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RESEARCH NOTE LS-45

• LAKE STATES FOREST EXPERIMENT STATION • U. S. DEPARTMENT OF AGRICULTURE

Hourly Variation in Fire Danger in the Lake States

Rating forest fire danger by combining basic weather and fuel moisture measurements has been a standard operating procedure in all forest fire control agencies for nearly 30 years. Fire danger is rated by determining a numerical index that represents the burning conditions for a particular unit of land; the index is then used to assist in fire preparedness planning for more efficient expenditure of funds for fire control.

Recent fire research has been directed toward developing a Unified National System of Fire Danger Rating — that is, a uniform procedure on a nationwide basis for measuring and interpreting forest fire danger. Already completed is a Fire Spread Index designed to indicate the *relative* rate of fire spread in light and intermediate forest fuels. Yet to be developed are reliable indicators of risk, ignition probability, and fire intensity. When all these indexes are completed and combined, they will give a more complete picture of fire job load requirements.

To obtain adequate weather measurements for fire weather forecasting, the Unified National System requires that the official danger rating measurement should be taken near the time of average maximum Spread Index for the day. Fire weather observations should be made during the afternoon period of highest fire danger so that the most meaningful fire weather is recorded and made available to the fire weather forecaster for use in his forecast for the following day. Fire weather forecasts made by the Weather Bureau utilize temperature, relative humidity, and wind observations as well as other weather factors taken during the time of day when fires are most likely to start and spread.

The study reported here was undertaken to provide answers to two questions for the Lake States region: (1) On the average, what time of day does the highest fire danger occur, and (2) is it possible to use 1:00 p.m. (a convenient observation time) as the official time for the daily fire danger measurement?

To determine when the most severe fire weather conditions may be expected, hourly Spread Index values and wind velocity readings were summarized for the months of April, July, and October

at four First Order Weather Bureau Climatological Stations. A 3-year period, 1961-1963, was used for April and July, and 2 years for October except at Grand Rapids, Mich., where 3 years was used. The four weather stations (International Falls and Minneapolis-St. Paul, Minn., LaCrosse, Wis., and Grand Rapids, Mich.) are representative of the daily trend in fire weather for the Lake States area. However, local fluctuations in wind, temperature, and relative humidity may produce a pattern of weather somewhat different than for any of the selected stations or for the region as a whole.

Fire spread index. — Spread Index for brush or timber fuel types is adjusted for cumulative drying conditions by means of the Buildup Index. However, for this study no adjustment for the buildup factor was made, so the Spread Index is related only to light surface fuels where fires may start easily and spread rapidly. Calculation of Spread Index was based on a fixed condition of vegetation (herbaceous stage) for each month and location. April and July were considered "cured" and "green" respectively. October was based on 20 days in "transition" and 11 days in the "cured" stage. Past records indicate that these are reasonable assumptions concerning the herbaceous stage of the vegetation.

Results show that average differences in Spread Index between the afternoon hours are small (table 1). Hence, fire danger conditions between 1 and 4 p.m. are, on the average, similar and represent the period of most severe fire weather for the day. Individual days may diverge considerably from this average daily pattern of fire weather.

Wind velocity. — Average hourly wind velocities for each of the four stations indicated only a 1 to 3 m.p.h. variation between the hours of 10 a.m. and 4 p.m., and average velocity remained nearly constant from 1 p.m. to 4 p.m. (table 2). The fact that Spread Index increased from morning to early afternoon while the average wind velocity showed little change demonstrates the importance of relative humidity on fine fuel moisture during