U. S. FOREST SERVICE
RESEARCH NOTE PSW-150

PACIFIC SOUTHWEST
FOREST & RANGE EXPERIMENT STATION
1967
P.O. Box 245 Berkeley, California 94701

Aerial Survey of Insect-Caused Mortality . . .

operation recorder gathers data quickly, cheaply

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ABSTRACT: An aerial survey using an operation recorder was made over a remote forested area of the Sierra Nevada, in central California. Data on insect-caused mortality were gathered. The survey saved several man-weeks of costly ground work that would have otherwise been required to obtain this information. The technique used proved to be an efficient and inexpensive way of collecting data for forest management decisions.

RETRIEVAL TERMS: Sierra National Forest; *P. ponderosa; P. jeffreyi;* Heitz Meadow; insect-caused mortality; continuous forest inventory; aerial survey; operation recorder; damage survey.

OXFORD: 587.6:453:624

In fall 1966, we made a rapid and inexpensive aerial survey over a remote part of the Sierra National Forest, in central California. We wanted to find out if suspected outbreaks of bark beetles were causing excessive losses of mature ponderosa pine (*Pinus ponderosa* Laws.) and Jeffrey pine (*P. jeffreyi* Grev. & Balf.) in the Heitz Meadow, near the south fork of the San Joaquin River. We recorded our observations on an operation recorder (fig. 1). This device has proved useful in making aerial surveys over large, inaccessible areas in the Eastern United States.[1]

Data from the aerial survey along with information from sample ground plots provided a rather clear picture of conditions. The survey took only 3 hours. By the following morning, data on forest types and extent of mortality were ready for the forest manager. If a conventional ground survey had been made, it would have taken several weeks to obtain similar information. Use of an aircraft and the operation recorder proved to be an efficient, effective means of quickly gathering data for forest management decisions.

PROCEDURE

To obtain a reliable estimate of tree mortality, the area to be surveyed was divided into four blocks on a map (fig. 2). Two flight lines were selected at random to sample each block; thus, eight flight lines were selected and marked on the map. At the beginning and end of each flight line, such prominent landmarks as peaks, stream junctions, or sharp ridges were marked and lettered consecutively. These points were used to prepare the final map and to help correlate airplane ground speed with the chart speed of the operation recorder.

AERIAL FLIGHT

The flight was made in an Aero Commander 500B aircraft. This twin-engine high-wing monoplane provides good visibility and stability at low cruising speeds of about 90 miles per hour, at which speed the survey was made. During the flight, two observers and the pilot operated an electrical keyboard (fig. 1) connected to the operation recorder. The observers viewed the forest through restrictive viewers (fig. 1) which allowed them to study intently a strip just a few chains wide. When the aircraft maintained a constant altitude of about 1,000 feet above ground, the strip width was about 10 chains. The observers activated their keyboards when observing

[1] Heller, R.C., Bean, J.L., and Marsh, J.A. *Aerial survey of spruce budworm damage in Maine in 1950.* J. Forestry 50(1):8-11, illus. 1952.

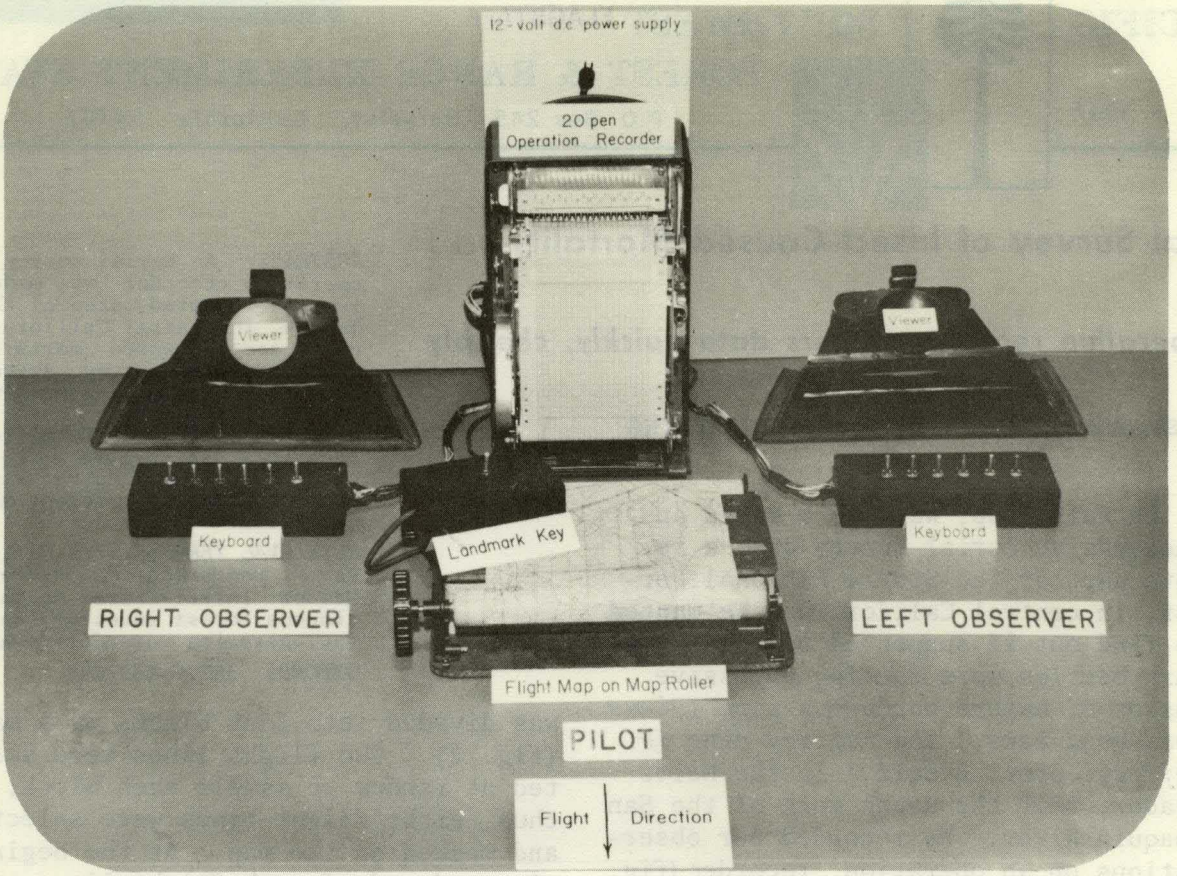

Figure 1.--*Instruments used in the aerial survey consisted of the operation recorder, two keyboards, two viewers, and the flight map mounted on a roller.*

pine type and counting dying pine trees. As the plane flew over landmarks that were lettered on the map, the pilot recorded the appropriate letter in Morse code by using a keyboard switch.

OPERATION RECORDER

The operation recorder has 20 electrically actuated pens that can be used singularly or in combination to record data on a moving chart. The rate at which the chart moves can be set. When a keyboard switch is held down, the corresponding pen is actuated and moves a short distance across the chart (fig. 3).

It is possible to correlate the time required to cover a given distance by the airplane with time it takes to cover this distance on the recorder chart. Therefore, observations made from the moving airplane can be located and measured on the recorder chart and later transferred by means of proportional dividers to a map (fig. 2).

RESULTS

Analysis of the recorder chart data determined that about 2,300 acres, 17 percent of the area, were observed and evaluated. We estimated the acres of pine type in each of the four blocks by a representative sampling of irregular blocks.[2] The number of fading pine trees was estimated by a cluster sampling design. From this analysis the following results were obtained:

[2]Schumacher, F.X., and Chapman, R.A. *Sampling methods in forestry and range management.* Duke Univ., Sch. of Forestry Bull. 7:102-115, illus. 1942.

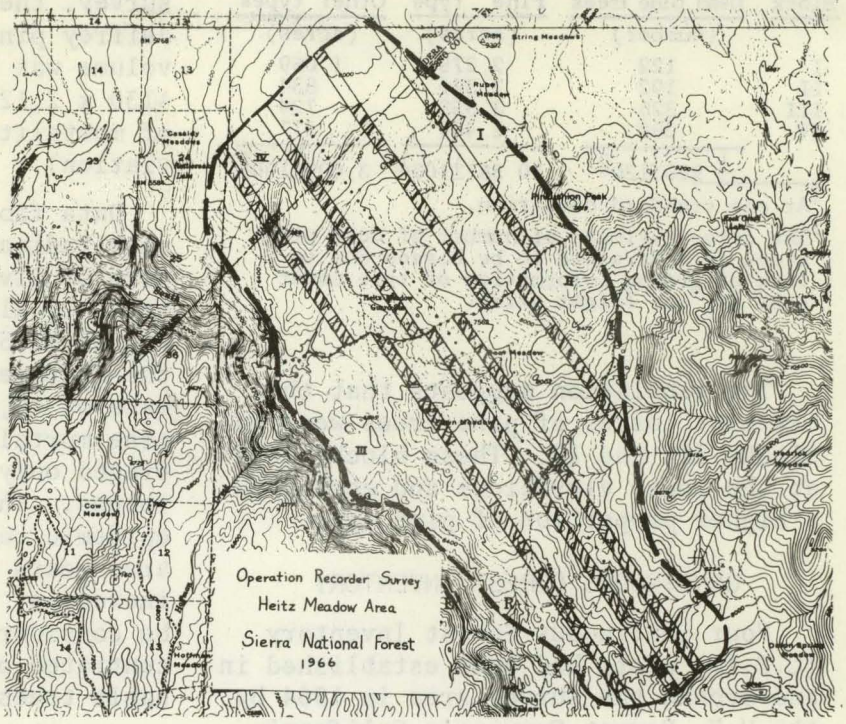

Figure 2.--*Area surveyed was divided into four blocks by randomly located flight strips. Crosshatched areas within strips are observed areas of pine type (scale: 1/2 inch = 1 mile).*

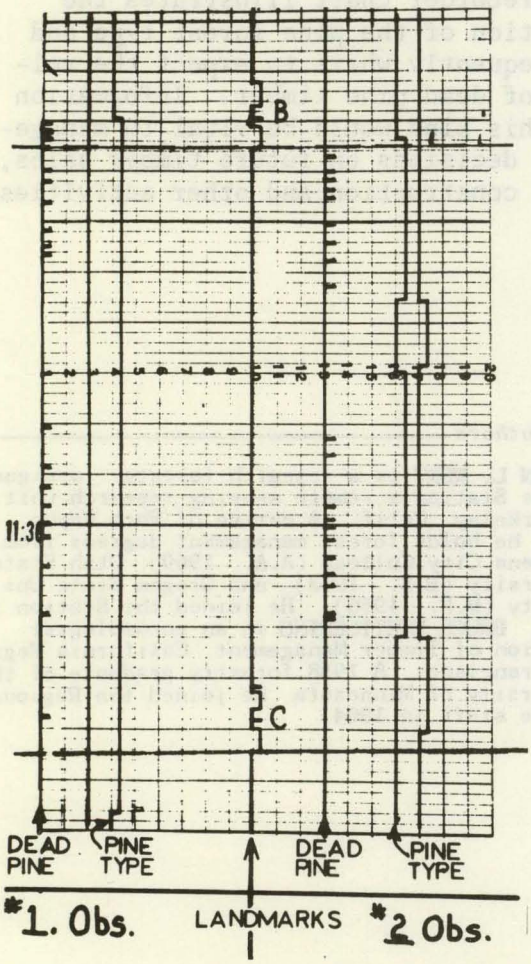

Figure 3.--*Portion of recorder chart shows notation of pine type and dead pine trees made by observers.*

Block	Dead pine trees (number)	Pine type (acres)	Other types (acres)
I	122	2,279	1,069
II	192	2,340	834
III	326	3,559	729
IV	280	2,409	377
	1/ 920±130 2/	10,587±100 1/	3,009±100 1/

[1] At one standard deviation.

[2] The error estimate of number of dead pine trees is understood to be biased due to lack of ground information of tree count over any one flight strip.

The tabulation suggests that the heaviest losses of pine trees were in blocks III and IV. These blocks were at the lower elevations and contained a higher proportion of pine type.

CONTINUOUS FOREST INVENTORY

Four Continuous Forest Inventory (C.F.I.) plots had been established in and around the survey area in 1964 by the U.S. Forest Service's California Regional Office. They are too few in number to provide a reliable estimate of volume loss, but they do indicate a reasonable average volume for the individual dead pine trees. This volume averaged 2,121 bd. ft. per tree. Using this average volume and the number of dead trees estimated from the survey, the estimated total loss of Jeffrey pine in terms of board foot volume was calculated as follows: 920 ±130 x 2,121 = 1.95 MMBF ± 275.73 MBF of mortality (at one standard deviation).

Data from the sample ground plots also indicated a total volume per acre of live and merchantable dead trees of all pine and associated species of 32,541 board feet. In view of the mixture of species and the estimate of 10,600 acres of pine type, pine mortality in the survey area averaged only about 1 percent of the volume. This loss does not represent epidemic conditions; however, the area bears watching. And if mortality increases, salvage operations should be considered because losses are concentrated on the oldest and most valuable trees.

The map which was produced from the recorder chart illustrates the location of the pine forest type and consequently where to expect the volume of dead pine timber. Information of this kind would be vital to management decisions on future timber sales, road construction, and other activities.

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