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THE TREND OF FOREST FIRE RESEARCH IN NORTHERN IDAHO

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Readers of the Idaho Forester do not need to be told why it is necessary to study forest fires in Northern Idaho. They have seen the fires sweep through virgin stands of merchantable timber and through beautiful young stands of valuable reproduction, greatly reducing the value of the merchantable trees and often completely destroying the young stands which soon would have been merchantable. The readers know that there are different causes of these fires, that some fire seasons are much worse than others, that some fires behave altogether differently from others, and that the cost of suppression, the actual cash value destroyed, and the ultimate loss to the State of Idaho vary as these factors vary. It may be of interest to explain how the United States Forest Service, especially the Branch of Research, is studying these variable conditions, and how the information obtained may be used to reduce the present high expense and loss caused by forest fires.

Coping with the annual crop of forest fires is somewhat like handling the annual sales of a certain seasonal article, rubber galoshes for instance. The manufacturer of rubber overshoes who meets the demands for his product satisfactorily needs to know four things as accurately as possible. He must know the season of the year when the demand begins, reaches a peak, and ends. He must know what sections of the country will make demands and the peculiarities of that section. He must estimate the amount of that demand. And he must know the classes of people who create the demand.

In forest fire protection the problem is very similar. We must know the average beginning, peak, and end of the fire season. We must know these facts for each section of the District. We must know about how many fires to expect in each section. And we must know the individual causes of these fires. The accumulation over a period of years of accurate records of the time of occurance of fires, their location, number, and causes will soon provide statements of the average conditions which must be met.

In Northern Idaho both the Federal and State Forest Services and the private timber protective associations have kept records long enough so that each organization now knows its average conditions very accurately. The fact is becoming all too apparent, however, that it is the departure from the average which is of greatest interest now. We have reached the stage in which we can supply adequate protection during the average year, but we are not yet prepared to guarantee adequate protection during the abnormal season, or to cut down our expenses and save the money that could be saved during years that are less dangerous than average. Most efficient protection means adequate protection at minimum cost The purpose of forest fire research is to discover the fundamental causes and effects which vary in such a way as to cause variable demands on the forest protective organization. When we know accurately all the controlling causes and their effects we should be able to expand the protective organization sufficiently to give adequate protection during the abnormal years, and to reduce expenses as much as possible and still provide adequate protection during the fire seasons that are less dangerous than the average.

In this investigation of cause and effect we usually have the effect clearly before us and then have to discover the cause or causes. Fires burn the forest materials; we know that, and we know what starts these fires. But why do most of these fires occur between June 15 and September 15 each year? Apparently the answer is, because the fuels are driest and most inflammable then. Is that the whole story, or is it also true that there is more lightning then, that there are more campers, hunters, and smokers in the woods, and more logging operations active in the summer than in the winter? How much of the variation in beginning, peak and end of the fire season should be charged to drier fuels and how much to the presence of the causative agencies? Obviously, if there were no agencies present to start forest fires, there would be no fires, even if the forest materials became drier than ever

before. But there are certain agencies always present, whereas there are seasons of the year when they do not produce forest fires. Apparently, then, the dryness or wetness of the fuels is the most important control of the starting of fires at least.

Working on this hypothesis, the fire studies conducted by the Northern Rocky Mountain Forest Experiment Station are attempting to determine how much moisture is in each of the important forest fire fuels from the beginning of the fire season, through the peak of the season, and to its close. Such information is useless for our purposes, however, unless we also know how much moisture in each fuel prevents its ignition, how much moisture permits ignition, and this in each case for each of the common causes of forest fires such as lightning, broadcast slash fires, burning brush piles, campfires, matches, smoking tobacco, etc., down to the tiny sparks from locomotive stacks, ash pans and brake shoes.

Obtaining such information calls for experiments, because we cannot wait for the slow process of obtaining records by finding a blazing match thrown by a careless smoker in each of the fuels at various moisture contents, or catching a camper leaving his fire first in duff, then on rotten wood, then in sound wood, etc., for each moisture condition of each fuel. We can duplicate those conditions experimentally, however, and that is the process being used to determine the amount of moisture in each fuel which prevents or permits its ignition by each of the common causes of forest fires. Lightning is the sole exception to this statement, and because we cannot duplicate lightning, as well as because we have not yet been present when lightning started a fire and left us intact to measure the moisture content in the fuel ignited, we have no measurements at all concerning when the fuels can or cannot be ignited by lightning.

So far most of our experimental tests of ignition have been devoted to the top layer of duff, the carpet of dead and decaying tree leaves, etc., covering the humus and mineral soil in the forest. Several reasons exist for choosing this particular material instead of twigs, slash, windfalls or snags as the object of our first work. The living forest is the most valuable type which we have to protect, and in the green forest, either young or old, there is undoubtedly more surface area covered by the duff than by any other type of fuel. The duff is a nearly continuous fuel; it is not broken up into small patches as often as twigs, dead branch wood, and windfalls. Without running through the duff so that it can ignite separate patches of the other fuels, fire can seldom spread rapidly or attain the momentum necessary for it to burst into a sheet of flame in the crowns of the trees. Hence, if the duff, especially the topmost layer, will not carry fire there is not as great a probability that a fire once started in some other material will spread rapidly. The amount of moisture in the top layer of duff is, therefore, of great significance. Furthermore, our measurements, which now include four consecutive fire seasons, have shown that the amount of moisture in the top layer of duff is usually about the same as the amount in dead branch-wood or slash, and is usually a little less than the amount in the outside half-inch wood of windfalls. A knowledge of the moisture content of the top layer of duff consequently indicates the amount of moisture in the other important fuels and, if used in conjunction with a knowledge of the relation of duff moisture content to duff inflammability, tells us whether or not fire will run through the duff, and how easily.

Eventually we must study the effect of moisture content on the inflammability of each of the other fuels. We already know, for instance, that rotten wood will hold and carry fire even when it has as much as 63% moisture content, or 63 pounds of water for every 100 pounds of dry rotten wood, whereas no case has yet been found in which the duff was burning when it had more than 25% moisture content. Such differences indicate the necessity of studying each fuel separately. We have commenced by concentrating on the duff alone and have found some facts which seem to have real practical value.

How will we use such information when we get it for all the fuels? Perhaps somewhat as follows: On the wall of his office the forest ranger will have a chart with the dates shown along the base and the fuel moisture contents up the left side. Perhaps twice each day the ranger or his assistant will read the instruments properly located to reveal the moisture content of each important fuel on nearby areas which are typical of his district. He will then plot those readings on his chart and observe:

"Well, the effects of that last rain are cer-

tainly disappearing faster than I thought they would. Twigs have dried out till they are extremely inflammable, the top duff is highly inflammable, dead branch wood and slash are in the zone of medium inflammability, snags are in the low inflammability zone, windfalls very low inflammability, and the lower layer of duff still has enough water so that it is non-inflammable. Only yesterday morning all those materials except twigs were too wet to burn. After the rain I put all my guards and smoke-chasers to work building new trails and repairing old ones but I guess I'd better put them back on patrol or keep them close to the phone to-day."

Or, in the opposite condition, the ranger will find that the fuels are still wet enough to permit him to keep his men working on improvements instead of fire protection. Early in the season the measurements should show him when the fuels are becoming dangerously dry, and, therefore, whether or not he will need his emergency men sooner or later than usual. In the fall the measurements should show when the temporary fire protection men can be released or diverted to other work. Measurements, instead of estimates, will point out the departures from the average condition and tell when to spend more money for adequate protection, and when to save money and still maintain satisfactory protection.

At present when rangers or forest supervisors want more men and more money to obtain better forest protection, the common questions from the guardian of the purse strings are:

"How are your fires behaving?" and "how dry is it on your Forest?"

If there are fires burning so fiercely that they cannot be suppressed with the available men, that is demand enough for more men and money. But sufficient men and money should have been on the job before those fires began to burn so fiercely.

If the ranger or supervisor is anticipating great danger before the fires appear, how will he answer the question "How dry is it on your Forest?" Will one supervisor say "too dry to suit me" another "Really quite dry," and another "Extremely dry"? And if they use these terms how will Purse Strings decide where it is driest, and which Forests should receive assistance?

It may help if Supervisor No. 1 says "My average fuel in the timber dropped below 20% moisture yesterday, and the average fuel in the old burn type is down to 11%." Supervisor No. 2 was not watching his forest conditions so closely, however, and he reports an average of 15% in the timber and 7% in the old burns. He probably gets men and money immediately and a warning not to wait so long next time. Supervisor Number 3, is unduly scared when his timber type reaches 25% and his open areas 15%. Money is withheld from him and safely saved.

Using measurements instead of estimates of dryness and using the same classes of fuels in each case so that one estimate is not based on duff dryness, another on dead weeds, and another on slash, such a reporting method should be more dependable than that available at present. One goal of fire research in

Photo by H. T. Gisborne, U. S. Forest Service

The highest degrees of fire danger prevail when sparks and embers, blown ahead of a large fire, start spot fires as in this case.

Northern Idaho is to supply such a method of measuring existing fire danger.

Measurements of prevailing moisture content are not enough, however, for the most efficient forest protection. We need forecasts for the future, as well as accurate statements of the present. As soon as we attempt to forecast fuel moisture content and inflammability, however, a new relationship of cause and effect springs up to demand further research. We may have found that moisture content controls inflammability, but if we are going to forecast either of those conditions we must know of an existing condition is not an accurate forecast of that same con-

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