DETECTION OF MOUNTAIN PINE BARK BEETLE DAMAGE BY REMOTE SENSING WITH COLOR FILMS

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INTRODUCTION

The forest manager needs to monitor and record the status of the forest resource for changes which have occurred, and those changes that are likely to take place. Knowledge about forest insect damage may affect decisions on the amount of allowable cut, plans for the orderly harvest of timber, salvage operations of dead or damaged material, and the control of insect outbreaks.

Because timber mortality is typically scattered in erratic fashion over vast and often inaccessible areas, monitoring insect damage is usually a difficult and expensive task. Often, high costs can be avoided by using aerial photography, which covers ground more quickly and cheaply than fieldwork, yet provides a permanent record of damage.

Information gained from aerial photography includes detecting, locating, estimating damage, and estimating the capacity for future damage.

This report concentrates on the use of normal color films in aerial photogrammetry primarily because it has been the most used and reliable method to detect mountain pine beetle damage (Wear, Pope, and Orr, 1966).

Chapter 1

HISTORY AND USES OF REMOTE SENSING IN FORESTRY

The term remote sensing, defined by Parker (1962) as the collection of data about objects which are not in contact with the collecting device, was first used in the United States about 1958. In forestry practice, the term is restricted to the collection of information from a space-platform such as fixed-wing aircraft, helicopter, or satellite (Howard, 1976).

In 1887, a balloon was used to take aerial photographs of forests containing beech, spruce, and pine and the technique was advocated in 1919 to inventory our national forests. The value of aerial photography for forest sketch-mapping was established by the beginning of World War II using black-and-white panchromatic film with a minus-blue filter which minimized light scattering at shorter wavelengths. Historically, lenses with a focal length of 152 mm and 205 mm have been used widely for forest photo-interpretation, and currently universally used with a 23 cm format. Occasionally, lenses of 254 mm or 305 mm focal length are preferred.

Remote sensing in forestry involves a wide variety of equipment and techniques, including multi-band or single-camera photography, and infrared black-and-white, infrared color, normal color, and panchromatic black-and-white film. Other methods involve optical mechanical scanners such as our Landsat and Earth Resources Technological Satellite; these utilize thermal infrared imagery and Side-Looking Radar (SLAR/SLR) measuring the microwave part of the electromagnetic spectrum.

Because in many cases the insects have left the tree by the time damage becomes visible from the air, aerial photography was not developed to detect initial damage (previsual damage) or evaluate size of insect

populations. Aerial photos often are used to estimate tree mortality, determine damage locations, detect damage trends from insect species such as the gypsy moth, spruce budworm, tussock moth, and southern pine beetle, and determine the need for or results of insect control measures.

Chapter 2

THE MOUNTAIN PINE BARK BEETLE

The mountain pine bark beetle, Dendroctonus ponderosae, Hopkins, has plagued the Front Range of Colorado for the past several years. Several thousand pines are killed each year by this bark beetle and the fungi it carries; and the epidemic shows no signs of abating.

The beetle's range as described by McCambridge and Trostle (1972) covers a wide area from the Pacific Coast eastward through the Black Hills of South Dakota and from northern British Columbia to northwestern Mexico. Its habitat varies in altitude from 2,000 feet in the northern latitudes to 11,000 feet in southern California.

In Colorado the insect attacks mainly ponderosa and lodgepole pines; but western white, sugar, whitelark, limber, pinyon, bristlecone, and foxtail pines are additional known hosts. Although broods are not produced in spruce and fir, they may be occasionally attacked and killed during outbreaks. Beetle attack alone may kill the host tree, but these beetles frequently carry a blue-stain fungus belonging to the genus Ceratostomella which also contributes to the death of trees. Sapwood of infected trees turns blue as a result of a chemical reaction between the wood tissue and the toxin produced by the fungus. Salvaged wood may be less valuable because of this blue stain. Epidemics occur every 20 to 40 years within a specified pine forest and may last six to eight years.

Because of the wide distribution of the beetle, there are wide variations in its life history. Normally there is one beetle generation annually in most of its range. Two and a partial third generation may develop in warmer climates below an altitude of 7,000 feet. In the coldest