RESULTS OF A WORKSHOP ON FUTURE RESEARCH AND DEVELOPMENT NEEDS

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ABSTRACT

A workshop held at the end of the symposium reviewed the need for future research and development. There is a need to develop our understanding of insect population dynamics, the interaction of insect populations with the host and jack pine stands, and to improve the array of tools available for direct control of populations. The emerging need to view insect population irruptions in terms of ecosystem function has changed the outlook of forest managers. The consequences of this change have to be reflected in prescriptions used in managing the jack pine resource. The workshop concluded by recommending that a future meeting be held to explore management of the jack pine budworm populations in jack pine ecosystems with participation of specialists from other disciplines.

INTRODUCTION

Workshops were held at the end of the Jack Pine Budworm Symposium to take stock of what had been accomplished over the past 9 years and suggest where new research and development might be required. This summary is an attempt to capture the consensus developed at the last such workshop. Many of the ideas were generously contributed by symposium participants, to whom credit must be given and I hope their ideas are accurately reflected here. I take full responsibility for any errors that may have occurred in committing their comments to paper. I apologize for any such errors.

A brief synopsis of the progress made can be evaluated from the perspective of how far we have come in developing an integrated forest pest management (IFPM) system for the jack pine budworm (*Choristoneura pinus pinus* Free.). Stark and Waters (1985) defined IFPM as "a process of synthesis where all aspects of the pest-host system are studied and evaluated to provide the resource manager with an information base for decision making". The decisions adopted in managing pests affect all aspects of resource management because of the complex interactions among socioeconomic and conservation concerns and the extent in space and time occupied by forests. These decisions have implications on the future development of individual forest stands affected by pests as well as forest-wide and, ultimately, global impacts. Thus prescription for individual stands impinge on the policies of land owners, regional, national, and international agencies.

The flow of information required in an integrated pest management (IPM) system is summarized in the systems structure discussed by Stark and Waters (1985). They distinguish between research and development (R&D) components and the application of information derived from these investigations. In practice, the division is artificial and the experience gained in managing pests can be fed back to the R&D components. The essential practical components of the system are the forest ecosystem and the integrated resource management (IRM) system in which the integrated pest management system is embedded. In the pest management component of the IRM system, pest and forest conditions are monitored; information on conditions are processed, in prediction models if necessary, to forecast the behavior of the ecosystem; the predictions are used in the IPM system to make decisions; the outcomes of these decisions are analyzed, again with models, to forecast treatment effects; treatments are selected, applied and evaluated; and finally, the process is iterated. The R&D components that are the foundation of the IPM system develop information on the reciprocal interactions among pest dynamics, forest stand dynamics, and the various treatment strategies feasible. Impacts of the pest are combined with the costs of treatments in a benefit/cost integration, which feeds information to the pest management system. This system structure is often embodied in a decision support system (DSS) that automates the process, giving the manager an ability to evaluate a variety of options to address pest problems.

WORKSHOP RESULTS

Population dynamics

Our ability to forecast the occurrence, location and duration of outbreaks needs to be improved. It is critical that an early warning system to detect population increases be developed because of the rapid appearance and short duration of jack pine budworm outbreaks. Pheromone traps offer a relatively inexpensive means of detecting outbreaks. However, they need to be evaluated for this purpose. The long-term monitoring of jack pine budworm populations in Manitoba using pheromone traps has not, as yet, extended into an outbreak. Light traps were suggested as an alternative trapping system to evaluate population status. Ideally, the early warning system should be evaluated throughout an entire outbreak cycle, preferably in concert with other populations studies.

The influence of pollen cones on population behavior should be investigated further; however, information on the spatial and temporal patterns of pollen cone production together with an understanding of the controls on this process need development. It is believed that, coupled with population data, this information can improve our ability to forecast outbreaks in specific locations. The possibility of exploiting trees that produce few pollen cones in specialized planting programs would be a direct application of this understanding.

Outbreak initiation, termination, and consequently duration seem to be under the influence of natural enemies as well as the host tree's production of pollen cones. There is a need to investigate the role of predators, including birds in low density populations. The exploration of natural enemies also has the potential of uncovering organisms that may be useful biological control agents. These investigations should include an assessment of pathogens in mediating population change.

An important consideration in managing outbreaks is an understanding of how stand attributes, the extent of stands, the spatial relationships among stands and landscape features influence the development and spread of outbreaks. The spatial heterogeneity of defoliation within trees, among trees in clumps, among clumps within stands, and among stands contribute to problems in characterizing the effects of populations. This pattern may be an important consideration when jack pine stands are managed. There is the possibility that the patterns produced by harvesting small areas may contribute to increased risk of damage to the residual forest. At the same time this understanding may provide a means of managing jack pine budworm populations on a forest-wide basis.

Stand dynamics

The importance of the tree in the dynamics of the insect is well recognized and the information of pollen production provides a means to manage populations by managing pollen production. On a larger scale, however, the aggregate of forest attributes is also influenced by the insect.

The susceptibility and vulnerability of jack pine stands to damage by jack pine budworm is poorly known. While this information has obvious value in forecasting the effects of uncontrolled outbreaks on the timber supply, the link between budworm outbreaks and fire has not received much attention. Yet fire controls the age structure of jack pine stands in a landscape and thus probably sets the spatial and temporal pattern of outbreaks in a region. Equally as intriguing is the possibility that outbreaks, by influencing stand development, may contribute to the way in which stands burn. Thus an investigation of historic data on fire behavior in stands of different origins, ages, sizes, stocking levels, and jack pine budworm histories on a variety of landscapes would be rewarding. The effects of excluding fire from jack pine forests may have important consequences on population behavior in addition to the obvious effects of stand development. There is clearly a need to understand the interaction between the insect, fire, and the development jack pine forests. This information will ultimately improve our understanding of jack pine ecosystems and our ability to manage them.

Treatments

Direct control has been applied when populations reached unacceptable levels. Traditionally the approach taken has been to target specific areas for treatment. The products currently used have monetary and environmental costs associated with them, which precludes their use in treating entire outbreaks. Yet they are of value in protecting valuable stands at risk to damage. There are few alternatives to *Bacillus thuringiensis* var *kurstaki* Blr. being developed. Concerns over the impact on non-target organisms in forests now eliminate most chemical insecticides from use in forest protection. A mimic of an insect growth regulator is being considered for registration but how it will be used in protecting jack pine budworm is unknown. The timing of treatments, application rates and the number of treatments needed to control defoliation are all under investigation. Viruses and other pathogens that may be effective in controlling populations have not been developed. *Trichogramma* spp. may be useful in controlling jack pine budworm because of the clumped distributions of insect hosts. However, this application is critically dependent on our ability to forecast population densities on a spatial scale that is presently beyond our capability. Nevertheless, there is a need to explore partnerships to develop this technology.

The strategy of suppressing population by direct control is worthy of investigation. In contrast to protecting stands from defoliation, it may be feasible to intervene early in outbreaks to prevent irruptions. The number of years over which vigilant population suppression would be necessary would be few because the outbreak period is relatively short in some areas. This strategy also requires that all or a significant portion of the stands harboring populations be treated. Despite the risk of inadvertently prolonging an outbreak it may be opportune to experiment with this strategy on small isolated stands. This experimental approach may also provide some insight into processes that determine population change.

Impacts

Studies of the impact of the jack pine budworm on the forest resource are still needed. This information is critical in establishing the susceptibility of stands to damage as well as understanding the costs and benefits of selecting treatment alternatives. The use of permanent sample plot networks is to be recommended, but provision for monitoring insect conditions in these plots must be made. There is also a need to assess the impact of other inimical agents on jack pine stands. The interactions among tree diseases, the insect, and its host are thought to be important in understanding the epidemiology tree decline and mortality.

The impact of jack pine budworm on the wood supply needs investigation. The opportunities to use harvest queues in managing damage from defoliation is a direct application of this knowledge.

Management

There is a need to evaluate the role of the jack pine budworm in the jack pine ecosystem. The jack pine budworm is but one component that influences processes in the ecosystem. We need to know the influence of other insects and diseases, historic patterns of landscape dynamics and historical patterns of outbreaks on ecosystem development. We might then have an ecological basis for prescriptions tied to ecosystem function. Furthermore, the public is far more likely to condone and even support these prescriptions if they can be made aware of the basis for the land manager's decisions.

On a more global level, there is the increasing demand for wood by an ever increasing human population. An urgency is created by this increasing demand because the forest land base growing wood is declining globally and people recognize that the ecosystem is not solely a commodity producer. Other values are derived from forested ecosystems and there is an insistence that forests be managed sustainably. There is therefore a need to establish a reasonable framework to allocate resources in these jack pine ecosystems to these competing demands. Econometric techniques offer objective methods to make choices. But this can only be accomplished by including jack pine budworm management in integrated resource management. Policy makers have to be included in this planning and they will have to include the public in their consideration of alternative management options.

CONCLUSIONS

There are many fronts on which progress has been made in the 9 years since the last symposium devoted to work on the jack pine budworm was held. At the same time, new demands have emerged for managing the jack pine budworm. The most significant development is the need to consider ecosystem values in addition to the traditional timber values in managing jack pine budworm. These new concerns can be incorporated conveniently in Stark and Waters' pest management system if the impacts of defoliation are evaluated on ecosystem function and benefit assessments include consideration of non-timber values. The issue of sustainable forestry also changes the context of jack pine budworm management and affects the way pest management is incorporated in the integrated resource management system.

As a consequence of these changes, the symposium participants were unanimous in recommending a new forum for a future meeting on jack pine budworm management. This meeting should be held in 3 years. Efforts will be made to include specialists in other ecosystem processes to develop a more holistic approach to jack pine budworm management.

REFERENCE

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JACK PINE BUDWORM BIOLOGY AND MANAGEMENT

Proceedings of the
Jack Pine Budworm Symposium
Winnipeg, Manitoba
January 24-26, 1995

W.J.A. Volney, V.G. Nealis, G.M. Howse,
A.R. Westwood, D.R. McCullough, and B.L. Laishley, editors

INFORMATION REPORT NOR-X-342

Canadian Forest Service, Northwest Region
1995

This symposium and publication were funded by the
Canada-Manitoba Partnership Agreement in Forestry