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ABSTRACT: From 1959 to early 1966, tree failures caused an average of more than two injuries or deaths per year on forest recreation sites in California. Annual property damage is estimated at $25,100. Conifers accounted for three of every four accidents reported; pines and true firs were involved in 6 of every 10 incidents involving property damage, and in 9 of every 10 failures resulting in death or injury. These findings are from data reported by or through Federal land agencies.

Accidents Caused by Hazardous Trees on California Forest Recreation Sites

LEE A. PAINE

Every 5 years California's population increases by the equivalent of a city the size of Chicago. More people with more leisure time, larger incomes, and greater mobility add up to an astonishing growth in the use of forest recreation sites. The number of recreation visits to developed sites on National Forests in California is already more than twice that in any other State. At the present rate of expansion, it will have doubled again by 1970.

The reduction of hazard resulting from the presence of dangerous trees thus becomes an increasingly important --and difficult--problem on these sites. Control of such hazard requires well-organized safety programs with specific goals. The goals set by recreation management and the research necessary to attain these goals efficiently depend on an adequate knowledge of the problems.

As an aid to management and research personnel concerned with such hazard control, the Forest Disease Research and Forest Recreation Research staffs at this Station made a joint study of tree-failure accidents on forest recreation sites in California. This note provides a breakdown of reports of such failures.

The data were reported by or through Federal land agencies in California. All National Forests and National Parks are represented as well as National Monuments and U.S. Bureau of Land Management campgrounds. Information was requested on all cases of in-season branch or stem failure which either required clean-up work or resulted in property damage or bodily injury, on recreation sites. Data do not include damage or injuries incurred during fire suppression or logging operations. Tree failures were not reported unless they occurred during a season in which the site was characteristically in use. The reports included data on failures with clean-up work for years 1964 and 1965, and on incidents involving property damage or bodily injury for the period 1945 to early 1966. A well-documented fatality in 1931 was also included in this study.

Casualties and Damage

Of the 171 in-season failures analyzed in this study, 7 resulted in fatalities, 8 in bodily injuries, and 92 in property damage. All the reported injuries and fatalities, with the one exception previously noted, occurred in 1959 or later.

Almost half--40 percent--of the reported tree failures caused personal injuries or property damage. This figure is derived from the 96 reported failures which occurred in 1965, the most recent year covered by the survey.

The annual property damage resulting from tree-failure incidents on Federal forest recreation sites in California is estimated at $25,100. The figure is exclusive of clean-up costs. It is the rounded-off product of the average loss in all reported cases of property damage ($644) and the 39 tree-failures which resulted in property damage during 1965. If the figure on estimated annual property damage is applied to the total number of tree failures (96) in 1965, every reported tree failure would represent an average of $261 property loss.

The average of the four reported settlements or awards in property damage cases amounted to $1,156. In fatality cases, two suits against the U.S. Government were reported--in the amounts of $150,000 and $200,000. Awareness of the losses represented by the preceding statistics may be heightened by the observation that 13 of the 15 injuries or deaths were reported for a 7-year period (1959-1965)--an average of almost two per year. Incomplete returns for 1966 include three additional injuries and another fatality.

Tree Species Involved in Accidents

Three out of every four trees involved in property damages, personal injuries, or fatalities were conifers. And conifers were the agents in all reported injuries and fatalities (table 1). Five pine trees were involved in an average of two injuries or fatalities per tree--four fir trees were associated with an average of one injury or fatality per tree. Ponderosa pine, Jeffrey pine, and lodgepole pine made up the pine group. The fir group included white fir and California red fir. Only one incense-cedar was associated with an injury. Equal numbers of property damage incidents were reported for pines and for true firs, although there were more failures among pines.

No accidents were associated with the relatively small number (10) of failures reported for tanoak, bigcone Douglas-fir, redwood, and Port-Orford-cedar.

For the two years 1964-1965, a total of 129 tree failures were reported which resulted either in accidents or in the need for clean-up work. However, the number of incidents (96) reported in 1965--the year in which these reports were first requested--may be more representative of the average annual number of in-season failures. Nearly one-third of the 129 failures were pines. The failures, by species, were as follows: pine 38; fir 22; incense-cedar 8; Port-Orford-cedar 1; Douglas-fir 4; bigcone Douglas-fir 3; giant sequoia 2; redwood 1; oak 24; other hardwood spp. 26. These figures are not necessarily representative of any relative tendency by a species toward failure because the species are not equally abundant on recreational areas.

Discussion

Branch failures made up only 8 percent of the total number of failures reported for conifers. And only one reported injury was caused by a branch failure. All other injuries and fatalities were associated with uprooting, bole, or butt failures. The low figures for branch failures may well have been influenced by the emphasis placed on the removal of dangerous branches during pre-season hazard control activities. At the same time land managers should in future planning

Table 1.--*Tree species involved in accidents resulting from tree failures on California recreational areas, 1931, 1945 to February 1966*[1]

Tree species	Trees causing accidents	Consequences of tree failures		
		Fatalities	Bodily injury	Property damage
	Number			
Pine spp.	28	6	4	28
Fir spp.	31	1	3	28
Incense-cedar	8	--	1	8
Douglas-fir	3	--	--	3
Giant sequoia	2	--	--	2
Oak spp.	14	--	--	14
Other hardwood spp.	9	--	--	9
Totals	95	7	8	92

[1]All failures occurred within or near agency boundaries, but an occasional incident was reported from an area not directly subject to agency hazard control (e.g., outside campground limits or on a summer home site).

consider the relative importance of stem failures.

Conifers accounted for two-thirds of all reported tree failures. Specifically, pines and true firs were involved in 6 out of every 10 property damage incidents, and in 9 of 10 failures resulting in injuries or death.

In any program to reduce predictable physical hazards on California forest recreation sites, special attention should be given to pines and true firs. Hazard detection and control in these two genera provide the key to prevention of most recreation-site accidents caused by dangerous trees in California.

What is an acceptable casualty rate? It is outside the scope of this report to suggest what limits may be acceptable in terms of casualties and property losses. But management should define such limits, rather than to accept passively the results of safety programs operating without well-defined, attainable, and realistic goals.

The identification and evaluation of losses in this report provide part of the necessary basis for selection of acceptable safety goals. Such goals may be expressed as the accident rate per campground, or per million visitors, or even per dollar invested in hazard reduction. As in traffic safety, campground hazard control is primarily a trade-off between losses and the many costs of measures to reduce losses.[1] In recreation management, too, complete control of hazard is beyond our means, but when reasonable goals are clearly identified, our efforts can be directed to the most efficient ways of attaining them.

[1]*Traffic casualties can be reduced.* Stanford Res. Inst. J. 10. pp. 2-4. June 1966.

The Author

LEE A. PAINE is studying problems in the biology and control of forest tree diseases. A plant pathologist, he has been on the Berkeley Station staff since 1957, when he joined the Forest Service. He holds bachelor's (1943) and master's (1947) degrees in forestry from the University of Idaho and a doctor of science degree (1951) from the Swiss Federal Institute of Technology.