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A Preliminary Report, Giving Some of the Results Obtained in a Study of Lightning Storm Occurrence and Behavior on the National Forests of Oregon and Washington

When do lightning storms occur, why do they occur, where do they occur most frequently, where do they start the most fires, is it possible to determine whether or not an approaching storm is liable to start fires, do lightning storms move along definite paths over the national forests?

Every forest protectionist realizes that an answer to these questions is vitally needed in those areas subject to frequent attack by lightning storms. To obtain an answer to these questions the lookouts in all western national forests have been observing and recording the occurrence and behavior of lightning storms. This report, prepared especially for lookouts, summarizes a few of the preliminary results obtained by analyzing the lightning storm records submitted by national forest lookouts in Washington and Oregon during the summer months for the last seven years. A more complete report will be published soon.

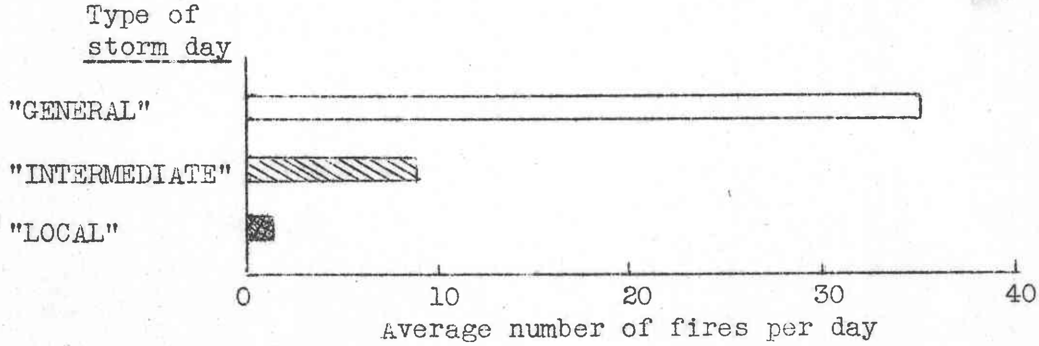
For every lightning storm the lookouts have made notes on the time of occurrence, duration of the storm, place of occurrence, and path of storm movement, together with observations on number of flashes, amount of rainfall and the like. In as much as several lookouts usually report on the same storm, it is possible by plotting all the information given for each storm to show its path rather accurately even though it extends over several national forests.

As the analysis progressed, it was found that three rather definite subregions in Washington and Oregon would have to be considered. Each subregion appeared to have characteristics of its own as concerns the formation and behavior of lightning storms. The Blue Mountains of eastern Oregon represent one of these subregions. The area along the Cascade range in Washington appeared to be another distinct subregion and all of the national forest area of western and central Oregon was included in a third subregion.

After making a separate map of storm occurrence and movement for each day, it was obvious that there are three main types of lightning storm days. On one type of day which is called here a "local" storm day there are only one or a few storms. Three instances of local storm days are given in Figure 1. It can be seen that none of these storms is very large or extends over a very large territory. At the opposite extreme is the "general" storm day on which many individual storms occur over a large part of the subregion. Three examples of this type of storm day are shown in Figure 2. The characteristics of the third or "intermediate" type of storm day are, as the name implies, intermediate between the "local" and "general" types.

Ordinarily, "general" storm days do not occur simultaneously in all subregions; in the past 7 years "general" storm days have occurred simultaneously in all three subregions only 4 times. In the average summer season there are in each subregion 4 "general" storm days, 6 "intermediate" and 15 "local" storm days.

The extremely widespread occurrence of lightning storms on general storm days suggested that the majority of lightning fires might originate on this type of storm day. It was found that 66% of all lightning fires start on general storm days. This means that for any given subregion, only 1 in 6 storm days is "general", but two thirds of the season's lightning fires start on this one day. As many as 10 fires have started on "local" storm days but this is very unusual; ordinarily no fires or only one or two start on a local storm day. The peak load of lightning fires comes (for both subregion and for individual forests) on "general" storm days. For example, on the general storm days shown in Figure 2 there were 215 fires (out of a seasonal total of 233) starting in Washington, 109 in western and central Oregon, and 87 fires in the Blue Mountains.



These significant results show conclusively that in lightning storm prediction and in distribution of emergency protective personnel most attention should be given to the "general" type of storm day.

Composite maps (see Figures 3 and 4) showing the paths of all storms in each year indicate that there are no consistently traveled lanes along which storms move. These maps do indicate, however, that certain areas are much more likely to be visited by lightning storms than are other areas. Figure 5 shows the average annual number of lightning storms on areas $12\frac{1}{2}$ miles square (100,000 acres). Although the exact number of lightning storms shown in Figure 5 may not always hold true for any one year, the proportions will be approximately as indicated and the zones of most frequent occurrence will remain as shown in this figure.

Maps similar to Figure 5 have been made for lightning fires. A study of the fire maps in connection with the storm frequency map (Figure 5) indicates that the zones of greatest lightning storm activity do not always coincide with the zones of greatest lightning fire frequency. For the present, however, these two maps can be used to advantage in determining where emergency lookouts should be concentrated.

For simplicity, the terms "movement" and "travel" are used in this report to indicate the appearance of movement due to the progressive building-up of the storm front. Most of the lightning storms in Washington and Oregon have progressively built-up ("moved") for distances of from 11 to 40 miles. Only a few storms have exceeded 80 miles in length. (See Figure 6)

Speed of "travel" is shown in Figure 7. It will be realized from an inspection of this figure that most lightning storms do not "move" faster than 20 miles per hour.

Direction of movement is shown in Figure 8. Here it will be seen that most of the lightning storms travel towards the north and east but the direction varies somewhat according to subregion.

Although the study is not yet completed, enough information is available for forest protectionists to make practical use of the findings in preparing for the prompt detection and suppression of lightning fires. As a follow-up of the study the Weather Bureau is now correlating the day by day maps of storm occurrence with concurrent weather conditions so that lightning storms may be predicted with a high degree of accuracy.

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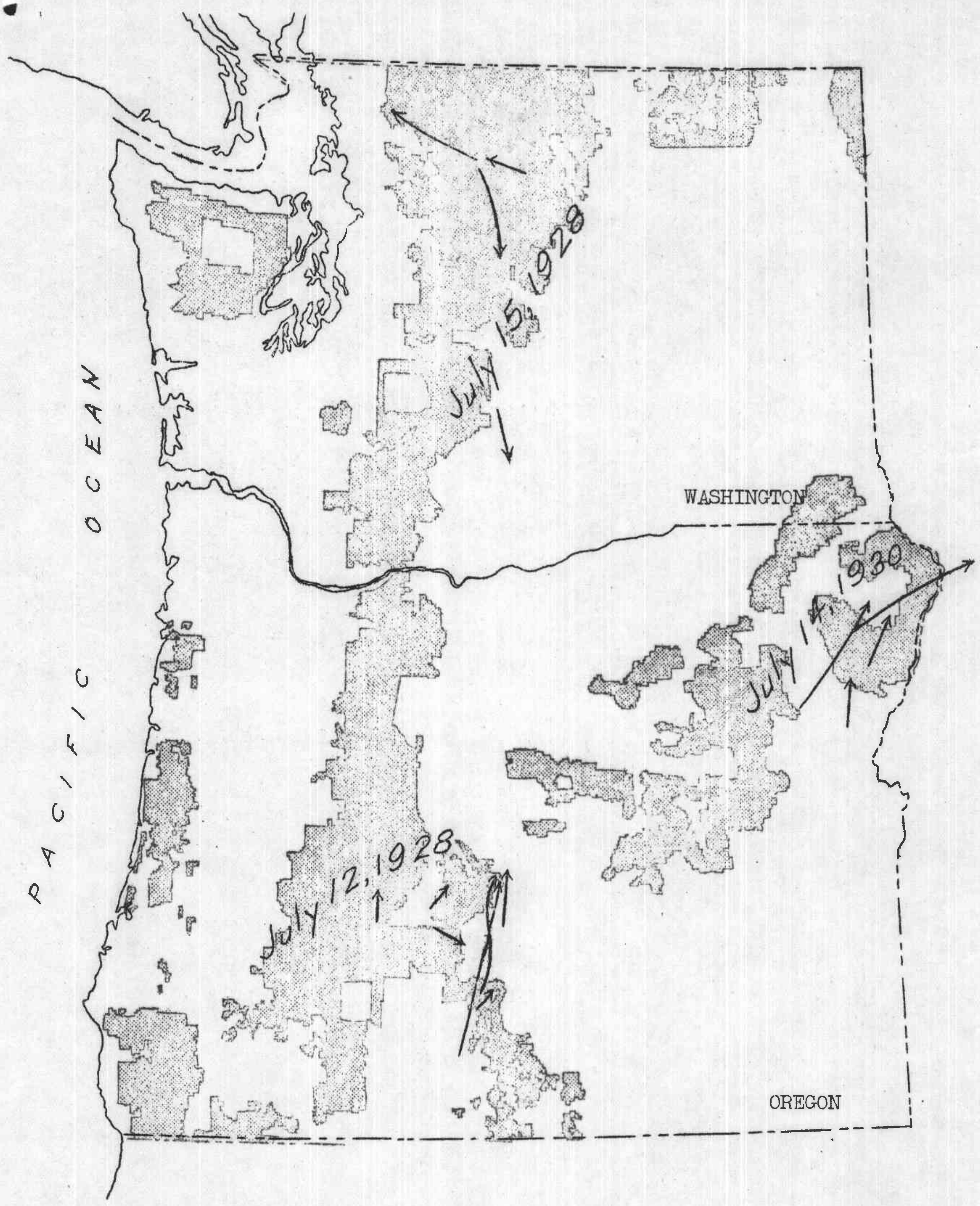


FIGURE 1 -- Examples of lightning storm occurrence characteristic of "local" storm days. The paths of movement are shown for three different days each of which was classed as a "local" storm day for Washington, the Blue Mountains or for western and central Oregon.

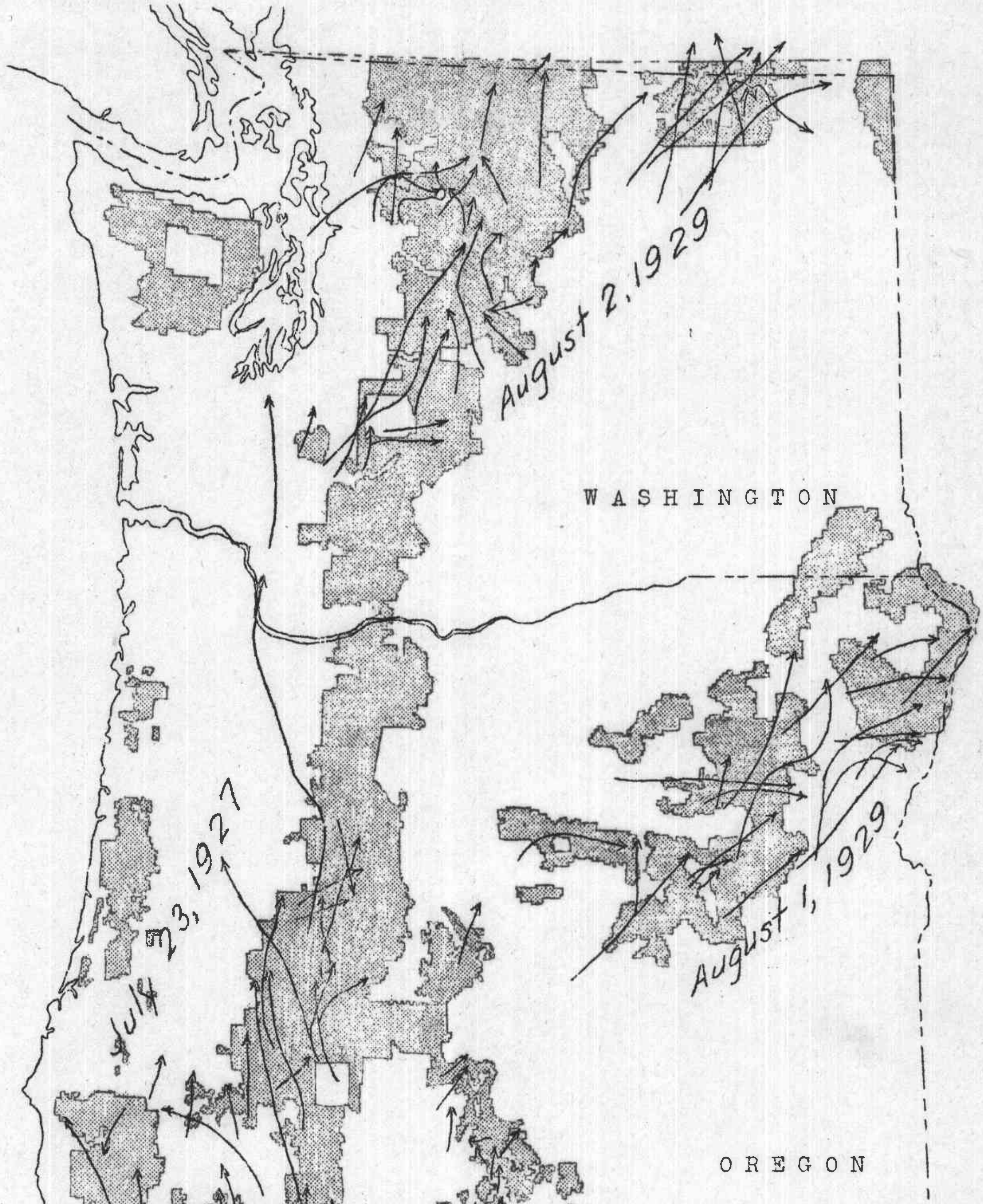


FIGURE 2 -- Examples of widespread lightning storm occurrence characteristic of "general" storm days. The paths of movement are shown for three different days each of which was classed as a "general" storm day for Washington, the Blue Mountains or for western and central Oregon.

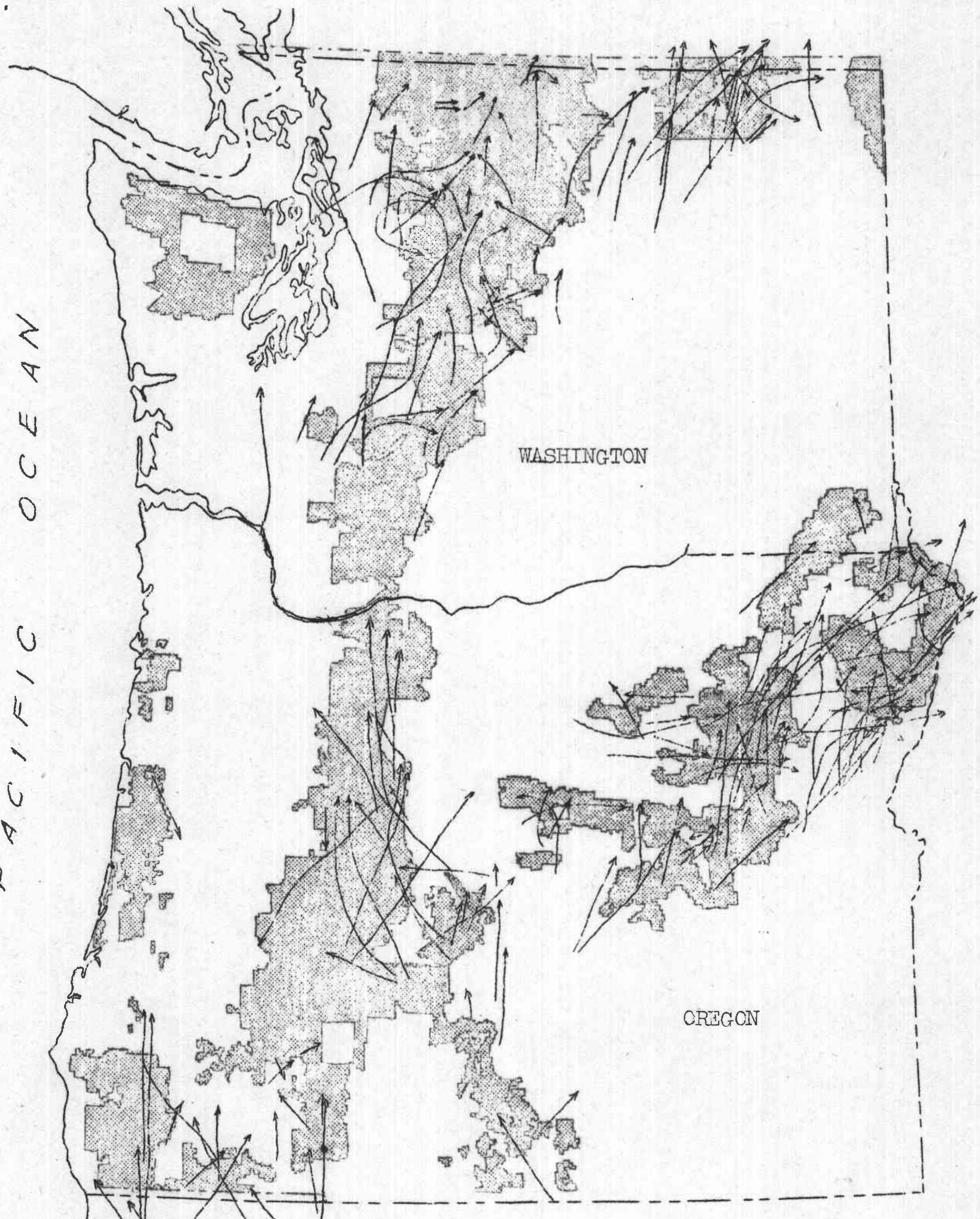


FIGURE 3 - A composite map indicating the occurrence of all lightning storms reported for the summer season of 1930.

29

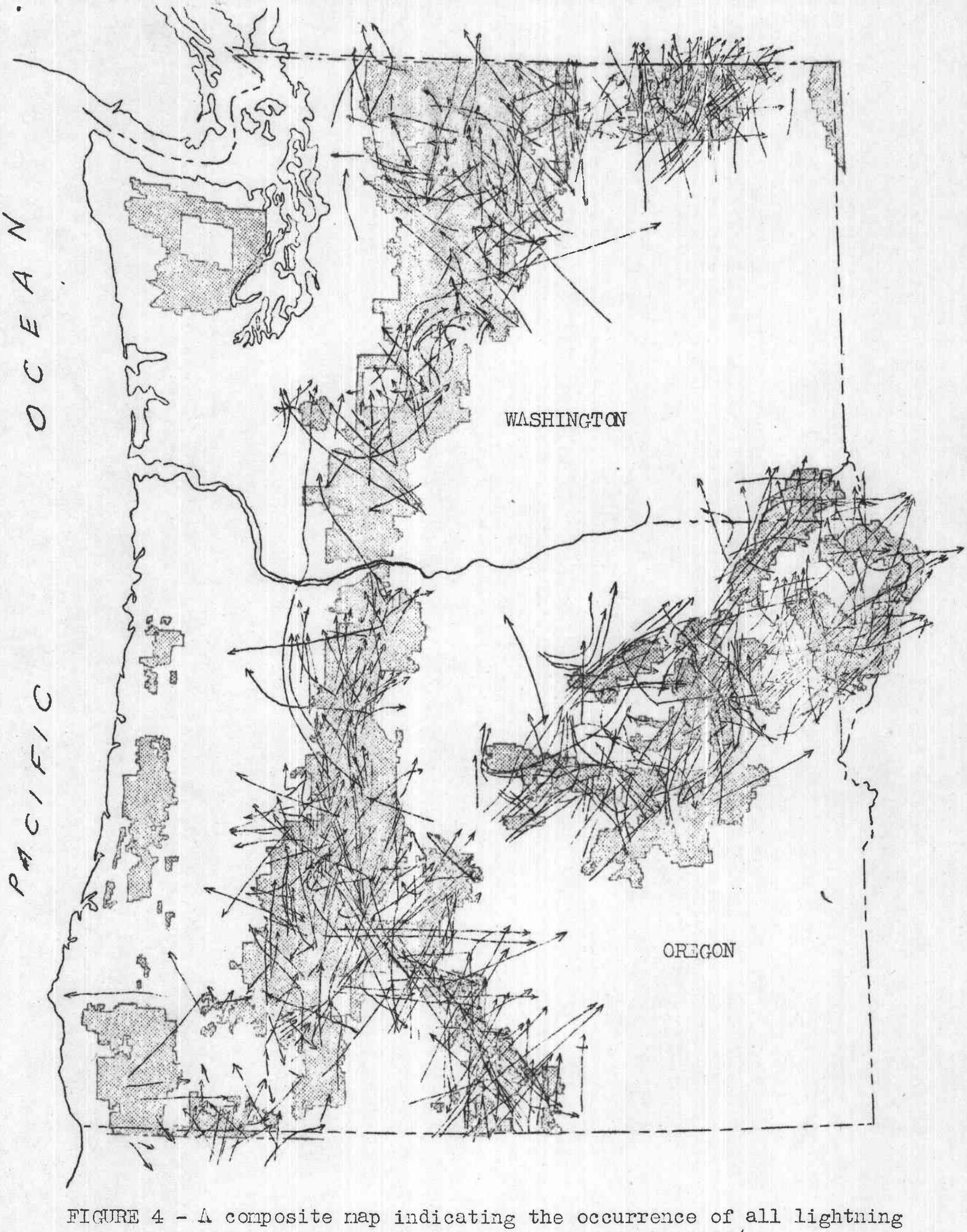
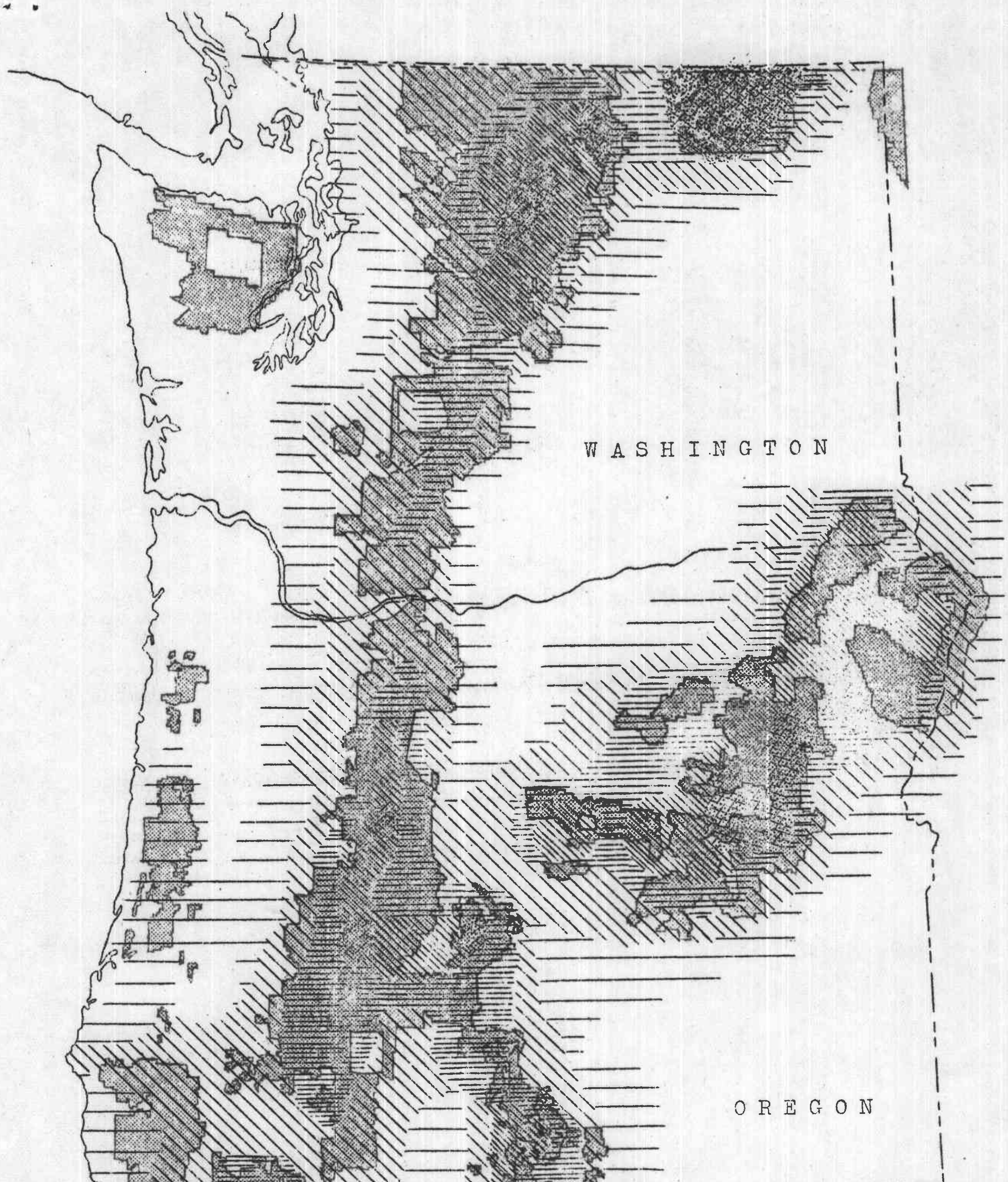


FIGURE 4 - A composite map indicating the occurrence of all lightning storms reported for the summer season of 1930.



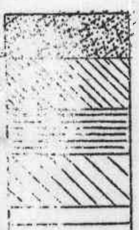


FIGURE 5 -- The average annual frequency of lightning storm occurrence. This map was prepared from reports by Forest Service lookouts, 1925 to 1931, and illustrates the number of individual lightning storms per 100,000 acres (12.5 miles square) during the average summer season.

FIGURE 6 - Length of Lightning Storms

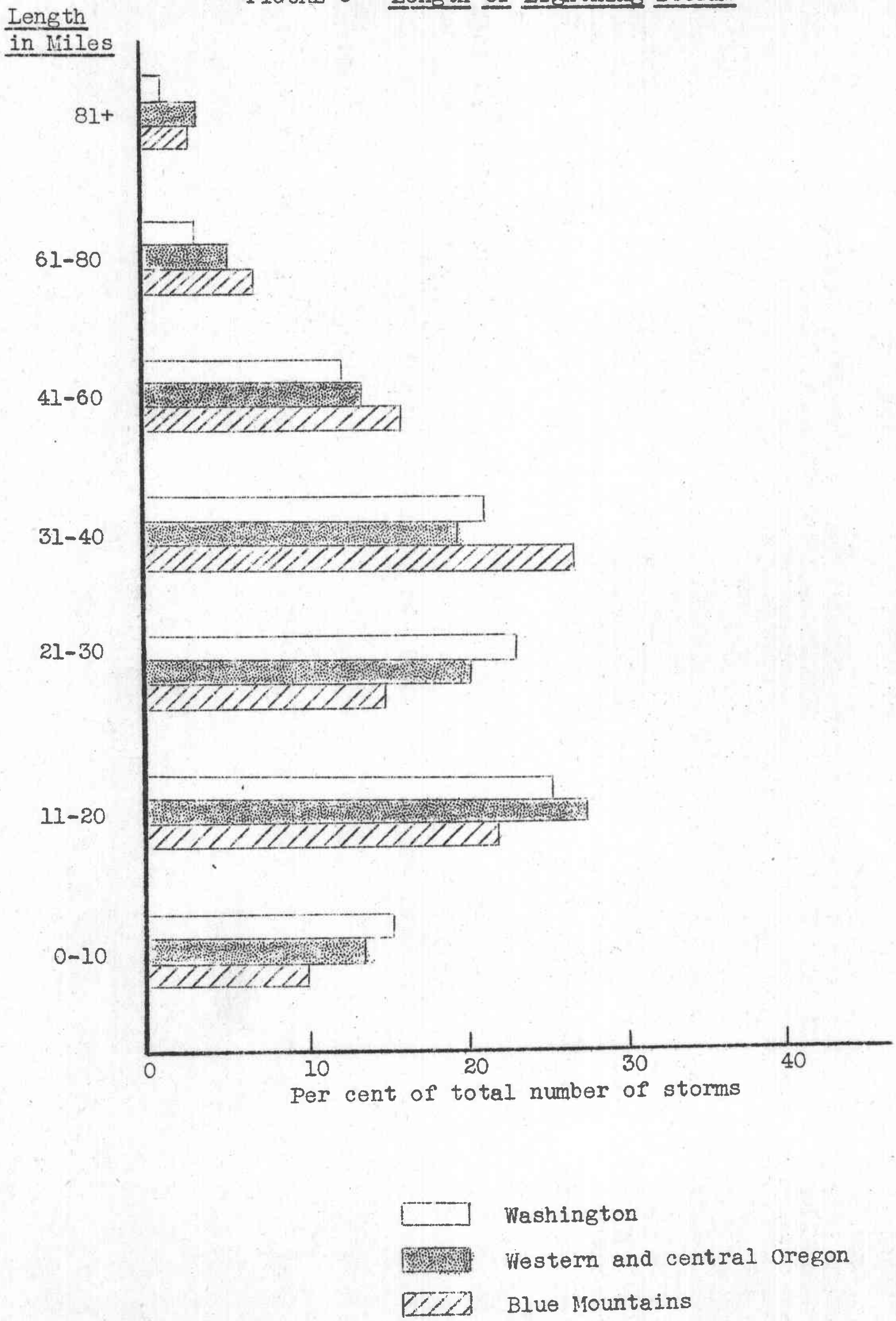


FIGURE 7 - Speed of Movement

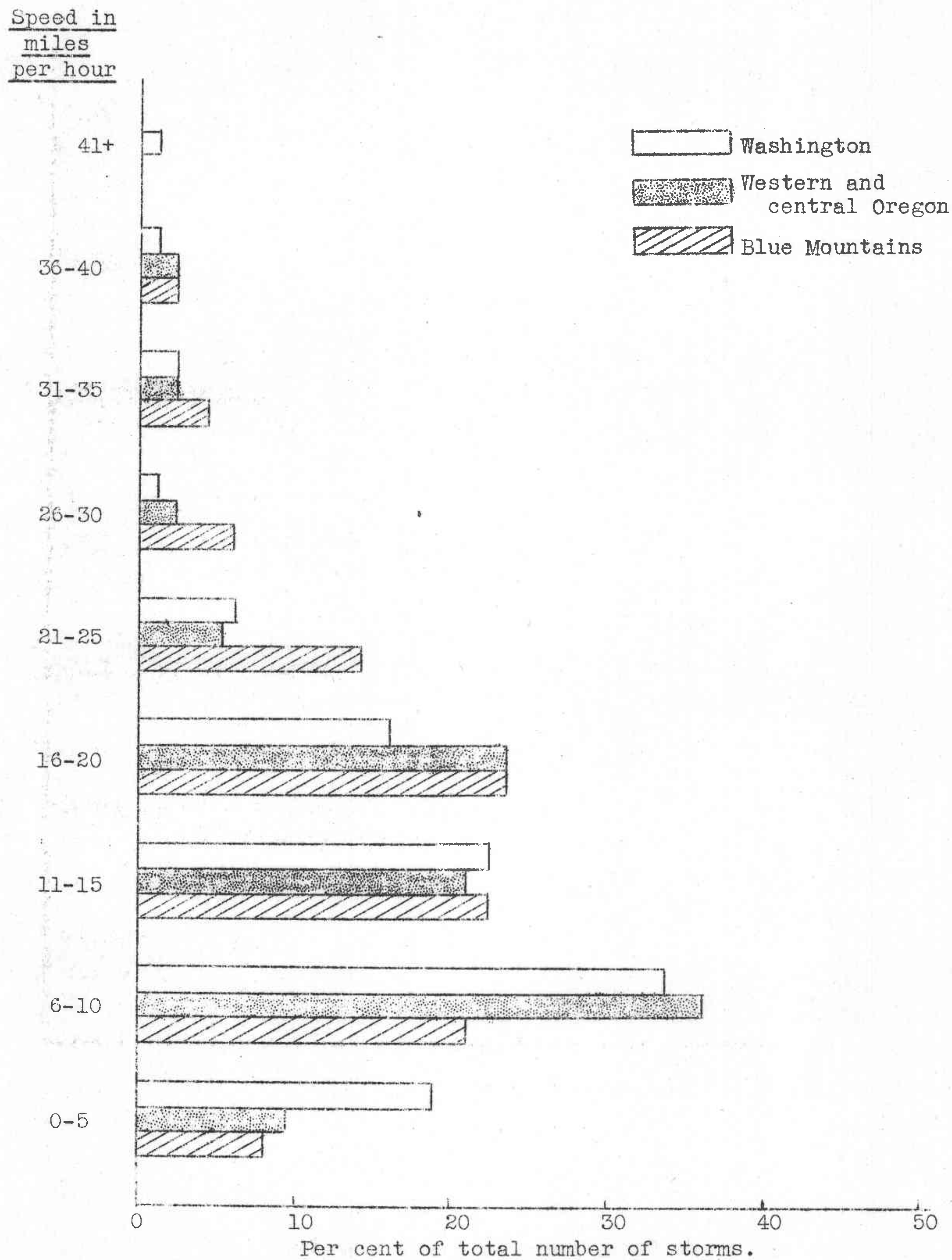


FIGURE 8 - Direction of lightning storm movement