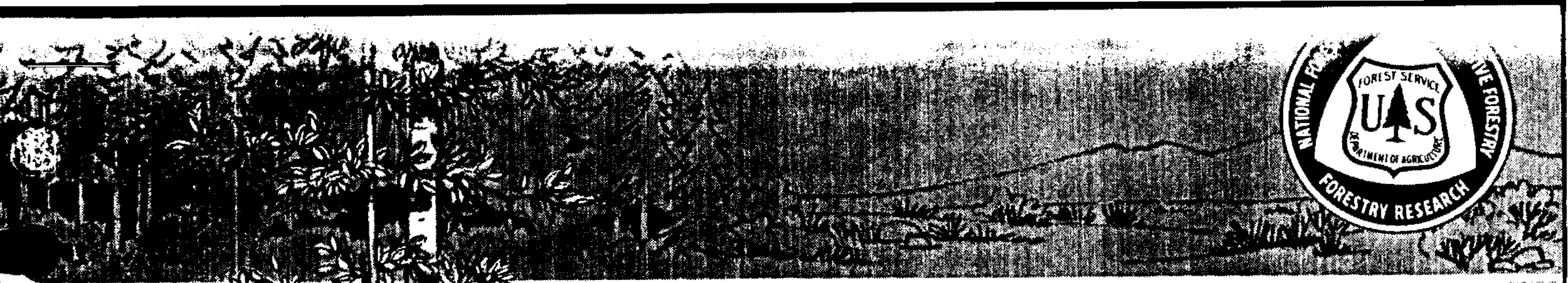

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USDA Forest Service
Research Note INT-213

November 1976

ACQUIRING FOREST INSECT IMPACT DATA

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ABSTRACT

Acquisition of pest impact information is a dynamic, continuing phase of management planning. Measurements should include classification of insect effects on individual trees and quantification of the effects on stand characteristics. The evaluation of the net effects of pests as forces of change requires establishment of a base from which changes can be measured. The primary unit of this data base is the forest stand. All measurements and acquisitions of impact data must be accomplished with direct concern for the use (ecological, economics, and social) of the data and in monetary units when possible.

KEYWORDS: impact, acquisition of data, models, use, analysis, and interpretation

Impact is the cumulative net effects of a pest on management activities that determine resource uses and values. These effects will range from very good to very bad. Consequently, the definition of impact and the way it will be gaged must be explicit in each situation.

The character and reliability of impact information used by pest control supervisors, resource managers, and research directors are entirely dependent upon the adequacy of data collection, data handling, and the analytical and interpretive steps from which the information is derived. Shortcomings in the scope, quantity, and quality of effort in any of these phases of the system place constraints upon the decision-making. Constraints cannot be ignored or circumvented, nor can inadequate and arbitrarily compiled impact information be accepted.

If impacts of forest pests on current and future timber production are only partially defined, how can economic analyses assess opportunities for optimizing timber production and associated benefit/cost returns now or in the future? In fact, if few relevant data have been taken, how can analyses be made of the direct and indirect effects of pest-caused changes in forest stand composition, density, and structure on watershed values?

Defensible criteria for decisionmaking on pest control must be stated. For example, studies investigate silvicultural treatments and consequent effects, studies investigate fire incidence and its effects, and studies investigate cause and effect in other functional areas; but, this research often produces little or no tangible recognition of the effects of pests on the ecosystem or management units involved or even of the interactions of pests with the phenomenon or treatment under study.

These considerations imply that evaluating forest pest impacts is an extremely complex task that not only involves identifying and measuring pest effects, but also foreseeing the kind of forest management that will be practiced in the future. Impacts will span the gamut from those that are easily quantifiable to those that are nonquantifiable now.

ACQUISITION

Data acquisition is a particularly dynamic phase in the impact evaluation process. The task of obtaining adequate pest impact information and of bringing it into management planning and decisionmaking is continuing and seems complex. It requires a comprehensive, flexible integrated system with specified data sources and capabilities for handling, analyzing, and interpreting data. However, the basic data needed for measuring impact may not be as complex as they are diverse.

Continual changes in impact criteria and basic analytical technology plus feedback from experience will require corresponding changes, adjustments, and additions to the methodology now available. Measurements should include classification of the direct effects of the impact agent on individual trees and quantification of the effects on stand characteristics. Recording occurrence of specific agents or complexes of agents is an essential complement to tree-stand data. Data on agents may be recorded either by organism or by specific agent-caused effects. Both sorts of data are needed for analysis and interpretation. Surveys will have to be concerned not only with measurement of pest effects in the forest, but also with determination of the present and future management in that particular stand.

Two basic types of management data are needed: (1) ratings of the effectiveness of management strategy and (2) where possible, expected benefits of that strategy in terms of dollar values. Total strategy effectiveness, and the effectiveness of strategy components of that strategy, must be rated qualitatively. The intensity of pest effects that modify effectiveness should be recorded. Ratings of the effectivenss of strategy and of the intensity of modifying factors that can be tabulated by cause in stand tables similar to life tables. The stand tables then could be used to identify losses of management strategy effectiveness by cause. Models for projecting potential effectiveness of the strategy applied at specified ages or age classes could be developed from these stand tables. The objective should be to develop methods of predicting accurately the changes in management effectiveness, given specified intensity of pest activity within specified ages or age classes. Benefit data must then be developed.

There are three basic alternatives to gathering the data:

1. Immediately establish sample plots and take measurements. This could be considered an unacceptable alternative in the context of waiting 30 years to get information that may be needed now.

2. Use exististing historical data. A reasonably accurate base line could be established on a site-to-site basis and effects on stands by major pests could, in part, be established.

3. Combine these two alternatives. Historical data would provide an immediate reliable base from which to work while the addition of new measurements yearly would update and increase the reliability of the base data. The greatest drawback to using historical data is the likelihood of its being in a noncompatible form.

The evaluation of the ne[illegible] of pests and other forces [illegible] establishment of a base from which changes can be measured. The primary unit of this data base is the forest stand. In addition to tree and stand measurements, the data base must include such stand descriptors as cover type or ecosystem, and provenance, and such area descriptors as geographic coordinates. Descriptors are required of the interaction between site and pests and of how they affect stand value. Site descriptors include soil type, topography, aspects, and productivity. Examples of pest descriptors are the percent of trees infested and the ratings of infestation. The effects of the interaction of these descriptors on such stand values as timber, range, wildlife, and water should be measured and quantified.

Some individual improvements in data acquisition could be:

1. Expansion of pest survey coverage to include pests of lesser importance, pests affecting noncommercial resource uses, nontimber resource uses, or both, and those pests not currently covered.

2. Extension and improvement of the current system of collecting and processing data, and improved coordination with complementary activities within other functions and disciplines.

3. Intensification of the specificity of surveys and development of criteria for the precision and accuracy of specifications.

4. Development of uniformity in collection, analyses, and retrieval of data for a central data-control system.

5. Establishment of regular feedback processes and decisionmaking models.

ANALYSIS AND INTERPRETATION

Once procedures for data acquisition and handling are established and systems are developed, analysis and interpretation of data become keys to successful impact assessment. There are three approaches to impact analysis: (1) forest stand tables; (2) tree-by-tree models; and (3) aggregate stand models. The analytical techniques applicable to each are not exclusive or duplicative; they are complementary. Alone, or more effectively, in combination, they will show (1) how and to what extent pests affect the productivity, usefulness, and value of forest stands; (2) how and to what extent pests interact with animals, weather factors, fires, and human uses of the resources; and (3) the relative importance of pests to changes that require modification of management.

Criteria for evaluating forest insect impact must be established. The evaluation should take into account all noticeable effects and the agents associated with them. The simultaneous occurrence of different symptoms, effects, pests, and the association of more than one organism with a single effect should be recorded. Past records of pest occurrence generally have been too restrictive. Often data have been taken on a single major pest and evidence of all others has been kept out of the record, which greatly limits analysis and interpretation.

It is necessary to have a frame of reference within which to evaluate any effect, given that the effect has been measured. Also, the effect must be appraised at the time a value is altered. Thus, data for particular stands or locations should encompass a significant time period, ideally from seeding (or planting) to harvest (or natural demise). Single point-in-time data do not provide the needed information for a complete accounting of pest-caused effects. In fact, single records of pest occurrence and related effects may be very misleading.

For example, the value of trees killed by spruce budworm at an early stage of stand development should not be considered a part of the insect's impact. Rather, at the time of normal harvest, any difference in value yield from the stand and that from an uninfested stand should be the appropriate measure. In some cases, however, the stand that experienced no mortality will require additional money for thinning since many stands are very densely stocked at an early age. Some form of forest management and some forest production goals should be implied in setting values. The time of harvest, the desired product, and appropriate stocking require an economic projection if harvest is to be at some future time. These factors all enter into the evaluation process.

In a timber production area, are all trees killed by pests accountable as loss and, therefore, a component of impact? Is real loss, the impact, calculated from some optimal stocking index? Or, is it the difference between net recoverable volume and potential gross volume? Or, more realistically, is it the portion of the net-gross differential that can be recovered now by more effective pest control and in the immediate future by improved technology? In a recreational area where esthetic values are important, is the base line for impact evaluation merely the present condition and appearance of trees and stands or is some lower or higher level of esthetic appeal feasible and justified? Similarly, explicit base lines must be developed for watershed protection, wildlife habitats, and other resource values and uses.

Accuracy and precision specifications must be developed for the various kinds of data taken. The confidence limits will be dictated in each case by (1) the nature of effects and the organisms involved, (2) the techniques used, and (3) the management objectives or value judgments that apply. These same considerations determine the frequency of observations and data recording. It cannot be assumed that generalized specifications will be acceptable for given effects or types of pests. For example, the requirements for accuracy and precision of data, and for the frequency of data collections, would logically differ between an area under intensive management on a 30-year rotation for one objective, an area under intensive management on a 90-year rotation for a different objective, and an area under management for an objective that will not be affected by the pests.

USE

All measurements and acquisitions of impact data must be accomplished with direct concern for the use of the data. Application of models that predict loss of values should yield estimates of net impact, in monetary units where possible. Two levels of programs with the means of establishing priorities. To evaluate pest impact, criteria must be established. These criteria should include the changes in (1) monetary values, (2) production of goods related to resource management objectives, (3) tangible services and (4) intangible services. Other criteria might be selected depending upon the objectives in determining impact.

Models can be used as ways to predict (1) trends in pest numbers, effects, or both; (2) pest population conditions, resource conditions, or both; and (3) the probability of different outcomes from alternative management strategies. Growth projections take into account the effects of pest-caused mortality and growth loss on timber supply and on allowable cut calculations. Numerous analytical procedures can be used to screen management options, including protection against pests. These analytical techniques provide sound reasons for including pest impact data in all decisionmaking. Further, they give the best evidence of the present voids in impact information and of the scope and scale of effort needed to fill these voids.

Finally, we must determine where and how information about the ecological and socioeconomic components of impact come together in the analytical aspects of decision-making. The pathways to action programs and research decisions are different, but they must interrelate. There is feedback at all steps in the system from both research and action programs. This feedback must be developed and used for optimal results. This assessment is necessary to monitor the consequences of human responses to effects of pests. In many instances, the magnitude of the impacts from people-pest encounters is uncertain, and undoubtedly will continuously change as understanding and familiarity with the primary effects increase.

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