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Stand Risk Rating for the Southern Pine Beetle: Integrating Pest Management with Forest Management

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ABSTRACT—Stand risk rating for the southern pine beetle, Dendroctonus frontalis *Zimm., is a first step toward dealing with a serious but sporadic insect problem. Two approaches, one utilizing readily available resource data, the other employing data obtained from aerial photographs, illustrate application of current knowledge to meet the protection needs of resource management—the primary role of integrated pest management. During a 36-month period in Louisiana, high-risk stands accounted for 13.4 infestations per 1,000 acres, four times the rate of low-risk stands; in Texas high-risk stands accounted for 9.9 infestations per 1,000 acres during 1973–1978, almost five times the number for low.*

One of the most damaging and unpredictable pests of southern pine forests is the southern pine beetle (SPB). Knowledge of SPB biology and ecology has grown immensely in recent years (Thatcher et al. 1980), but the onset or collapse of outbreaks still cannot be effectively predicted. Many factors that affect the SPB also affect the host trees—not necessarily in the same direction, or to the same extent. In the absence of a predictive biological understanding of the SPB, risk rating of stands can be utilized to develop sound, long-range plans that integrate pest management and forest management at minimal cost.

This article describes two cost-effective approaches to implement stand risk rating over a large land base. Readily available inventory data are used in one system developed in Louisiana for national forests (Lorio 1978, Lorio and Sommers 1981); the other system was directed at mixed ownerships in east Texas (Mason 1979, Mason et al. 1981). These applications exemplify the practicality of integrating pest management strategies with operational forest management.

The Methods

Stand risk rating embraces the idea that SPB activity cannot be adequately predicted, but it is possible to identify stands where abundant food and habitat favor beetle reproduction. Forest managers can easily apply this understanding while planning routine activities for both timber and pest management purposes.

The first approach uses generally available inventory data, such as forest type, tree size and age, stand density, and site index. This method assumes the following: loblolly (*Pinus taeda* L.) and shortleaf (*P. echinata* Mill.) pines are the primary host species; an incomplete understanding of SPB population dynamics prohibits accurate prediction of infestation occurrence and severity; food and habitat needs for abundant SPB reproduction are related to recognizable stand characteristics; stands best meeting food and habitat needs also represent a valuable timber resource; and routine forest inventory data can be applied to rate stands for risk.

Details of the process, as applied to Continuous Inventory of Stand Conditions (CISC) data for 120,000 acres of the Kisatchie National Forest in central Louisiana, are presented by Lorio and Sommers (1981). CISC is an automatic data-processing system used for national forests in the South. It makes up-to-date descriptions of timber stands readily available. Five data fields in CISC (forest type, stand condition class, method of cut, operability, and site index) were used in a subjective manner to rate stands as high, medium, or low in risk of SPB attack.

The second approach, developed by Mason et al. (1981), is best suited for areas that include a wide variety of ownerships for which detailed resource data are not available. Work by Hicks et al. (1980) indicated that some commonly measured tree, stand, and site characteristics could be applied to describe infested and noninfested stands. Mason (1979) selected certain of these variables which could be accurately interpreted from 1:60,000 scale color infrared aerial photos, supplemented by large-scale (1:10,000 and 1:5,000) photo samples. The best combination of variables found in stepwise discriminant analysis of infested and noninfested loblolly pine stands was height class, basal area class, and landform class. With these variables, a five-class system of risk rating was developed for east Texas.

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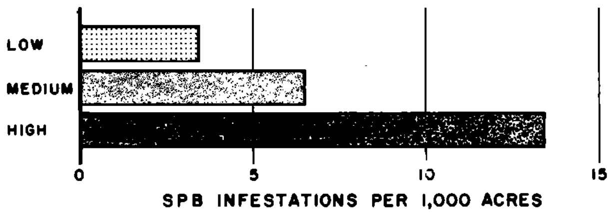

Figure 1. Frequency of 561 SPB infestations on the Catahoula Ranger District, Kisatchie National Forest, by risk classes, July 1977–June 1980.

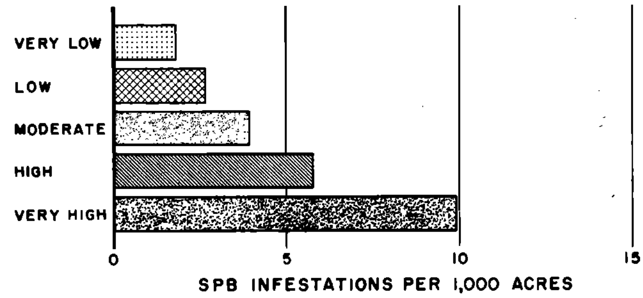

Figure 2. Frequency of 480 SPB infestations on mixed ownerships in east Texas by risk classes, 1973–1978.

Testing and Validation of the Methods

Both systems were first tested in areas where they were developed. In each case, frequency of infestations within risk classes was considered the best criterion.

With the system based on CISC data, an initial 25-month study (June 1975 through June 1977) of infestation data (504 single- or multiple-tree spots) showed that stands rated as high risk averaged 9.3 infestations per 1,000 acres, as compared to 6.8 and 3.2 infestations for medium- and low-risk stands. Subsequent evaluations (July 1977 through June 1980) with 561 spots and updated CISC data averaged 13.4 per 1,000 acres for high-risk stands, twice the rate for medium, and four times the rate for low risk (*fig. 1*). Only 23 percent of the forest had high- and medium-risk stands. Such areas can be easily identified on maps and computer printouts and assigned treatments to reduce risk or given attention in aerial or ground surveys for SPB activity.

In east Texas, a similar approach was taken to test the five-class rating system through the data base derived from aerial photos and infestation records compiled by the Texas Forest Service (Pase and Fagala 1980). A discriminant equation correctly classified 73 percent of the 1,140 plots used in model development. A group of 10 randomly located blocks, representing approximately 182,000 acres, was stand-mapped from aerial photographs. Each stand was rated and the acres per class calculated. Moderate-risk stands predominated, with only 14 percent of the area represented by high- and very high-risk conditions. Of 480 SPB multiple-tree infestations (1973–1978), however, 9.9 per 1,000 acres occurred in very high-risk areas, 5.8 in high, 3.9 in moderate, 2.7 in low, and 1.8 in very low-risk stands (Mason et al. 1981) (*fig. 2*).

Similarities in the two approaches and their apparent success in areas where they were developed led to reciprocal tests in areas somewhat remote from their origin. Primarily, we wanted to test the Louisiana CISC-based system on national forests in Texas and to evaluate the Texas photography-based technique in central Louisiana (Autry 1980). We also wanted to explore relative costs and implementation problems likely to arise with extrapolation and use by personnel not involved in development of the systems.

Comparative results paralleled those obtained with each in the areas where they were developed. Although the CISC-based system could be tested with only 158 infestations on 42,000 acres of national forestland in Texas, the infestation trend was similar to that in Louisiana. In Texas, 6.7 infestations per 1,000 acres occurred in high-risk stands, 5.1 in medium, and 3.1 in low. The aerial-photography-based technique was tested on 177,000 acres of Louisiana national forest with results comparable to previous findings in Texas. On average, 12.0 infestations per 1,000 acres were located in very high-risk stands, 4.6 in high, 4.2 moderate, 1.9 low, and 0.69 in very low. Autry (1980) suggested that the three-level grouping represented by these results was adequate for Louisiana, with very high risk representing the upper level, high and moderate the medium level, and low and very low the lower level.

Application Aspects

Obtaining the necessary forest stand information was the only problem in implementing either system. In actual practice, the CISC data are accessed by computer, the risk-rating program is executed, and a printout of stand risk ratings is produced. In applying the CISC-based system in Texas, it was necessary to work with available printouts of computerized CISC data and resolve apparent discrepancies with existing stand maps.

Inadequacies in the resource data, such as large heterogeneous areas grouped into one stand, limit the potential utility of stand risk rating. Stand dynamics and application of management treatments require periodic updating of stand risk. A salient feature of stand risk rating based on a continuously updated inventory system, such as CISC, is that ratings can be obtained at convenient intervals as the data base changes.

The primary problem in applying the aerial-photography model in Louisiana was the time required to locate, select, and acquire the photographs. No significant difficulty affected application of the system. Ground checks of estimates for basal area and total tree height showed that classification of those two variables was correct 96 percent and 92 percent of the time. Landform was estimated subjectively from U.S. Geological Survey topographic maps with no apparent problem. Color resource photography (1:15,840) was used to supplement NASA 1:120,000 and 1:60,000 color infrared enlargements, rather than the small-format samples previously employed. Also, longleaf pine (*P. palustris* Mill.) was not a component in the Texas study area, and so was excluded from the pine ratings in Louisiana. Longleaf was assumed to be a low SPB risk; subsequent evaluations have indicated that the species should be considered a low to moderate risk.

Costs of applying either of the systems are minimal. With the CISC-based system, execution of a computer program on an existing data base is the primary requirement. Preparation of risk-rating maps, including labor, ran costs to $0.0081 per acre. The aerial-photography model cost $0.0155 per acre. In actual application over large areas, when the same data are used for hazard ratings as for other management purposes, actual cost would be much less for either approach.

Forest Management—Integrated Pest Management

Forest managers commonly attack serious but sporadic pest problems, such as the SPB, on an ad hoc basis. Only when outbreaks are evident can they justify the time, effort, and expense to deal with them. Frustration and apparent futility are frequent results.

The term *integrated pest management* (IPM) signifies that management of an organism capable of becoming a pest is a part of resource or forest management. Stark (1977) emphasized that IPM is the discipline that brings together knowledge to meet the protection needs of resource management. The approaches to stand risk rating described here are examples of a first step toward that goal. The CISC-based system is currently in use on the Kisatchie National Forest to assist in the 10-year stand selection process for regeneration and thinning. Forest Pest Management, a unit of the Southeastern Area of State and Private Forestry, USDA Forest Service, is currently transferring this technology to other national forests. The Texas aerial photo system is in use on a mix of ownerships in east Texas and Louisiana. Neither is universal in the sense that it can be applied across the range of the SPB. Primarily, both approaches demonstrate that ordinary inventory data, collected for a wide variety of purposes, can be interpreted and applied in an operational setting to reduce pest losses with minimal effort and at low cost.

Pest management can be effectively integrated into forest management if:

1. researchers or pest managers understand the needs and limitations of forest managers;
2. they strive to apply existing resource data to the problems;
3. they develop feasible and useful techniques that are easily applied; and
4. forest managers are willing to incorporate the methods into their operations. ■

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Forestland Market Values

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ABSTRACT—Data from the U.S. Department of Agriculture's Economics Research Service indicated that forestland values in Appalachia, the Southeast, and the Delta States increased at rates well above the rate of inflation between 1971 and 1979. Forestland prices for 1979 were highest in the Southeast and lowest in the Lake States. Compared to alternative land uses, forestry was found to be very low valued. The per-acre selling price of forestland declined as size of the transaction increased, but began to stabilize for tracts of 200 acres or more in area.

Even though land is a factor in forest production, analysts have frequently ignored its cost in analysis of forestry investments. There are many reasons for this neglect, but the primary one may be that documented information on transactions is difficult to obtain (Pleasonton 1974).

The lack of accessible data has been alleviated somewhat by recent activities of the USDA's Economics Research Service (ERS), which began reporting some information on forestland market values in 1971. ERS publishes values annually in its Farm Real Estate Market Developments reports. This article examines the ERS data and describes recent trends in forestland market values. Changes reported are for four regions as well as for the contiguous 48 states.

Data Source and Analysis

Real estate market data are published annually by ERS (until recently the Economics, Statistics, and Cooperatives Service, ESCS). Information on land sales is obtained through semiannual surveys of farm real estate brokers, local bankers, county officials, and others (ESCS 1979). No attempt is made to obtain a random sample of land transactions; sources are individuals who are knowledgeable about local market conditions. The reports, however, represent a large number of land sales from across the nation.

The surveys focus on land that has been used primarily for agricultural activities such as grazing or row crop production. According to the buyers, however, a certain portion of this land is purchased with forestry as the intended primary land use. These transactions form the basis of ERS's reported market values of forestland. The diversion of former agricultural lands to forestry seems plausible because, according to ERS personnel, approximately one-third of the land classified as "agricultural" does in fact support stands of forest trees. Land values include the worth of both the land and standing timber.

The reporting of forestland transactions is concentrated in certain regions of the country *(table 1)*. In 1979, the farm real estate sales reported by ERS totaled