

DEVELOPMENT OF AN EXPERT SYSTEM FOR ENDEMIC POPULATIONS OF MOUNTAIN PINE BEETLE IN LODGEPOLE PINE FORESTS

Dale L. Bartos

Operations Research Analyst, Intermountain Research Station, Forest Service, U.S. Department of Agriculture, Logan, UT 84321

Kent B. Downing

Associate Professor, Forest Resources Utah State University, Logan, UT 84322

Expert Systems (ES) contain information about a specific area of interest. Currently, ES are being used more and more in the area of natural resources. These ES are an excellent way to organize existing knowledge for use by the land manager or research scientist. This paper details the approach we took in developing a basic ES.

Our ES deals with endemic (initial stages prior to outbreak) populations of mountain pine beetle (MPB), *Dendroctonus ponderosae* Hopkins (Coleoptera: Scolytidae), in lodgepole pine, *Pinus contorta* Douglas var. *latifolia* Engelm., stands. The scientists on the MPB project with the Intermountain Research Station, USDA Forest Service, furnished the expert information about MPB. We first developed an ES to organize existing knowledge and to identify areas of needed research. Our long-range goal is a detailed ES that can be used by land managers in the decision-making process.

We will examine each phase in the development of our ES: (1) knowledge acquisition; (2) programming rules induced from knowledge acquired; and (3) verification (Fig. 1).

KNOWLEDGE ACQUISITION

We acquire facts, interrelationships, and predicted outcomes by extracting information from published literature and from experts. Because much of the knowledge used for successful decision making in natural resources has evolved through professional experience, and because ES programming allows us to incorporate this kind of qualitative, heuristic reasoning, we view skilled practitioners and researchers as sources of meaningful information for model building. We capture their thought processes and their knowledge of facts and how they interrelate those facts. This enables us to explain within the program how predictions or conclusions were generated (Fig. 2). Capturing knowledge from experts is difficult and time consuming and has been referred to as the "knowledge acquisition bottleneck" (Feigenbaum 1977). The main problem arises from the inability of experts to describe their own reasoning processes—they are not "expert" at articulating what they know (Shapiro 1987).

We are applying several techniques to cope with this problem: (1) interviewing experts about known and suspected MPB dynamics; (2) watching and questioning experts as they go about their work; (3) diagnosing actual situations or cases where conditions might be expected to result in MPB outbreaks and where they should not; (4) feeding information back to the experts in different formats, such as flowcharts, decision trees, and three-dimensional graphics to elicit additional information; and (5) supplying experts with knowledge acquisition software that helps elicit ideas and automatically derive decision rules.

3.1.2.3

FY 89

PROCEEDINGS:

RESOURCE

TECHNOLOGY 88

*International Symposium on Advanced Technology
in Natural Resource Management*

*Lincoln Center
Fort Collins, Colorado, USA
June 20-23, 1988*



Sponsors

*U.S. Department of Interior,
Fish and Wildlife Service
Bureau of Land Management
U.S. Department of Agriculture, Forest Service
University of Arizona
Colorado State University
Texas A&M University
Virginia Polytechnic Institute and State University
University of Idaho*