRE PROTECTION ON WILDLIFE

By A. T. CRINGAN¹

The next speaker is A. T. Cringan, forester, who for years served as district biologist in Western Ontario and who now is lecturing in wildlife management at the Ontario Agricultural College, at Guelph.

INTRODUCTION

In this paper I wish to review certain facets of the role of fire in the ecology of forest game, then go on to speculate about how forest fire protection may influence populations of forest wildlife.

Before considering the effects of fire on game, it is necessary to remember that faunal succession exists, just as does plant succession. There is an optimum habitat for every species of animal, and this optimum is restricted to some particular stage of a certain plant succession.

Three of Ontario's native species of grouse demonstrate this fact. The sharp-tailed grouse is found on abandoned farmlands, recent burns and cut-overs and open muskegs in western Ontario. It decreases, then usually disappears, as the forest canopy closes. The ruffed grouse appears during the sapling stage, sharing the habitat with the sharptail, and may experience optimum conditions during the early polewood stage. Subsequently it declines, although remaining in small numbers even in the climax. The spruce grouse appears during the polewood stage, at about the time the sharptail disappears. Its optimum habitat is in the sub-climax and climax (after Grange, 1949).

Deer, moose and caribou also illustrate this principle. High populations of deer and moose require large areas of young forest, interspersed with older stands. They are mammals of the early successional stages. The woodland caribou almost always requires large areas of sub-climax or climax forest, and may be considered a climax species.

THE IMMEDIATE EFFECTS OF FIRE ON WILDLIFE

Forest fires may immediately affect wildlife by killing individuals or, during the nesting season, by destroying nests. While these effects on individuals cannot be disputed, it is questionable that fires normally influence whole populations. I know of no reliable study into the immediate quantitative effect of wildfire on the population of any species of wildlife.

Undoubtedly fires kill, and large fires may kill many individuals. But natural mortality, from all factors, is an impressive vital statistic for all wildlife—85% per year for many songbirds; 75% of the ruffed grouse alive in June will die within a year; a third to a half of the deer present in early summer must, in the long run, die before the following summer. With such tremendous mortality forces operating, mortality by fire may simply replace mortality by malnutrition, exposure, predation or some other means.

Depiction of forest fire as a destroyer of wildlife and a population-reducing agent has a great sentimental appeal, but little basis in fact.

¹ Ontario Agricultural College, Guelph, Ontario.

SHORT-TERM INDIRECT EFFECTS OF FIRE ON WILDLIFE

The habitat of wildlife may be affected in a number of ways for the first few years following a forest fire.

Immediately after the fire, there may be little food and shelter for any species of terrestrial wildlife. Consequently there could be a shortage of early successional wildlife species for a short time, and of climax species for a much longer time. Still, there are usually some unburned places offering facilities to small animals, and occasionally even to larger game.

Following this period of food and shelter deficiency, there is often a great increase in the production of herbs and browse following fires. This browse may be of superior quality (Dewitt and Derby, 1955), owing to the fertilizing effect of ash. A combination of these quantitative and qualitative effects may lead to vastly improved conditions for game of the early successional stages.

On the other hand, intensive fires, particularly those on shallow soils or areas already burned over, may result in serious habitat impairment of long duration.

LONG-TERM INDIRECT EFFECTS OF FIRE ON WILDLIFE

The main long-term indirect effect of fire is in the succession it causes. In the absence of other succession-initiating factors, fire creates habitat for wildlife of the early and middle successional stages, at the same time destroying or adversely affecting the habitat of climax species.

The effects of uncontrolled fire, whether immediate, short-term or long-term, are exceedingly complex. Fire may result in either improvement or deterioration of habitat. Figures showing total acreages burned are, in truth, barren statistics on which to construct a thesis concerning the effects of wild-fire on game. We should also consider the nature of the forest burned, sizes of fires, their intensity, distribution of unburned cover types in relation to the burns, and many other aspects of the environment, not to mention the biology of the wildlife species in question. To properly analyze the question might require Univac's services to consume the reams of data that would be collected by the scores of investigators that would be necessary to investigate the problems properly.

To simplify the problem, I wish to suggest that fires on the average improve conditions for game of the early successional stages, keeping in mind that this is not always so. In the Kenora District of western Ontario, fires burned an average of 10,000 acres annually during the thirties, and only 1,000 acres per year during the forties. The big fires of the thirties created large areas of choice feeding habitat for white-tailed deer. Lenses of unburned coniferous swamps scattered throughout the burns yielded shelter. The results were dramatic. The deer erupted, reached a high population level between 1945 and 1950, then crashed. This record is now history. The present deer habitat of the Kenora District is now inferior to that of 10 years ago, and is likely to remain so, until some other succession-initiating factor acts to the extent that fire formerly did.

POSSIBLE EFFECTS OF FOREST FIRE PROTECTION ON BIG GAME IN THE
SIOUX LOOKOUT FOREST DISTRICT

With the foregoing ideas in mind, I wish to theorize as to the effect of fire and forest fire protection on big game in the Sioux Lookout Forest District. The Sioux Lookout Forest District comprises 40,660 square miles, of which 33,748 are land.

Forest Protection in the Sioux Lookout District Prior to 1926

No data concerning acreage burned annually prior to 1926 are available. Some residents think that the number of forest fires increased around 1910, when the trans-continental line of the Canadian National Railways was built. They also believe that fires were just as bad immediately prior to 1926 as they were in the period just following. Therefore, I shall use the average area burned annually between 1926 and 1940 as an estimate of annual losses prior to 1926.

Areas of the Sioux Lookout District Burned Since 1926

The average area burned annually has decreased greatly since 1926, according to District Annual Reports. The mean area burned annually between 1941 and 1955 was 30.1 square miles, less than one-fifth of the average of 154 square miles per year between 1926 and 1940.

The area burned over in 1956, 135 square miles, was the largest in any year since 1948, when 167 square miles were burned over, and the second largest since 1937. Consequently, the total area burned between 1956 and 1960 will likely be greater than the average five-year totals experienced since 1940; future 10-year and 15-year totals will not necessarily be influenced as greatly.

**Effect of Forest Fire on Age Composition of the Forest
of the Sioux Lookout District**

Changes in the ages of the forests of the Sioux Lookout Forest Protection District as a result of fires may be computed using the detailed information on which the foregoing summary is based. Computations that I have used are subject to the following assumptions:

- (1) that areas burned annually prior to 1926 were of the same size as those burned between 1926 and 1940;
- (2) that 20% of all areas burned have already been burned within the last 15 years;
- (3) that 80% of all areas burned have not been burned for at least 150 years (the unreality of this assumption is admitted; it is to simplify computations);
- (4) that areas burned from 1956 to 1980 will be essentially similar to those burned between 1946 and 1955;
- (5) that all other succession-initiating factors have little effect (the unreality of this assumption is also admitted).

If these assumptions are correct, forest fire protection has already markedly changed the areas of forests of certain ages in the district. For example, in 1940 there were 1,850 square miles of 0 to 15-year-old burn, and in 1955 there

were only 260 square miles of such burn. At the same time, the area of mature forest has probably increased. *If the present efficiency of forest fire protection is maintained, it is possible to predict the time during which stands of fire origin of particular ages will become scarce.*

Stands of fire origin age—class	Years during which such stands will decrease in area
0 - 15 years	1940 - 1955
16 - 30 years	1956 - 1970
31 - 45 years	1971 - 1985
46 - 60 years	1986 - 2000
61 - 75 years	2001 - 2015
76 - 90 years	2016 - 2030

The area occupied by stands of fire origin less than 15 years old has already been reduced to less than 15% of the area occupied by such stands prior to 1940. Similar reductions will eventually occur to all young age classes.

While the decrease in areas of young timber is rapid, the relative increase in areas of mature timber is much slower. The computed area of old (151-years and over) forest increased by only 11% between 1940 and 1955.

Effect of Resultant Habitat Changes on Moose

Burned over areas seem to provide the best conditions for moose within 15 years of being burned. Such areas have been assigned a carrying capacity of four moose per square mile; 16- to 30-year-old stands, two moose per square mile; 31- to 45-year-old stands, one moose per square mile; and older stands, four square miles per moose. I am unable to cite any published references as to these capacities, but believe that results of work now in progress will support this idea in principle, even if not in exact detail.

On this basis, the carrying capacity of the Sioux Lookout Forest Protection District would have been about 20,000 moose in 1940, **13,000 of these on the 5,550 square miles of forests of fire origin less than 45 years old!** In the absence of other succession-initiating factors, the carrying capacity is likely to drop to 10,000 moose by 1985, of which only 1,800 will be carried on the 780 square miles of forests of fire origin less than 45 years old.

The projected decline in moose-carrying capacity is rapid and is directly proportional to the decrease in area burned annually.

Effect of Resultant Habitat Changes on White-tailed Deer

I am unable to suggest how deer populations in the district may be influenced by forest fire protection, as they are more strongly affected by other variables, such as weather, than are moose. It is likely that the carrying capacity for deer will decrease more and earlier than that for moose.

Effect of Resultant Habitat Changes on Woodland Caribou

The woodland caribou fares best in mature stands, is present in forests approaching maturity, and absent from young forests. I have assigned a carrying capacity of one caribou per 10 square miles to forests between 91 and 150 years in age, and of one caribou per five square miles to older forests. On this

basis the carrying capacity of the forest protection district would have been about 3,800 woodland caribou in 1940. It should gradually increase to 4,500 by 1975 and 5,000 by the year 2,000, as the area of mature forest slowly builds up.

The carrying capacity of woodland caribou increases much more slowly than that of moose decreases.

Discussion

Forest fire protection, in the absence of succession-initiating factors like logging and forest insect outbreaks other than fire, may cause the moose-carrying capacity to decline rapidly and the woodland caribou-carrying capacity to increase slowly. The combined carrying capacity for all species of big game undoubtedly decreases.

This phenomenon can certainly be expected in the hinterland portions of the Sioux Lookout Forest Protection District, where logging is unlikely to begin for many years, and in adjacent parts of the Patricia West and Patricia Central Wildlife Management Districts where forest protection is now being practiced.

The projected change in moose carrying capacity may have far greater management consequences than a drop from 20,000 to 10,000 would indicate. If the 1940 moose population had reached the capacity of the range, there would have been about 13,000 moose on 5,550 square miles of good range. This would have been a healthy population, in itself capable of sustaining a kill of 25% to 35% annually—or between 3,200 and 4,500 harvestable moose each year. The availability of this density of surplus moose would make hunting—and management—much easier. On the other hand, by 1985 there may be only 1,800 moose on good range having high productivity, and this number may sustain a harvest of only 450 to 625 animals per year. The remaining 8,200 moose in the district may sustain a kill of 10% to 15%, owing to the lower productivity of animals on poorer range. The total allowable harvest from a population at carrying capacity by 1985 is likely to be between 1,270 and 1,855 moose per year. Had the range conditions of 1940 been stabilized, a total harvest of between 3,905 and 5,555 moose might have been maintained.

Hunting will not be as good as formerly. It will become increasingly difficult to persuade hunters to harvest moose in the future, owing to the anticipated decrease in yield. Management will be harder to achieve as a result.

Projected increases in caribou carrying capacity will not commence soon enough or be sufficient to compensate for decreases in moose carrying capacity. The over-all supply of big game for the gun is bound to deteriorate in areas influenced by forest fire protection but not influenced by logging or forest insects, owing to the inevitable changes in carrying capacity.

There were estimated to be about 20,000 moose in the Sioux Lookout Forest Protection District in 1956-57, at which time I computed the carrying capacity to be about 13,500 moose. As the population continues to increase and as the capacity is certainly declining, the two may soon come into serious imbalance.

On the other hand, I estimated there to be only about 2,000 woodland caribou in the district in 1955, when the computed carrying capacity was 4,100. It should take the caribou at least several years, perhaps 10 or more, to reach the general capacity of the range within the district.

It is wise to also consider the current role of logging as a succession-initiating factor. In 1953, the actual cut of timber in the Sioux Lookout Forest District was about 11 per cent of the allowable cut (Anonymous, 1953). This level of utilization suggests that about 1.65 per cent of the land area of the district would be occupied by forests between 0 and 15 years old as a result of logging, if an average rotation of about 100 years is applied.

Fire, as we have seen, resulted in about 6 per cent of the land area being in this condition in 1940, and fire protection reduced such areas to about 1.1 per cent by 1955.

It can be seen that full utilization of the allowable harvest, on an average rotation of 100 years, will necessitate that about 15 per cent of the land area of the district will be occupied by forests up to 15 years old. This in turn implies that conditions for moose and deer will ultimately be far superior to those resulting from the large fires prior to 1940, at the same time implying that the environment of the caribou will further deteriorate.

Epizootics of forest insects comprise another important succession-initiating factor in the Sioux Lookout Forest District. It seems likely that the combination of efficient fire protection and low utilization of harvestable surpluses will continue to lead to epizootics such as the budworm outbreak in the Lac Seul area between 1940 and 1956, and the previous infestation of the same insect in the same area 85 years earlier (Blais, 1954).

Proper consideration of these three major succession-initiating factors should enable the wildlife manager to make medium-term predictions, perhaps in the order of 10 to 20 years, of trends in big game carrying capacities and populations.

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