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become the predominant species in what were mixed pine-fir stands with pine as the dominant overstory. In the 20 years since their release, many firs have replaced the dead pines and become the larger, dominant trees. Since 1987, the study area has experienced a prolonged drought. Many of the white firs have suffered extreme moisture stress, are severely weakened, and have been successfully attacked by fir engraver, *Scofytus ventralis*. Consequently, the white fir component of the stands is now dying at an alarming rate. What the tree composition of these stands will be in the future is not known. A disease outbreak in 1971 (along with an infestation by the Jeffrey pine beetle) seems to have changed what were predominantly overstory Jeffrey pine stands with understory firs, to rapidly developing white fir stands. Thereafter, the prolonged drought since 1987 and the fir engraver beetle outbreak have killed a large part of the fir component. These stands appear destined to remain in a dynamic state of change indefinitely if elytroderma disease outbreaks and droughts become regularly reoccurnng events.

EVALUATING IMPACT OF GENETICALLY TRANSFORMED *POPULUS* ON DEVELOPMENTAL BIOLOGY OF THE IMPORTED WILLOW LEAF BEETLE

K.K. Alien and E R .Hart[cc]

In an attempt to enhance host-plant resistance against folivorous herbivores, hybrid aspen clones Hansen and Crandon *(Populus alba* x *grandidentata)* have been genetically transformed with cnn 2, a proteinase inhibitor gene from potato. The product of this gene is a protein molecule that binds and inhibits the action of trypsin and chymotrypsin. To investigate the impact of this gene, bioassays are performed with the imported willow leaf beetle, *Plagiodera versicolora.* Beetle larvae have been raised through one larval generation on whole, excised poplar leaves and data collected on leaf area consumed, mortality, development rate, and pupal weight. Beetles also have been reared for three successive generations (egg to adult) on a single transformed clone to examine chronic exposure effects. Finally, beetles will be raised in a whole-tree environment to examine behavioral differences on selected clones.

AN EXPERT SYSTEM FOR MOUNTAIN PINE BEETLE UNDER ENDEMIC CONDITIONS IN WESTERN LODGEPOLE PINE FORESTS

D.L. Bartos[dd] and K. Downing[ee]

Expert Systems are an excellent way to organize existing knowledge for use by land managers or research scientists. Our objective was to develop an expert system that would deal with endemic (low) levels of mountain pine beetle in the lodgepole pine type of the Intermountain West. Initially, a knowledge acquisition program was written to aid in obtaining knowledge from the experts on the functioning of the system. This information was then fed into KnowledgePro (an expert system generator) which produced the expert system. Users provide parameters (e.g., dbh of the stand and infested trees, stand elevation, and various temperature values) pertinent to the stand in question. The expert system uses this information to determine if the mountain pine beetle population will increase, decrease, or remain static for the coming year. The developed system mimics the current knowledge closely.

AN ADVISORY SYSTEM FOR MOUNTAIN PINE BEETLE MANAGEMENT

BJ. Bentz[ff]

Mountain pine beetle *(Dendroctonus ponderosae)* is responsible for the loss of economic benefits on millions of acres of lodgepole pine in the western United States. Unsuccessful efforts to eradicate this native pest have resulted in investigations to ascertain methods for prevention of population buildup. Toward this goal, recent research endeavors have identified conditions within the forest stand which are favorable to beetle population increase. If resource managers can identify stands with these conditions in a timely manner, they will be able to minimize future impacts caused by the mountain pine beetle. Silvicultural treatments which alter the stand conditions may be prescribed, thereby making the environment less favorable for beetle population growth. The expert system being developed will incorporate these and other strategies for mountain pine beetle management into the current decision process used by Forest Service silviculturists. Included in the system is knowledge representing the managers decision network, and quantitative models for identifying the susceptibility of a stand to mountain pine beetle impact, and the loss expected.

BIOLOGICAL CONTROL OF FOREST INSECT PESTS USING TRICHOGRAMMID EGG PARASITOIDS

S M **Smith, E. Forsse, R. Bourcnier, Z. Wang, N. Maheswaran, and K. Strom[gg]**

Egg parasitoids of the genus *Trichogramma* are being investigated for their use against forest insect pests such as the spruce budworm *(Choristonewa fumiferana),* the forest tent caterpillar *(Malacosoma disstria)* and the spruce budmoth *(Zeiraphera canadensis).* The propensity, timing, and temperature threshold for flight by *T. minutum* held under varying environmental conditions has been established in the laboratory. These studies are now being linked to parasitization levels under semi-field conditions. Shifts in fecundity, longevity, and flight of parasitoids reared continuously at high laboratory