

FOREST PEST MANAGEMENT PAPERS
1980-1984

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FOREWORD

Forest pest management in British Columbia is an exciting new and dynamic responsibility for many foresters and specialists in government and industry today. As policy shapes and as programs grow, the Chief Forester, Branch and Regional staff of the Ministry of Forests have been called upon to present information and perspective on a variety of pest situations and issues. Some of these presentations were made to special groups and international organizations vitally interested in pest management. Unfortunately, few Ministry of Forests staff would likely have knowledge of, or access to, the information offered in these verbal deliveries.

This collection of eleven papers spanning the period 1980 to early 1984 has been assembled for the interested reader who otherwise might not have had the opportunity to comment. Accordingly, it is our intention to periodically issue collections of "Pest Management Papers" as part of the Internal Report series. We welcome your comments, thoughts and suggestions.

W. Young
Chief Forester
April 1984

PAPER NO. I

THE MOUNTAIN PINE BEETLE
IN SOUTHEASTERN BRITISH COLUMBIA -
AN HISTORICAL OVERVIEW

by

W. Young
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Ministry of Forests
Victoria, B.C.

Paper presented at the joint meeting of the Western Forest Fire and Western Forest Pest Committees at the 71st Western Forestry and Conservation Association Annual Meeting, Victoria, B.C., December 1980.

THE MOUNTAIN PINE BEETLE IN SOUTHEASTERN
BRITISH COLUMBIA - AN HISTORICAL OVERVIEW
by W. Young

Today, I have been asked to provide an overview of the history of the current mountain pine beetle infestation in the Flathead area of British Columbia - an area lying in the mountainous southeast portion of the Province.

Interestingly enough, the spruce forests in this same general area were subjected to attacks by the spruce bark beetle in the 1960's and a major subsequent salvage program undertaken.

The letterhead of the Western Forestry and Conservation Association shows the flags of the United States and Canada along with the statement:

"One forest under two flags."

Any assessment of the mountain pine beetle situation in Canada, and the Pacific Northwest States, brings reality to the statement that both countries have one forest of mature lodgepole pine being attacked by one beetle.

Unfortunately for British Columbia and Alberta, the beetle does not respect the 49th parallel regardless of how wide a swath was cut to delineate the boundary between the two countries.

Indications that British Columbia could be faced with a mountain pine beetle problem of epidemic proportion surfaced in the mid 1970's. This awareness was directly related to the blossoming infestations already underway south of the border in the adjacent states.

Today, the situation in the Flathead area is devastating and today it becomes difficult to appreciate the situation as it was four or five years ago.

The mountain pine beetle issue in British Columbia became a most controversial one in the latter 1970's. The main focus was in the Flathead area and, in particular, the Akamina-Kishinena drainages in the extreme southeastern part of the Province.

The infestation that was exploding in the adjacent states began to affect British Columbia to the same extent during this period.

Since I will be referring to the opinion of Parks people on both sides of the border later, I would like to quote the following statement from the May 1978 report of the United States Forest Service entitled "Forest Insect and Disease Management":

"Beetles have infested lodgepole pine stands on adjacent National Forests, State and private lands, and adjacent lodgepole pine stands in British Columbia. Parts of these stands would not have been infested were it not for the epidemic infestation in Glacier National Park."

I don't want to discuss what could or could not have been done in Glacier National Park to attack the infestation. I merely want to emphasize again that the beetle respects no boundaries - neither park boundaries, State or Provincial boundaries, nor international boundaries.

To address the burgeoning infestation, logging programs were accelerated in the Flathead area. In addition to the salvage logging of the dead material, we began to address the need to harvest green material currently under attack to try and get ahead of the infestation.

It is here where controversy and conflicting opinions within the public sector come to the fore as one of the areas where scattered beetle

infestation had erupted was the Akamina-Kishinena drainage. The drainage contained mature lodgepole pine and was susceptible to a major expansion of the infestation.

The area had received a "map reserve" approximately twenty years earlier as having potential for "park wilderness" designation.

Now the controversy really began with segments of the public calling for early salvage of the infested timber and those saying that the beetle infestation potential had been overemphasized and was merely a ploy by the Forest Service and the forest industry to increase the rate of harvest. Newspaper reports even attempted to heap ridicule onto the Forest Service saying that our field people had got lost and were actually assessing the wrong valley.

Pressures to cancel forest harvesting plans mounted as public groups and Parks officials on both sides of the border called for a halt on any logging in this drainage. At this time articles and pictures were appearing in both United States and Canadian magazines showing scenes of salvage logging and referring to the "devastation" being created in the Flathead area on the Canadian side by this logging. In particular, United States concerns involved the potential effect on Glacier National Park through change in waterflow patterns plus the effect on the wildlife resource adjacent to the international boundary. Canadian concerns addressed similar "conservation" issues north of the border.

This erupting conflict, fueled by segments of the public on both sides of the border, resulted in the Government of the United States expressing its concern with respect to the logging in these drainages adjacent to the border.

As a result, Government of Canada officials visited British Columbia to discuss the matter as the lands and the forest resource concerned were under provincial, rather than federal, jurisdiction. Later, Government of Canada officials met with their United States counterparts. The result has been that the harvesting program was continued along with the adoption of a process designed to keep the Parks and Forest Service people on the United States side aware of the forest harvesting programs underway in this part of the Province.

I have addressed this particular issue at some length since the beetle presents more than a technical problem but a significant social problem in the broadest content.

The situation in the southeast part of the Province is extremely serious. You'll hear more of the forest harvesting operations underway but, needless to say, the sustained capacity of the forests in this part of the Province will be severely impacted by the beetle attack and the resultant salvage programs. The infestation has now spread to Alberta and is causing major concerns in the southwest part of that Province.

In conclusion, the beetle knows no boundaries, Provincial, State, park nor international. It is truly one mature lodgepole pine forest in western North America that is being impacted.

PAPER NO. II

ECONOMICS OF FOREST PEST MANAGEMENT -
THE INTEGRATION PROCESS IN BRITISH COLUMBIA

by

P.M. Hall
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Presented at the Joint Meeting of the Entomological Society of Canada and
Entomological Society of Alberta, at Banff, Alberta, October 5-9, 1981.

ECONOMICS OF FOREST PEST MANAGEMENT
THE INTEGRATION PROCESS IN BRITISH COLUMBIA
by P.M. Hall

The theme of this symposium is the economics of entomological effort. This is an important aspect of a science - what are the benefits to be gained and are they worthwhile from any economic and social point of view. Favourable cost to benefit ratios are required if pest management operations and research are to function on any significant scale. Costs and benefits are relatively easy to determine in operational situations - dollars spent versus the value of the resource protected or versus the increase of product that would otherwise have been lost to pests. Research, on the other hand, is more difficult to assess. The benefits are realized when the research results are incorporated into an operational program. Until that time, research must be considered as "money up front" to ensure more efficient operations and social benefits in the future.

The British Columbia Ministry of Forests is responsible for forest management. As such, the ministry's activities are primarily operational in nature and the remainder of this presentation will deal with the scope of our problems and what we are doing about them.

The forest resource of British Columbia represents the largest single industrial base in the province. The forest land base amounts to 52.1 million hectares of which about 94% is managed by the provincial government through the Ministry of Forests. This area supports a total wood volume of 8.1 billion cubic meters, 94% of which is softwood volume. The volume of wood scaled in 1979, which approximates the amount harvested, was about 76.2 million cubic meters while the value of forest products shipped in that year

approached 7.2 billion dollars. These figures indicated the size of the resource and the value as it existed under recent market conditions.

As well, there are significant investments in silviculture in terms of regeneration of cut areas, stand tending of second growth stands, site rehabilitation, fertilization programs and other facets of intensive forest management. In the 1980-81 fiscal year over 35 million dollars were spent by the Ministry's Silviculture Branch in their operations and this level of activity is expected to increase steadily. These investments must be protected from pest losses. The application of effective treatments incorporated into management regimes aimed at reducing pest losses to tolerable levels will avoid both the high costs of establishing forests over again and the loss of the several years of productivity attained in the period between the initiation of a forest stand and its destruction by pests. With the projected increased demand for forest products coupled with a shrinking forest land base and a projected fall down in volume as we switch to harvesting lower volume/unit land area second growth stands, we cannot afford to accept large scale losses to pests.

The forest resource is immense, and represents a significant portion of both the current and future economic health of the province. Such a resource must be carefully managed and large scale losses due to insects, diseases, parasites, undesirable vegetation and fires must be avoided as much as possible. The forest represents an extremely complex system with tree species and age class diversity spread over a large, varied terrain. Management techniques for pests common to monotype agriculture, within well

defined boundaries, are not practical in many cases in forest management. The complexity and the length of crop rotation present unique problems in reduction of pest-caused losses as the same tree or stand may come under damaging pressures several times in its lifespan and from several different damaging agents. Because of this, pest control in the form of silvicultural practices will be encouraged and implemented to reduce potential losses whenever possible while more expensive direct treatments will be used as required. Whatever treatment is used, it must be economical as well as effective and environmentally acceptable - there must be a favourable cost to benefit ratio with all possible benefits including economic, social and aesthetic values incorporated into the analysis. The Ministry is not concerned only with profit for the licensees or revenues generated for the Crown in the form of stumpage and royalties. The Ministry is also vitally concerned with wood supply to particular regions to ensure a base for the economic stability of communities. To achieve this goal, large varied Timber Supply Areas (TSA) have been created throughout the province - each with its own Annual Allowable Cut (AAC) and each supplying timber to existing wood processing communities on a continuous basis. The determinations of the annual cut do not normally take into account sudden pest outbreaks which may destroy management plans for a continued, organized flow of wood.

Rough estimates of forest losses to pests in British Columbia are in excess of 16 million cubic meters of timber per year. Significant pests include mistletoe, various rots, insect defoliators such as the western spruce budworm (Choristoneura occidentalis Free.) and the Douglas-fir tussock moth (Orgyia pseudotsugata [McD.]) and, the most economically important forest insect group at this time - the bark beetles (Dendroctonus sp.). Many areas

of the province are under attack by the mountain pine beetle (Dendroctonus ponderosae Hopk) and by the spruce beetle (D. rufipennis [Kby]). Together these two species of insect have extensively damaged hundreds of thousands of hectares of mature and overmature, commercially valuable timber. The direct economic losses include lost or degraded wood volume. As well, revenues to the province have been decreased due to lower rates of stumpage. The long term harvesting plans have been upset with the forest industries being redirected on a massive scale into wood salvage and beetle control operations rather than into a more orderly harvesting regime. More roads have had to be constructed and replanting of cut over areas has been delayed because of the stepped up harvesting schedule of certain types of stands. The losses are enormous and the benefit of effective control operations is readily apparent.

The B.C. Ministry of Forests recently underwent a large reorganization, setting new priorities and decentralizing the decision making process, allowing individual regions of the province greater flexibility to meet their specific requirements. Pest management was identified as a high priority in the new organization and new positions were created in Victoria and in the regional offices to deal with the problems on a continuing basis. The mandate of this group is to put into operation orderly and effective management programs aimed at decreasing pest losses.

The Pest Management Section of the Protection Branch in Victoria is comprised of a manager, a forester, an entomologist, a pathologist and a control agents specialist. This group functions in drafting ministry policies, guidelines and procedures for pest management. As well, it funds

relevant operational research projects and integrates the results of these and other research findings into newer and more effective management regimes. Close liaison is maintained with universities and Canadian and American forest research establishments to expedite the transfer and integration of new techniques into our own operational programs. The specialists in Victoria also act as advisors to the regional personnel, keeping them up-to-date on current research and the results of programs throughout the province, minimizing duplication of effort and encouraging consistent procedures for similar problems.

There is a pest management coordinator in each of the six forest regions of the province. The coordinators serve as administrators or expeditors, identifying priority areas of concern and allocating limited resources to achieve the maximum effect. In several regions, forest entomologists and other specialists have been hired to provide additional expertise, both for advising the pest management coordinator and for providing training in identification and quantification of pest losses. The function of the regional personnel is to design and implement specific programs to prevent or limit losses, keeping in mind the advice and guidelines outlined by the Victoria Headquarters staff.

Funding of pest management programs in British Columbia is increasing as our capability increases. In 1977 there were 29,000 dollars allocated - enough to pay one staff forester to oversee pest management. After reorganization and the formulation of the current five year plan this funding has been increased by several orders of magnitude. The 1981-82 pest

management budget for the province is approximately 2.7 million dollars. At the end of the current 5 year planning period total base pest management expenditures are expected to be approximately 7 million dollars annually (in 1980 dollars).

This is the base-line funding which is assumed to be adequate barring emergency circumstances. This funding, as normal operations, provides for detection, assessment, treatment and treatment appraisal capabilities. These four elements are the basis of the pest management effort:

- 1) to identify which organisms are causing damage to the inventory;
- 2) to assess the importance of the damage;
- 3) to determine which treatment, if any, is desirable; and
- 4) to appraise the results of the treatment so that it may be repeated in similar circumstances, or modified to produce more effective and economically viable results.

At present, the pest management organization is concentrating on the first two areas - detection and assessment, creating a baseline inventory of pest damage which is required if intelligent management decisions are to be made.

Detection methods include ground observation and aerial photography and sketch mapping. The Forest Insect and Disease Survey of the Canadian Forestry Service (C.F.S.) is encouraged and supported financially to provide the Ministry with an overview of the pest situation in the province. Ministry pest management staff then make more detailed surveys to determine exact locations and extent of pest occurrences, prioritizing surveys on the basis of stand accessibility and value and determining the number of trees or the

volume being affected. These types of surveys are expensive and limited resources (both Provincial and Federal) are spread thinly. Unfortunately, many insect infestations are still not detected until significant damage has occurred, notably incipient bark beetle infestations and some shortlived but damaging defoliator outbreaks such as a currently increasing infestation of Douglas-fir tussock moth.

At present, treatments for bark beetles are labour intensive. Survey crews must cruise timber to detect freshly attacked trees. Once these trees are found, the main treatment is felling and burning to eliminate the population. Costs for such treatment may range from \$50 to more than \$100 per tree depending upon accessibility and infestation intensity. This strategy can be quite effective to retard the spread in small areas, however; individual, lightly infested drainages can be sanitized and preserved for several years in this manner if detection and treatment capabilities are retained on an annual basis. The Ministry has judged these operations to be beneficial particularly for treatment of remote stands, so that longer term harvesting plans can be put in place. Road building for pure salvage of old attack may no longer be necessary, allowing industry to operate in already accessible areas that have a large component of fresh attack. Operations in such areas would remove a significant portion of the beetle population along with the more commercially valuable newly attacked wood. Detection and treatment of newly infested trees is expensive and more research is required into detection techniques and into insect dispersal. Knowledge of where the insects would go would aid in setting stand priorities for survey. As well,

new treatment options including pheromones, biological agents and chemical pesticides, must be federally registered for operational use. Although we consider our current operations to be economically beneficial, a reduction in total costs would release additional funds to be spent on other, currently neglected, areas of forest pest management, areas which may become much more important as we move into managed second growth stands.

The same requirements for management systems are found when considering forest defoliators such as the western spruce budworm and the Douglas-fir tussock moth. Early warning survey methods are required so that any proposed treatments can be organized prior to significant damage. Researchers at the Pacific Forest Research Centre, C.F.S., are now in the process of calibrating a pheromone system for tussock moth. This system should be operational in the near future and the information gained on where populations are increasing coupled with inventory data on which stands are at risk and are of sufficient value to justify treatment will enable treatments to be applied effectively to only those areas of greatest concern.

We are implementing more efficient surveys for defoliators. However, operational control options are non-existent. At this time in Canada there is only one pesticide temporarily registered for forestry use against the tussock moth. In the United States, two agents, acephate and a nuclear polyhedrosis virus specific to tussock moth, are registered for use. To protect our crop we must have operational treatment alternatives.

An operational trial was conducted in cooperation with C.F.S. researchers on a small, newly detected tussock moth infestation to increase the information base concerning the application methods and efficacy of the

virus. This operation was carried out over an area of approximately 40 hectares at a cost to the Ministry of about \$110,000, or about \$2,750 per hectare. In an operational sense this could be considered a cost benefit disaster as the stands were of little commercial value and not even on commercial forest land. Most of this cost was generated by the peripheral research. The money appears to have been well spent as the information gained will be invaluable if and when the virus is registered for operational use. The benefits of this type of research should be realized in the near future and are deserving of support by management agencies concerned with developing a varied array of management alternatives.

Presently all Ministry activities have been dealt with, as best as possible, under the base funding allocations mentioned previously. Funding of the pest management capability was determined and allocated on the basis of what was considered to be adequate for the normal case, with some allowance for limited emergency or operational trial treatments to relatively small areas. However, the province is experiencing wide-scale losses to our most valuable stands on a grand scale. As mentioned previously, bark beetles have infested and killed mature and overmature pine and spruce over hundreds of thousands of hectares. These losses have disrupted TSA planning and forced severe alternatives in the calculation of A.A.C.'s. A new look at the cost benefits of bark beetle control operations was taken and the pest management staff were asked to supply information detailing the current losses and to try to project the amount of losses expected in the future (with no additional treatments) and the total volumes of pine and spruce at risk. Full rates of

stumpage were applied to these volumes as well as an estimate of the end product values of materials produced in an attempt to estimate the potential economic losses. When considering the size of the land base and the inventoried volumes of potentially susceptible stands, it became apparent that the potential losses could be expressed in billions of dollars, notwithstanding social and other considerations. Requests were then sent to the regions asking for control proposals based on:

- 1) their current capabilities to complete the programs,
- 2) the wood volume at risk in the potential control areas, and
- 3) an estimate of the probability of success of the programs.

These submitted proposals were then assessed and ranked and a request was made to the government for additional emergency funding. The proposal was approved and 11.4 million dollars to be spent over 2 years was allocated to fund an emergency bark beetle control program. The dispersal of this fund, the operations carried out and the end results will be carefully monitored. At the end of the program a more realistic appraisal and cost to benefit analysis will be carried out. If successful, this program may form the base for considerations of future emergency situations, allowing pest management in the province even more scope for fulfilling its mandate of reducing pest losses to tolerable levels.

In summary, the forest resource is one of the most important assets of the province, and properly managed, will supply wood products to the people of British Columbia for generations to come. Planning in forest management will include considerations of pest management strategies. Severe, unplanned

for losses to the resource resulting from pest activity must be avoided. The damage caused by pests will not be eliminated but it can be reduced to levels acceptable to managers. Any losses suffered, however, must constantly be monitored so that inventories can be updated to reflect the actual amounts of harvestable volumes available and that potentially catastrophic infestations can be intercepted and effectively treated in time to reduce their impact. Although limited pest management systems may now be in place in certain situations, further research is required to decrease the costs of all aspects of pest control. Detection, dispersal characteristics of individual species, damage appraisal and the development of alternative management strategies are all avenues of further research and development to be eventually integrated into forest management. Such integrated management will decrease the costs incurred by the activity of individual pest species and allow the released funding to be directed towards other currently lower priority pest management activities which may in the future become higher priority problems.

Pest management must cease to be considered as a separate discipline. It must be considered as only one facet of a comprehensive forest management program, incorporated into other protection activities, silvicultural activities, inventory systems and all other facets of forest management. The British Columbia Ministry of Forests has recognized the importance of pest management in overall forest management and has begun to commit resources accordingly. In the future an integrated forest management program will ensure continued optimal production from the forest crop.

PAPER NO. III

THE IMPENDING IMPACT OF
INSECT DAMAGE IN BRITISH COLUMBIA
AND WHAT IS BEING DONE

by

R.C. Sutton
Protection Branch
Ministry of Forests
Victoria, B.C.

An address to the Western Forest Fire Committee of the Western Forestry and Conservation Association on December 3, 1981, at Sun Valley, Idaho.

THE IMPENDING IMPACT OF INSECT DAMAGE IN BRITISH COLUMBIA
AND WHAT IS BEING DONE
by R.C. Sutton

When we talk about major insect problems these days in British Columbia, we are of course referring to bark beetles -- the mountain pine beetle (Dendroctonus ponderosae) and the spruce beetle (D. rufipennis). The mountain pine beetle is causing the lion's share of the damage.

The mountain pine beetle is the most devastating forest insect pest of mature pines in western Canada and adjacent areas of the United States. Infested trees usually begin dying within a few weeks after attack from the combined action of the beetles girdling the living bark and the blue stain fungi which is carried by the beetles; both blocking the translocation of water and nutrients in the tree. Early detection of new outbreaks is made difficult because visible symptoms of attack, foliage discoloration, do not occur until the summer following attack, one year later.

The spruce beetle problem is similar to that of the mountain pine beetle with some minor differences.

There are few direct control options available in the early stages of an outbreak, and almost none once the infestation is large and expanding.

THE EXTENT AND IMPACT OF THE BARK BEETLE PROBLEM

Starting in the 1970's, bark beetle populations have currently reached epidemic proportions in 5 of 6 Forest Regions. At the present there are over 550,000 hectares (1.4 million acres) attacked, with wood volume losses in lodgepole pine and Engelmann and white spruce of over 76 million cubic metres, stumpage losses estimated at over \$80 million, and export value

losses in the billions of dollars. Because of accelerated salvage operations there has been overcutting of the annual allowable cut in some managed units, major disruptions in wood harvesting plans and schedules, and problems with species product mixes at some processing plants and their markets.

Salvage and marketing of attacked stands have not reached desired levels in 1981 because of a protracted wood workers strike and the poor economic climate in both our countries. In the longer term, the flexibility of forest management options will be constrained because of the reduction in species profiles. Also, forest rehabilitation and regeneration requirements and their costs are going to increase greatly.

In addition to these adverse wood products and forest management impacts, many wildlife habitats have been drastically modified, the aesthetics and recreation potentials in both park and non-park lands have been adversely affected, watershed capabilities for domestic and agricultural water supplies may become altered or put at risk and, overall, there is the spectre of potentially huge and uncontrollable wildfires in already devastated landscapes.

The following slides best illustrate the extent and severity of the problem. (Thirty slides will be shown. Their context is presented as an appendix to this paper).

WHAT IS BEING DONE IN TIMBER AND PEST MANAGEMENT

The first thing that happened was a lot of people and groups started talking to each other, formed committees, agreed on action plans, wrote briefs, and plain raised hell. This happened and is still underway at local, regional, provincial, inter-provincial, and international levels. While the democratic process takes time to jell it eventually results in productive things. The very necessary good work of putting together timber salvage

operations and the revision of harvesting plans is well underway in many areas. Trade-offs are always involved in emergency situations and not everyone comes away satisfied.

One of the major battles won was to convince our provincial government, during bad economic times, of the seriousness of the problem and the immediate need for emergency funding in order to implement extensive bark beetle control measures. Despite the major damages already incurred in our forests, there is an immediate threat of further bark beetle attack to some 2.5 million ha, involving 520 million m³ of wood, with an estimated stumpage value of \$590 million and an export value in excess of \$30 billion.

The government was convinced of the urgency of the matter and allocated an additional \$11.4 million to be spent in fiscal years 1981/82 and 1982/83. This funding is being used to retard the spread and further invasion of these insects by undertaking prioritized sanitation logging of vulnerable mature stands. One of the major tasks will be the construction of road access to facilitate the removal of priority stands before or during the beetle attack. Another major activity is conducting detailed ground detection surveys to facilitate planning and scheduling of these emergency harvesting operations. Some single tree brood disposal operations will be undertaken in feasible circumstances and some trap tree programs for the spruce beetle will be established.

However, only a minor amount of this special funding was earmarked for fire protection purposes.

THE FIRE PROBLEM IN BEETLE-KILLED STANDS

There is clear recognition that the cycle of mature and overmature lodgepole pine forests-- death by bark beetles--wildfire cleanup and

regeneration--back to lodgepole pine forests--is one of nature's ways of recycling this tree species. This type of cleanup and regeneration is quick and efficient, and many of the dead and dying stands of today are creatures of the same process 60 to 110 years ago. Now, however, man, his property and his other values are firmly entrenched in this scenario and the "quick and efficient" natural way is not acceptable.

There is a lack of data and experience on fire behavior in recent beetle-killed timber, mainly as far as I can gather, because no fires have occurred in recent infestations. However, there is no question about the ability of these dead stands to burn, and to burn hard. The large fires in the 1920's and 30's in our east Kootenay area are proof of this.

Prevailing weather conditions and the time of year will have a major bearing on how beetle-killed lodgepole pine stands will burn by wildfire. Certainly, the first five years could be a critical period while dead needles are retained on the tree. There then may be a lull after needle drop until about 10 years when bark starts sloughing, producing shaggy ladder fuels for a few years. The third and worst period will occur after twenty years when the stands start falling down and maximum ground fuel loadings are reached.

Communities and residents within and adjacent to beetle-killed stands have recognized the potential fire danger and many have been vociferous in their demands for added protection.

WHAT IS BEING DONE IN FIRE PROTECTION

As mentioned previously, there have been no significant additional funds allocated for fire protection purposes. However, there has been a reassessment of priorities in relation to the hazard prone areas. Positive steps are being taken in the following:

1. Our protection people are working with the Provincial Emergency Program organization in developing evacuation plans in the event fires threaten settled areas.
2. The salvage and sanitation timber sale program will also serve as a major means for reducing fuel loads in beetle-attacked stands.
3. The new road access being built for sanitation timber sales will also assist in faster ground attack in otherwise inaccessible areas.
4. Fire control plans at district and regional levels are being modified, where necessary, to prioritize and improve fire detection, reporting and initial attack procedures; and large fire preorganization will be more comprehensive.
5. Some firebreaks are being built in key areas to protect communities as a backup to suppression activities and in the extreme, as areas from which to backfire under emergency conditions. However, funds for this must come from other activities.
6. Fire prevention public information and awareness activities will emphasize the concerns in beetle areas.
7. Fire prevention regulations on industrial operations will be rigidly enforced.
8. Burning permits will be tightly controlled and, in some areas, refused during critical months.
9. Recreational sites will be fireproofed and campfire bans may be imposed earlier and maintained longer.

10. Private landholders will be encouraged to fireproof their lands.

The above steps will improve the odds of success in preventing or combatting fire in our beetle-killed forests. Unfortunately, the element of luck--either good or bad-- is going to have a much higher profile in the determination of fire losses. Where fires start, and what fuels they spread into are now of even greater importance to fire managers. These odds are now stacked against us for generations over large areas of our province.

What of the future? We know enough about the biology of bark beetles. Our problems are in applying existing knowledge to our land management practices. Over the long term our rehabilitation process must provide a more variable mosaic of age classes and species types, and utilization practices must minimize areas of over-mature timber. This will require an improved integration of timber management and silviculture programs. Bark beetles do not recognize administrative boundaries. This will require there be better levels of understanding, and working agreements between adjacent provinces, states and countries, including park lands, so that policies and practices are not in conflict.

Appendix 1

SLIDE PRESENTATION TEXT

1. All bark beetle infestations start like this; Nelson Forest Region.
2. ---- and grow like this,
3. ---- and like this.
4. You have troubles when it starts looking like this. Mountain pine beetle infestation in the Flathead River area of the Nelson Forest Region in the southeast corner of B.C.
5. More Flathead River, advanced attack.
6. ---- and more. Imagine wildfire in this scene.
7. Progressive fill-in of attack until all trees are infected and dead.
8. Salvage logging and sanitation logging for control of the insect.
9. Clear cutting merchantable areas.
10. Large cut blocks created which ordinarily would have been treated differently.
11. Salvage and spread-control logging.
12. West central interior of the province, Cariboo Forest Region, mountain pine beetle infestation in lodgepole pine stands.
13. ---- more of same.
14. The Chilcotin area of the Cariboo. While much of the pine is non-merchantable, the fire danger to residents is extreme.
15. Dangerous beetle-killed forests for the next 70 kilometres, Cariboo Region.

16. East central interior of the province, Prince George Forest Region, bark beetle attacks and salvage operations.
17. Manning Park straddles the Cascade Mountains. Bark beetles starting to attack its dry east side, and the spruce budworm has been active on its wetter dry west side for the last 15 years.
18. Mountain pine beetle attack in the west end of the Kamloops Forest Region, west of Lillooet.
19. Fireguard protecting recreation cottages in Kamloops Region.
20. Area under attack by bark beetles to 1975 -- 39,000 ha
21. Area under attack by bark beetles to 1980 -- 551,000 ha, a 14 fold increase.
22. Forest areas now at risk to bark beetles -- 2.5 million ha.
23. Provincial average annual wood losses, 19 million m³ (wildfire 15%, insects 8%, diseases 77%)
24. Recent provincial annual wood losses, 33 million m³ (wildfire 9%, insects 46%, diseases 45%)
25. Wood volume losses; to 1975 -- 900,000 m³, to 1980 -- 76 million m³; at risk -- 521 million m³.
26. Stumpage losses; to 1975 -- \$1.3 million; to 1980 -- \$83 million; at risk -- \$587 million.
27. Export losses: to 1975 -- \$630 million; to 1980 -- \$5 billion; at risk -- \$36 billion.
28. Twenty years ago, lodgepole pine was considered a low value species and its marketing was difficult. Today, our mills and markets have adapted to small diameter trees and this pine is now number three in volume

harvested. Because of the mountain pine beetle epidemic, there are more volumes requiring salvage than the industry and markets are capable of taking, and this means it will be left as a fire hazard.

29. Spread of the infestation is indicated by this bar chart, representing tree mortality in only one of our five Forest Regions under attack.

(1978 -- 500,000 trees, to 1980 -- 10 million trees, an increase of 20 fold in 3 years).

30. For the Nelson Region, the importance of the volume contribution of lodgepole pine in maintaining the allowable cut -- now at serious risk.

PAPER NO. IV

FOREST INSECTS AND DISEASES
IN BRITISH COLUMBIA

by

W. Young
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Ministry of Forests
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Presentation at a public meeting at Vancouver, B.C., on February 17, 1981 as part of a panel.

FOREST INSECTS AND DISEASES
IN BRITISH COLUMBIA
by W. Young

In my earlier letter to the forest industry, universities and public groups, I said that any British Columbian interested in the resources of the Province should be generally aware of the situation relative to forest insects and forest diseases in the Province. As I mentioned, the impact of both forest insects and forest diseases on the forest can be beneficial, bad or very bad.

I hope that the presentation tonight will indicate that forest insects and diseases are not associated with mature timber only and that all our worries will not disappear as soon as the over-mature forests are replaced by younger healthier forests. Only if such were so. But the insects and diseases that attack old growth forests may also attack the immature forest or they may be simply replaced by others that attack cones, tree seeds, seedlings and young forests. Forest insects and diseases will be with us forever and we must learn to live with them and minimize their negative impact through control measures and adjustments in our management strategies.

I would hope that tonight will be the start of an annual update to interested people in the Province that will be scheduled in a number of coastal and interior centres.

I'm especially sensitive to the fact that I am not an entomologist, pathologist, nor a chemist, and that I may have some difficulty fielding the more technical questions as well as those with a more local flavour. However, I'd like to give a general Provincial overview tonight.

In my presentation I'll discuss the forest insects and diseases that are of major concern and outline:

1. current control and management programs underway
2. a "crystal-ball" look at the long term management strategies relative to these insects and diseases

DOUGLAS FIR

1. Western Spruce Budworm

I'd like to reemphasize two points that Mr. Van Sickle made with respect to the western spruce budworm.

First, it is not the same spruce budworm that infests the eastern Canadian forests and where the primary target is the balsam fir.

Second, the western spruce budworm attacks Douglas fir, not spruce, in western North America. Why it was called spruce budworm instead of Douglas fir budworm is beyond me.

Most realize that the western spruce budworm's main impact is in the Fraser Canyon and Pemberton area and up into the Kamloops - Lillooet dry belt area. Many of you may have seen this infestation when passing through Spuzzum in the Fraser Canyon or along the highway leading to Manning Park from Hope. In other words, the main target seems to be the Douglas fir in the coast-interior transition zone.

You have just heard that the population has increased in the last couple of years after a significant decrease in population reported in the fall of 1977.

A good acreage of the immature forests is also under repeated attack each year. Unlike the eastern Canadian situation where mortality occurs

quickly, Douglas fir can withstand repeated defoliation for several years before trees begin to die. However, there are significant deformities and growth loss as a result of these attacks. In fact, it is the repeated annual attacks on the immature forests, rather than on the mature forests, that is the main cause for concern. Work is being done on this type of loss and the results will be incorporated into the next timber supply analysis for the area. If present attacks continue, the infestation will contribute to a "fall-down" in the planned rate of harvest in that the projected growth rates for these forests may have to be adjusted downwards. There is much to be learned about the western spruce budworm and its attack on the Douglas fir resource of western North America. Both countries, the United States and Canada, have joined forces under a study group known as CANUSA to jointly address the surveys, research and control aspects of the western spruce budworm. Later, Dr. Millar will address the research work underway relative to the western spruce budworm. Unfortunately, it appears that the budworm attacks Douglas fir whether it is a mature or an immature tree; whether it is in a pure stand or mixed with other species.

The current program underway is to:

- 1) continue to monitor the severity and spread of the attack
- 2) assess the effect of repeated attacks on the immature Douglas fir forests and to quantify the growth projection impact;
- 3) continue to adjust forest harvesting priorities, where practical, into infested forested areas;

- 4) continue the use of the current ecosystem classification for species selection in reforestation programs;
- 5) continue research into control methods which are environmentally acceptable. There should be few research programs that should receive a higher priority than this.

2. Douglas Fir Bark Beetle

The Douglas fir bark beetle is most commonly associated with the interior forests and the current situation is not serious.

A "trap tree" program has been in existence for many years in the Douglas fir dry belt. Here, scattered large Douglas fir trees are felled and disposed of after they have attracted and been attacked by the beetles.

Douglas fir bark beetle can often be part of a two-pronged attack and supply the "coup d'etat" to kill trees that have already been weakened through an attack by another insect or disease. Some minor evidence of this is showing up in the budworm infested areas in the Fraser Canyon.

This would prove extremely serious if the defoliated weakened trees are subject to an all-out attack by the Douglas fir bark beetle.

A more significant example of this two-pronged attack would be the Douglas fir tussock moth infestation in the Kamloops areas some five years ago.

This did involve a secondary attack by the Douglas fir bark beetle which resulted in the need to introduce a rapid salvage logging program to log the dead and dying trees.

The Douglas fir bark beetle is an insect that generally attacks the larger and older trees. Since the Douglas fir forests of the interior dry belt are normally managed on a selection basis and are located in the more

accessible areas of the Province, the regular period logging generally tends to harvest the larger and, thus, the more susceptible trees. A significant contribution to the control of the Douglas fir bark beetle has been the concerted effort toward a sanitary logging program including how stumps, disposal of slash, salvaging of small infestations, addressing single tree attacks, etc. Thus, I believe that the continuation of the current logging process, the maintenance of a pertinent trap tree program, where required, should allow us to look into the future with some confidence with respect to the Douglas fir bark beetle.

3. Douglas Fir Tussock Moth

Like the western spruce budworm, the Douglas fir tussock moth is a defoliator. However, unlike the western spruce budworm, the Douglas fir tussock moth is a defoliator that eats both old and new foliage, thus causing mortality in 1-3 years. This attack creates sufficient stress on the trees to make them extremely susceptible to a "coup d'etat" by the Douglas fir bark beetle. The moth can attack both mature and immature trees. With the last most serious outbreak in the Kamloops area, the weakened defoliated trees were attacked by the Douglas fir bark beetle which caused considerable mortality. Again, forest harvesting priorities were shifted to these infested, dead and dying forests. The fact that the Douglas fir tussock moth created this receptive environment for the Douglas fir bark beetle contributed to a rapid increase in the Douglas fir bark beetle population in the area.

The future looks promising with respect to this insect. A pheromone has been developed that can be used as an attractant to detect any increase in

the tussock moth population density. An effective virus pathogen has been isolated which is specific to the the tussock moth itself. In fact, it is a natural virus that causes the natural collapse in a major tussock moth infestation. The virus is obtained by crushing the dead bodies of the tussock moth caterpillar itself and to introduce it earlier into the cycle of the population. A small operational trial of approximately 100 ha is under consideration this year in the Similkameen.

SPRUCE

1. Spruce Bark Beetle

The interior of the Province contains vast acreages of mature and over-mature spruce forests which support an endemic population of spruce bark beetles.

These forests are in an advanced age and, along with the shallow-rootedness of the spruce, are very susceptible to being blown down by wind. These downed trees still in the shade of the overall canopy become a prime breeding haven. Major outbreaks have occurred in the past with major losses - the last serious infestation being in the mid and late 1960's. In the 1962-65 period, approximately fifteen million cubic metres of mature spruce forests were attacked and killed. Although much of this was salvage logged, this amounted to 20% of the total annual volume logged in B.C. today. Or to put it another way, a sufficient volume of timber to build 750,000 houses.

Weather conditions (viz severe early cold weather before snow) finally knocked back this earlier attack. Currently, the problem is serious again.

Some of the control programs underway:

- 1) adjustments in forest harvesting priorities to divert logging programs into infested areas;
- 2) the importance to salvage small areas of blowdown, wherever feasible, will continue to be stressed;
- 3) continuation of trap tree programs in conjunction with pheromone attractants;
- 4) continued adherence to an ecosystem classification process in determining species selection in reforestation programs. Early assessments of spruce plantations in the area show a healthy natural mixture often occurring involving balsam, lodgepole pine and aspen. Mixtures of spruce and Douglas fir are treated with caution as this causes new problems in that Douglas fir is the alternate host for *Adelges cooleyi* or the spruce gall aphid which can cause deformities and growth losses in such mixed plantations and would have a negative impact in the growth of spruce. Here is an example where a mixed forest is less desirable than one of pure spruce.
- 5) the realization of a mosaic of forest types and age classes which is generally occurring and should be an improvement over the huge areas of homogeneous forests in the area - almost all being the result of forest fires;
- 6) the fact that spruce bark beetle primarily attacks the older and over-mature trees should mean that its impact will be less severe when the forest profile is primarily comprised of forests between

1 and 100 years of age. Although such gives us hope for the future, the potential for a major infestation is very real now as the extensive forests in the Prince George area are generally comprised of mature and over-mature spruce forests.

TRUE FIR (BALSAM)

1. Two Year Cycle Spruce Budworm

This budworm, is a different "critter" from the western spruce budworm.

Rather than Douglas fir, the target species are balsam and spruce.

The current infestation is primarily centered to the south and east of Prince George and is light to moderate. While defoliation does occur, mortality has not been serious.

No direct control actions are planned at this time although, where feasible, logging priorities will be redirected to the infested areas.

In the long term, we would expect a decrease in the infestations as the mosaic of the forest gradually changes to younger, healthier forests since the primary target for the two year cycle spruce budworm appears to be the mature and over-mature trees.

2. Sawfly

Sawfly attacks in 1978 and 1979 in the Kesley Bay area resulted in the defoliation of some 700 hectares of balsam trees. These were then attacked by bark beetles in 1980 which is resulting in significant mortality. Harvesting priorities are currently being adjusted to divert logging operations from non-infested timber into this area under attack.

3. Balsam Bark Beetle

Balsam bark beetle has been part of an insidious infestation of alpine fir trees in the interior balsam fir forests. Its impact is on the higher elevation forests in the southern interior but is found in the lower elevations in the north.

Since the infestation is scattered, it is not dramatic but the insect causes a continuous and insidious mortality.

More emphasis on the research into this insect should be made.

DWARF MISTLETOE

Dwarf mistletoe is the cause of some of the most serious and continuous losses in growth productivity. While it is of concern in the coastal hemlock forests, it is an extremely serious disease in many of the interior forests of lodgepole pine and Douglas fir.

Although the infestation does not spread quickly in area, it does spread rapidly between layers of trees in the forest.

Thus, the control programs must address the need to eradicate the infestation in all layers of the forest.

In lodgepole pine, control programs are underway to:

- a) direct logging into the infested forests
- b) address post-logging treatments that will eliminate the infested understory. Several thousand hectares were so treated in 1980.

While the control of dwarf mistletoe in the interior lodgepole pine forests is relatively straightforward, the control measures in the infested Douglas fir forests pose other problems.

The interior dry belt Douglas fir forests are generally logged on a selection logging system. In addition, a mistletoe classification system has been introduced to assist in identifying the infested and susceptible trees. While this program is meeting with some success, the fact is that the understory of young Douglas fir remaining after logging is usually also infested.

Adding to the challenge is that much of the mistletoe infested Douglas fir forests are situated in the Okanagan areas. While some segments of the public want to see limited logging (and certainly selection logging) in these areas, pathologists tell us that the only way to eradicate the dwarf mistletoe infestation is to eliminate the infested understory during, or immediately following, the logging process. Here is another example where the solution is not a simple one as the latter option would involve the clear cutting of the infested areas.

The battle to control dwarf mistletoe infestations will be a long one - many many decades.

MOUNTAIN PINE BARK BEETLE

Earlier in the history of British Columbia, vast forest fires were allowed to burn unattended throughout the interior. Undoubtedly, many of them were started by man in order to achieve some objective - be it wildlife management, range use or mining. The result of this fire history is that we have vast areas of homogeneous mature and over-mature forests of pure lodgepole pine. Except in the real wet belt areas, these lodgepole pine forests are found throughout the interior of the Province.

Like the mature spruce forests in the Prince George area and their current susceptibility to the spruce bark beetle, the mature lodgepole pine forests are most susceptible to attack by the mountain pine bark beetle. Throughout western North America (British Columbia, Alberta, Washington, Oregon, Idaho and Montana), this is a battle that can't be won while the huge acreages of homogeneous, mature lodgepole pine forests exist. Control strategies can only hope to:

- 1) slow down the rate of spread to buy time.
- 2) harvest the infested and higher priority susceptible forests.

Tonight, we chose to present one case study. While it could have been on the spruce bark beetle, Douglas fir bark beetle or dwarf mistletoe, we chose to address the mountain pine bark beetle. Bob Ruault will be responsible for this presentation so I will not discuss the mountain pine bark beetle infestation any further at this time.

YOUNG FORESTS

1. Terminal Weevil

The threat of terminal weevil attacks in the young forests of spruce and pine is of concern. The weevil attacks the tip of the young tree and while not killing the tree, can cause "die-back" for up to five to seven years of growth. The resultant multiple leaders can cause severe deformity and make the tree much less valuable or of no commercial value when it should be ready for harvest.

Currently, weevil damage is of concern and in much of the lower coast, sitka spruce is simply not considered as an option to plant because of the

weevil problem. In addition, the potential for damage in the increasing plantations of spruce in the interior is very real.

There is some indication that "shading effect" is of some benefit and that the trees are not attacked as readily once they've reached a height of 15-20 feet. Thus, a minor aspen component in a conifer plantation of the interior may have a beneficial effect.

Again, damage from the weevil is of concern and is constraining the full adoption of the ecosystem classification for species selection in the Province's reforestation program (e.g. constraints on the coastal sitka spruce reforestation options). Thus, it is important that research efforts continue to address the weevil. One potential thrust could be the tree breeding program. We have isolated several hundred apparent weevil-resistant sitka spruce trees and these have been out-planted in areas of high weevil incidence to test their resistance. Other research-type studies have been undertaken by governments and universities including one on the west coast of Vancouver Island involving Dr. John McLean of U.B.C. who is in the audience tonight.

2. Black Army Cutworm

In the early 1970's black army cutworm damage was severe in several new plantations throughout a wide range of the interior. Previously, this insect was unknown in the forests and was confined, primarily, to agriculture endeavors.

In the past few years little evidence has been noted. The reduction can be attributed to adjustments made in site preparation and plantation scheduling following some good practical research.

3. Root Rot

Root rot diseases are one of the most serious threats to young forests and are one of the major concerns relative to forest management programs in British Columbia, Washington and Oregon.

To date, no "control" measure is available.

Some of the work currently underway:

- 1) close inspections of young forests for evidence of root rot before considering for spacing;
- 2) consideration of alternate species selection in the reforestation of heavily infected areas. One promising alternative is the planting of western white pine which is resistant to root rot. Unfortunately, however, white pine is most susceptible to blister rust which normally prevents any white pine from reaching maturity.
- 3) consideration of stump treatment in spacing programs but such can cause other problems and the results, to date, are mixed;
- 4) trials to uproot stumps after logging to lessen the source of infection prior to planting the new forest. Some of you may have seen one such trial adjacent to the road between Duncan and Lake Cowichan. This type of treatment is very expensive;
- 5) the essential continuation of research into the root rot problem.

4. Cone and Seed Insects and Diseases

Cone and seed insects and diseases are also a concern. At times, the presence of insects in the cones cause many plans to collect cones and maintain seed supplies to be aborted. The fact that an increasing percentage of the seed supply will originate from seed orchards over the

next two decades should provide a greater opportunity for control. In fact, the investment in seed orchards to obtain improved seed simply means that these attacks in an orchard must be controlled.

In conclusion, the management for forest pests in British Columbia is, and will continue to be, a complex challenge.

Unlike our major competitors such as the southeast States and the Scandinavian countries, British Columbia's forests are complex and diverse. With the climatic and topographic extremes that exist in B.C., it is little wonder that our forests are also most diverse. Add to this challenge the interactions of an important and diverse fishery and wildlife resource, it is apparent to me that the integration of an effective pest management program in this Province does not lend itself to simplistic solutions. Often, the most effective treatment will not be the most acceptable treatment. Or the solution to resolve one problem may simply result in a different and more serious problem. This is but another example of a resource issue where the answer is not in simplistic solutions but in intelligent choices.

PAPER NO. V

AN OVERVIEW OF THE MOUNTAIN PINE BEETLE
INFESTATION IN BRITISH COLUMBIA

by

W. Young
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Paper presented at the Mountain Pine Beetle Problem Review Workshop, November 3, 1981, in Fairmont Hot Springs, B.C.

AN OVERVIEW OF THE MOUNTAIN PINE BEETLE
INFESTATION IN BRITISH COLUMBIA
by W. Young

The mountain pine beetle and the devastation that it has caused during the past five to six years will have a major negative impact on future timber supply projections in the interior of British Columbia. This is especially so in areas such as right here - the East Kootenays.

Today, I'd like to give you a brief overview of the situation in British Columbia with the aid of a few slides. Specifically, I'll discuss:

- the history of the recent mountain pine beetle infestation
- the impact of these infestations
- the actions being taken
- recommendations

Twenty years ago, lodgepole pine was not one of the major species harvested in British Columbia. While increased harvesting of this species had begun in the better stands in the north-central interior by 1960, the harvest of lodgepole pine in the southern interior was not significant.

Today, however, lodgepole pine has become one of our most important interior species - both for the manufacture of lumber and pulp. The percentage of the interior B.C. harvest that was attributable to lodgepole pine increased some 350% in the twenty years prior to 1980 until today that species comprises some one-third of the total interior harvest. In the Nelson Forest Region (where we are now), the increase has been even more dramatic with over a 900% increase in the percentage contribution since 1960. For a variety of reasons including the poor market situation and the rate of

infestation, it is becoming impossible to salvage all the dead and dying timber. For example, a recent submission by the Association of British Columbia Professional Foresters stated that of the 23,000 hectares infested in the Flathead Valley of the East Kootenays, only 6,000 hectares had been logged or were loggable.

Let's look at the problem.

Apart from some earlier more localized infestations of spruce bark beetle, wood losses caused by insects up to 1975 were not excessive. Annual average losses were estimated at some 1,400,000 cubic metres annually. Recently, the losses from all forest insects has increased dramatically with such losses estimated to be 46% of the annual losses in the Province from fire, insects and disease.

From 1975 to 1980, the area of infestation in British Columbia rose dramatically from 38,700 hectares to approximately 550,000 hectares.

Even more frightening is the fact that there are some 2,500,000 hectares of lodgepole pine considered susceptible to attack.

Close to home, Canadian Forestry Service data in the Nelson Forest Region shows how the number of attacked trees has increased. It is in southeastern and central British Columbia where infestations to date have been most serious.

Many areas of attack involve steep slopes and inaccessible areas which cause major and often insurmountable challenges to salvage operations.

Through the following slides, let's look at the overall impact.

Up to 1975 only small attacks.

1980 more attacks.

Shows the area which could be attacked in the near future.

This slide shows the wood volumes lost. Note that the annual loss during the 1975-80 period is approximately 15 million cubic metres a year or ten times the annual loss up to 1975.

Stumpage losses to the province have been considerable and are expected to increase. Of course, potential revenue to the federal government through other avenues is also lost.

Losses from estimated reduced exports are also substantial. The problem is further aggravated today because of the economic downturn which is having major effects on the industry. Throughout B.C., the rate of harvest is beginning to be curtailed for this reason. Thus while the beetle infestation is spreading faster, salvage is slowing down.

In the Nelson Forest Region of British Columbia and especially in the East Kootenays, the sawmills have been handling increasing volumes of lodgepole pine in a cooperative program with the Ministry of Forests to minimize losses and help in the control program (i.e. until the recent economic downturn). Major planning efforts against the mountain pine beetle have come through two active committees founded several years ago: the East Kootenay and the Kettle Valley Insect and Disease Control Committees. These committees are comprised of representatives from the Forest Service, major timber operators, Canadian Forestry Service and other agencies concerned with land management such as Parks Branch (B.C.) and the Ministry of Environment (B.C.). The committees recommend changes necessary in harvesting plans to deal with the beetle situation in order to speed up harvesting when necessary. The committees have achieved a large measure of success. A report from the Nelson Forest Region puts the problem into perspective. In part, the

report says that mountain pine beetle salvage efforts have caused serious disruptions of normal harvesting plans....."because the sustained salvage program has resulted in removal of extensive areas of lodgepole pine there will also be long term impacts on the species profile and on the location of future logging opportunities.....most licensees in the East Kootenay have come close to their target of deriving 70 percent of their log supply from mountain pine beetle salvage. Intensive mountain pine beetle salvage has also been undertaken in the Kettle Valley area. Overall, salvage production has not yet resulted in overcutting of the AAC of any TSA. However, there are indications that we are facing another spruce bark beetle epidemic, in which case overcutting may occur. Because spruce stands are often not on common road systems with lodgepole pine our ability to concentrate on mountain pine beetle will be further diluted."

A reanalysis of timber supply management programs and the pertinent rates of harvest is currently being undertaken throughout the Province with 30 of the 34 Timber Supply Areas completed. Throughout the interior of the Province, this analysis is reconfirming that the timber supply areas usually have a significant imbalance of age classes.

Often, there is a larger component of mature and over-mature white spruce and lodgepole pine with a related shortage of older immature age classes. The susceptibility of these old-growth forests of spruce and pine to bark beetle attacks has lead to the confirmation of an approved rate of harvest in excess of the long run sustained yield level. This decision often results in a future fall-down projection in the short-term. All the reforestation programs in the world will not solve a short-term timber supply

problem. It can only be minimized (or eliminated) through increased utilization practices and increased protection measures against fire, insects and disease.

What the Forest Service and others have done. The change in tree species cut is shown in the next slide.

Signs such as these are becoming more common.

An aerial view of harvesting in a beetle-infested spruce forest.

Salvage harvesting programs have inevitably resulted in large clear cut areas.

In August of 1981 the Government of British Columbia announced an \$11.4 million program for bark beetle control including the building of access roads into beetle-infested areas for selective sanitation logging. We emphasized that this is not a salvage operation. Rather, the top priority is getting to the margins of the infested areas in order to slow down the spread of the infestation and to buy time through pertinent control measures and selective harvesting programs.

As the Minister of Forests said at the time: "Up to now the biggest barrier to sanitation logging has been the lack of road access to the threatened stands of timber. Now we are providing the money to build the roads. With the orderly planned harvest of threatened wood, we can take suppression measures to inhibit the spread of the beetle and lay the foundation for reforestation programs that will minimize the recurrence of beetle infestations in the future."

Of the \$11.4 million, \$7 million is being spent in the current fiscal year.

What of the future? We know the biology of the mountain pine beetle. Our problem is to apply the existing knowledge to our land management practices.

Like all insects, the mountain pine beetle knows no boundaries. What we need are mutual agreements for action where the beetle invades another province, state or country. Such agreements should include undertaking control programs, salvage logging, rehabilitation and reforestation programs in areas adjacent to boundaries. In addition, arrangements for sharing fire fighting equipment and services should be made. It is ineffective for one province, state or country to undertake control programs and sanitation logging plans to inhibit the spread of infestation if it is allowed to spread unimpeded adjacent to the boundary. I believe these agreements should also include national, provincial and state parks. Huge infestations in parks are just as explosive as they are on other forest lands.

Some horrendous future problems are anticipated as a result of the current infestation. Where salvage operations have not been undertaken, vast areas of dead and dying trees pose an explosive fire hazard. Cost of rehabilitation will be excessive.

The submission prepared by the Association of B.C. Professional Foresters estimated rehabilitation and reforestation costs in the Flathead valley alone to be some \$10,000,000. The briefs called for the valley to be given disaster status and for the Government of British Columbia and Canada to jointly finance this rehabilitation project.

I hope that these few minutes of discussion and the supporting slides have given you some appreciation of the current British Columbia situation.

Of course, the threat from mountain pine beetle can be alleviated to a significant degree in the long term by forest management programs. A more variable mosaic of age classes, minimal areas of over-mature timber, mixed species types, etc., will all contribute. While timber management and silviculture programs must work toward this end over the future decades, I've chosen not to develop this theme in my presentation today. I understand that the theme of this meeting is to clarify the "state of the nation" (or nations) TODAY and work toward short term solutions to minimize the negative impacts of the mountain pine beetle infestation. I simply wanted to clarify that in my opinion long term solutions lie primarily in the judicious choice of timber management and silviculture options.

I appreciate that this is not the appropriate time in today's program to discuss proposed options and programs. When that time comes later today, I'd suggest that we develop some cooperative and compatible programs between Provinces, States and countries to address the mountain pine beetle infestation simultaneously on five broad fronts.

- control programs
- salvage programs
- fire protection programs
- rehabilitation and silviculture programs
- research

PAPER NO. VI

MONEY MARKET OR PEST MANAGEMENT INVESTMENT?
I. THE MOUNTAIN PINE BEETLE SITUATION
IN BRITISH COLUMBIA

by

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A paper presented at the 73rd Western Forestry Conference, Portland, Oregon, 1
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MONEY MARKET OR PEST MANAGEMENT INVESTMENT?
I. THE MOUNTAIN PINE BEETLE SITUATION
IN BRITISH COLUMBIA
by R.F. DeBoo

INTRODUCTION

The mountain pine beetle (Dendroctonus ponderosae) currently is recognized as the most devastating pest in pines in British Columbia. According to recent estimates by the Canadian Forestry Service, more than 66 million trees were killed during the 10-year period 1972 - 81. Another 10 - 15 million trees may be lost in 1982.

The current severe attack is attributed to a combination of favourable weather and suitable host conditions during recent years. Abundant mature lodgepole pines (Pinus contorta) extend across the province and result in part from indiscriminate burning of the forests by mining and railroad interests near the turn of the century. The efficient fire suppression program now in place in B.C. has kept many of these 80-100+ year old, beetle-vulnerable stands alive and otherwise healthy.

Beetle attack currently extends from areas near the tip of the Alaska panhandle to the southeast corner of the province and the Idaho-Montana border (Figure 1). Extensive beetle-killed forests occur on the Chilcotin Plateau and in the Flathead drainage adjacent to Glacier National (U.S.) Park. The British Columbia Ministry of Forests, with the cooperation of the Canadian Forestry Service and the forest products industry, have the major responsibility for charting and conducting beetle control operations.

Costs associated with short term management of lodgepole pine for reduction of losses to the mountain pine beetle include costs for survey and

detection, single tree disposal and laying out of cut boundaries. Costs are continuing, commencing when pine stands reach susceptible size and age and ending with harvest and initiation of a more beetle-proof second forest. This is in contrast to management practices directed toward pathogens or other pests where program costs are usually all "up-front" and can be discounted over the entire stand rotation period. Even when there are no mountain pine beetles apparent in a stand, surveys must be maintained for detection of incipient infestations where application of direct control methods is a tenable alternative.

Mountain Beetle - Life Cycle and Impact in B.C.

The mountain pine beetle has a 1-year life cycle throughout most of its range in B.C. Adult beetles attack the trunks of trees in mid-summer and build egg galleries in the inner bark. Young larvae hatch, feed for a while and overwinter. Feeding continues and is followed by pupation in the following spring. Young adults develop by late spring or early summer. After a brief period of maturation, beetles emerge and fly to infest new trees. This cycling may be repeated annually until the available food supply is largely depleted.

Transmission of a blue-stain fungus occurs as the mountain pine beetle adults invade healthy trees. Fungal spores adhering to the beetles stick to the tunnel walls, grow and kill living phloem and sapwood. Thus the combined effects of large numbers of beetles and a cell-killing pathogen usually results in the rapid death of the attacked tree.

Attack usually spreads from a few individual hosts to coalescing groups of trees, so that whole stands may be killed in only a few years time.

Sequences of attack and approximate timber losses during recent years are summarized in Table I.

Table I: A Summary of Mountain Pine Beetle Infestations
in British Columbia, 1972 - 1980, and the Potential for Future Attack.

<u>Cumulative/Potential Attack</u>		
<u>Period</u>	<u>Area Infested (acres)</u>	<u>Wood Volume Loss (Est. fbm)</u>
1972-1975	75,000	1,980,000
1976-1982	414,200	2.9 billion
Now At Risk	3,200,000 (Potential)	3.2 billion (Potential)

ECOLOGICAL AND SOCIAL CONSIDERATIONS

Impacts of mountain pine beetle transgress timber values and cause serious ecological and social disruption. The following factors (often difficult to evaluate or express financially) must be considered when calculating losses due to devastating beetle infestations.

1. Loss of timber values including stumpage, royalties, direct and indirect taxes.
2. Disruption of long-term management plans requiring additional road-building, logging costs and reforestation costs.
3. Disruption of yield analyses which have an impact on mill operations, community stability, community income, etc.
4. Wildlife and range values will change making integrated resource management difficult.
5. Changes in watershed quality with some impact on fisheries management objectives.

6. Destruction of aesthetic values affecting property values, tourism and recreation industries.
7. Increased fire protection costs.

Many of these impacts can occur in only a few years time, but the associated losses may accumulate and extend over many. Thus, pest management policies in British Columbia, as elsewhere, must accommodate actions which may be accountable financially only in part. It is the responsibility of the management agency to provide resources in an orderly, planned manner over a long term to ensure economic, environmental and social stability to the greatest extent possible.

ECONOMIC IMPLICATIONS

The loss of the lodgepole pine resource in British Columbia to mountain pine beetle would be economically disastrous. At present, lodgepole pine is the number 2 species harvested, accounting for about 12 million m³ (2.5 billion fbm) or 23% of the annual harvest (prior to the recent market decline). This harvest represented about \$1 billion (U.S.)² in income to the province annually from various sources. In addition, several hundred sawmills and their employees are largely dependent on this species. In normal economic times, the forest industry directly employs nearly 10% of the provincial labour force and supports another 15% indirectly.

Support of these processing centres and the people living there requires an orderly extraction and replacement of the pine resource. In British Columbia, these procedures are contingent upon Timber Supply Area management

²For purposes of this discussion, \$1.20 Canada = \$1.00 U.S.

plans, cut controls, and prompt reforestation procedures. Beetle attack resulting in widespread stand destruction may thereby deplete the wood supply at a far greater rate than is ideal and thereby make plans and controls inoperative.

MANAGEMENT STRATEGIES

As for many forest insect pests, viable management strategies for the mountain pine beetle may be separated into 2 broad categories:

(1) prevention, and (2) direct control.

1. Prevention - Strategies for the prevention of massive beetle damage must rely upon the basic premise of reduced susceptibility. This must involve long-term planning for the determination of objectives and silvicultural prescriptions. For mountain pine beetle, the following planning considerations will contribute to minimizing the risk of volume loss.

- Stand rotation age, based on optimum wood production, should be about 80 years maximum,
- Cutting priority must be given to older stands to reduce potential centres of infestations. These older stands should be prioritized in terms of values at risk, susceptibility of stands and the probability of an infestation occurring based on climatic data and infestation history,
- Reforestation plans should include consideration of age and species mosaics to minimize susceptibility of whole management units,
- Mixed stands should be considered, especially with regard to other values attached to wildlife, watershed and recreation.

2. Direct Control - Unlike situations for insect defoliators and other exposed pests, application of insecticides is not a feasible option for the large-scale control of this bark beetle. Control activities are usually directed at the infested host trees instead.

The best alternative in the case of existing widespread and severe infestations is the prioritization of such areas within supply area harvesting plans. This procedure involves the close collaboration of industry and government, and may require special subsidies for the construction of access roads, bridges, etc., for the orderly extraction of wood. Additional accommodation may be required at the mill yard to process the preponderance of pine being harvested.

If prioritized harvesting is not feasible in certain areas or if harvesting would not remove all infested trees, surveillance will permit an aggressive sanitation program to "buy time". Small-scale patch logging and single-tree disposal operations would contribute to the maintenance of a green forest. All of these direct control strategies will contribute to the destruction of beetles and when applied properly will reduce the resident populations to low levels.

Direct control is feasible and it is working in British Columbia.

However, the decision to exercise direct control procedures must be made on an infestation to infestation basis. Attempts at controlling large infestations may be doomed to failure as the capacity for beetle population increase will far exceed the capability of management agencies to remove significant proportions of insects. Localized infestations are

amenable to direct control and excellent results have been obtained in British Columbia during recent years.

Successful direct control operations are dependent upon good surveys to locate population centres. All strategies should be incorporated into the program. Large, central infestations should be harvested with priorities placed on removing beetle broods. As well, single tree disposal should be practised on fringe areas to fully sanitize a stand or control area to the fullest extent possible.

Direct control programs are not "one-shot" efforts. Follow-up operations must be planned for subsequent years to truly protect an area.

Direct control will not solve the problem. The basic problem is the susceptibility of the tree or stand of trees. Direct control will, however, greatly reduce the spread of an infestation and allow needed time to implement more long-term strategies.

STAND VALUES AND TREATMENT COSTS

A recent report by the Canadian Forestry Service (Safranyik et al. 1981) states, ".....there is no economically uncommitted allowable cut in British Columbia ...". Based on this, they go on to make a fairly comprehensive dollar estimate of mountain pine beetle losses. A decline of each million board feet in allowable cut results in a loss of about 8.8 jobs in the logging and sawmilling industries with an income loss of approximately \$138,000 U.S. from forest industry employment. Applying a local multiplier of 2, total employment dollar loss is about \$276,000 U.S. Total losses must also include lost revenue from stumpage (\$5,000 U.S./Million f.b.m.) and tax

revenue losses (combined provincial and federal of about \$26,000 U.S./million f.b.m.), although these may not be incurred in total. On the basis of these values and the estimated 1.6 billion board feet loss in 1980, the potential economic impact for this single year is estimated to be approximately \$600 million U.S.

Another method of expressing values of forest products in B.C. is in terms of export value³. The value of each bd. ft. of wood product exported from province averages \$0.33 (U.S.). With reference to table I, then, losses during the period 1976-1981 amounted to about \$957 million (U.S.) and an additional \$10.6 billion (U.S.) of product is threatened by the mountain pine beetle.

Stumpage prices and harvest volumes for the period 1955 to 1981 are summarized in Table II. Of particular importance is the increasing percentage of the total harvest for lodgepole pine during this period.

Table II. Volumes and Stumpage Values for
Lodgepole Pine in B.C. from 1955 to 1981

<u>Year</u>	<u>Volume (billion f.b.m.)</u>	<u>Stumpage (1982 U.S. \$)</u>	<u>Lodgepole Pine as % of Total Harvest</u>
1981	2.6	0.48	23
1980	3.0	0.61	19
1979	3.1	1.80	19
1978	2.9	0.75	18
1977	2.8	0.15	19
1976	2.4	0.15	16
1960's	-	-	5
1955	-	-	2

³"Exports" includes the value of lumber, plywood, pulp, paper, shakes/shingles, etc., exported.

Calculations based on such parameters quickly provide insight into the importance of the lodgepole pine resource and the reasons for considering aggressive direct control actions and long term management regimes.

Crude estimates suggest that the timber value of this threatened resource alone may surpass 20 billion (U.S.) 1982 dollars.

In view of the current and potential losses attributable to this single pest, the B.C. Ministry of Forests inaugurated a \$9 million (U.S.) emergency beetle suppression program in addition to programs being carried on under existing regular funding. The program consists of more than 70 projects including intensive detection surveys, single tree disposal programs, construction or upgrading of access roads into priority areas and refinements in the processing of cutting permits to allow rapid harvesting of identified areas.

Projects are funded on the basis of the size of the infestation being considered, the values to be protected, methods proposed and the estimated probability of success. Projects are co-ordinated with harvesting plans to ensure that the direct control is as effective as possible. Excellent co-operation has been given by industry as they are directing their cut capacities into appropriate areas. Most projects are planned to incorporate a follow-up project for at least the year following.

Costs of single tree disposal have varied considerably from area to area depending upon terrain and difficulty to access. Average cost per tree is approximately \$30 but were up to about \$80 when access was by helicopter.

Not all infested areas within the province have been considered for treatment. As mentioned previously, action was taken on priority areas where

an opportunity for success existed. This assignment of direct control options to infested areas with specific characteristics is a requirement if the funds are not to be wasted.

The purpose of the program is not to eradicate mountain pine beetle in treated stands. Rather, the objective is to drastically reduce the rate of spread and retard the damage levels to allow time for orderly harvesting and liquidation of highly susceptible stands. If no action had been taken, further vast areas would be killed and much of it would not be salvaged in time to recover some of the value. The resource has to be protected as much as possible to ensure a continuous supply of timber.

CURRENT PROSPECTS IN BRITISH COLUMBIA

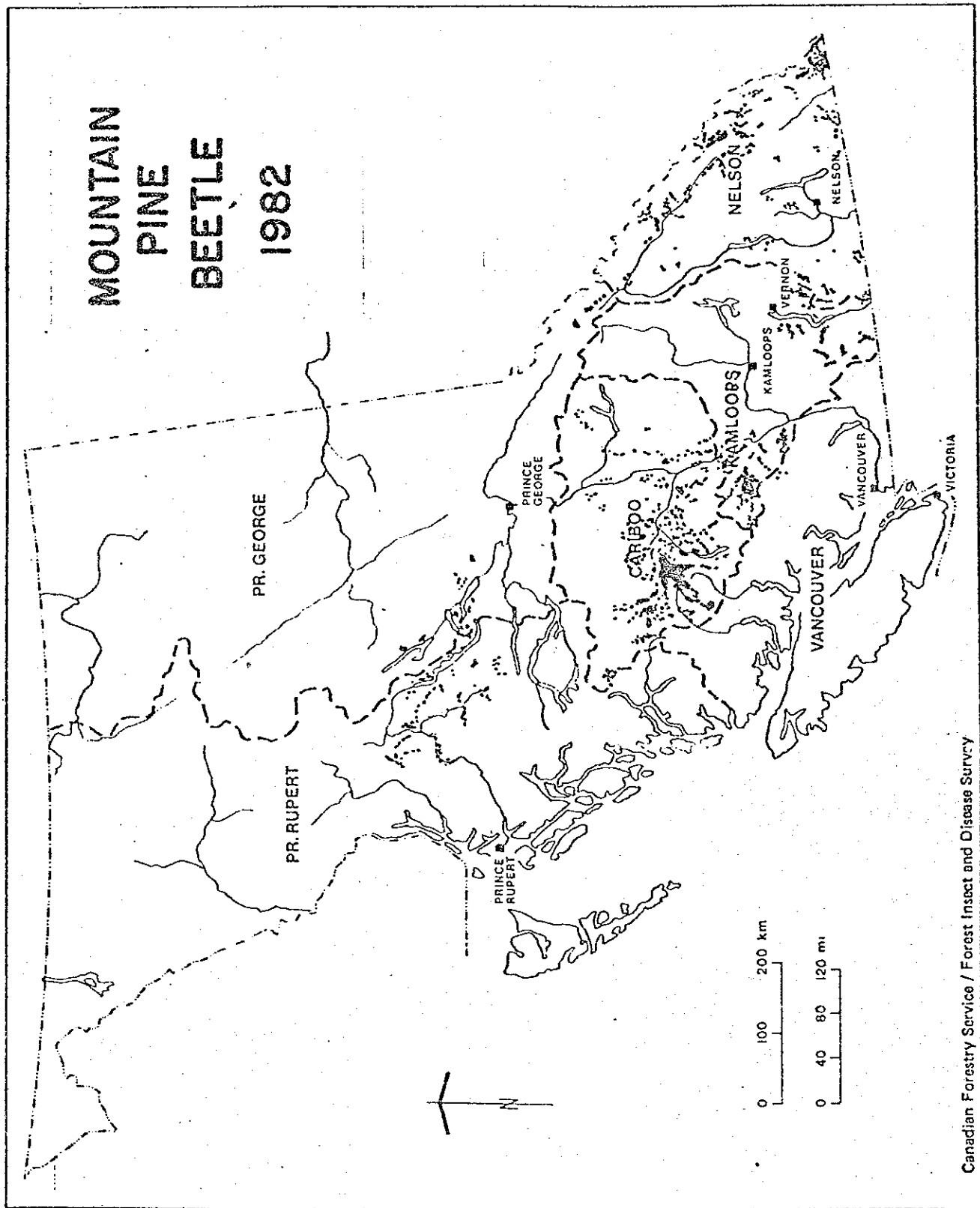
The unpleasant current marketing climate in British Columbia, as elsewhere, may seriously impede the initiatives undertaken recently. Without the revenue generated by the forest products industry, funds available for emergency control operations for mountain pine beetle will be very difficult to obtain. Accordingly, some major initiatives may have to be abandoned. But regional activities - from near the tip of the Alaska panhandle to the Idaho-Montana borders - will not be relinquished completely. Regional priorities will be adjusted, new proposals submitted to the Ministry Executive, and new plans and programs will be inaugurated.

ACKNOWLEDGEMENT

Thanks are extended to Peter Hall of Protection Branch for assistance in the preparation of the manuscript and to Ken Russell of the Washington State Department of Natural Resources for presenting this paper to the conference on my behalf. Dr. G. A. Van Sickle of the Canadian Forestry Service, Victoria, kindly provided the map for inclusion in this paper.

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Canadian Forestry Service / Forest Insect and Disease Survey

(Figure 1. Distribution of tree mortality caused by mountain pine beetle in B.C.)

PAPER NO. VII

FOREST PEST CONDITIONS
IN BRITISH COLUMBIA IN 1982

by

W. Young
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Talk and slide presentation to the Cariboo Section of the Canadian Institute of Forestry on January 20, 1983 in Prince George, B.C.

FOREST PEST CONDITIONS
IN BRITISH COLUMBIA IN 1982
by. W. Young

The Forest Pest Review Committee (F.P.R.C.) is comprised of representatives from Government agencies (Provincial and Federal), Universities, Technical Schools and the forest industry. Its prime function is to keep abreast of forest/disease conditions in British Columbia and to assess appropriate action programs.

Each fall, the Canadian Forestry Service (A. Van Sickle) presents a current assessment of insect/disease conditions as determined through the Forest Insect and Disease Survey.

Al Van Sickle has been kind enough to lend me his slides for tonight. So my talk will concern the review of the status and impact of major forest insects and diseases throughout British Columbia and the Yukon in 1982 with a partial forecast of conditions for 1983.

Mountain pine beetle infestations continued to expand and intensify in 1982. Red, recently killed trees were evident and sketch-mapped over more than 290,000 ha from southeastern B.C. to north of Smithers. Fully three-quarters of this area was in the Cariboo Region. This year alone an estimated 56 million lodgepole pine trees were killed. An additional 45 million trees were attacked by the 1982 flight of the beetle and most of these will become evident mortality next summer. Current views representative of stand conditions include: Tatla Lake, Goldbridge, White River, and Lussier River.

Spruce beetle, the other major bark beetle problem also increased in area and number of trees killed. Mature white and Engelmann spruce were

killed in stands totalling 99,000 ha mostly in the Prince George, Prince Rupert, Cariboo and Nelson Regions. While more than half of the infestations continue to be in the Prince George Region, the greatest increase occurred in the Prince Rupert Region where part of the population completed development in 1 year rather than the normal 2 year cycle. Conditions vary greatly, from this situation along the Bowron River southeast of Prince George to more isolated patches of attack associated with recent logging or fringe blowdown.

In this the second year of the Douglas fir tussock moth outbreak, severe defoliation in the Okanagan-Thompson area totalled 12,000 ha, an elevenfold increase over 1981. Defoliation was most concentrated and severe in the Pritchard, Monte Creek, Armstrong-Falkland area, with some extensions into the Cariboo and Nelson Regions. A virus has greatly reduced populations in some areas, however, outbreaks are expected to continue in most areas in 1983. This is an example of foliage recovery in 1982 following defoliation and virus treatment in 1981 near Hedley. Douglas fir stands defoliated by western budworm declined to 17,000 ha of mostly light intensity in the Kamloops-Ashcroft area. For the first time in more than a decade, defoliation was not recorded in the Vancouver Region, but budworm were still present in pheromone traps and up to 15% of the buds had been mined near Boston Bar.

Although "2 year cycle budworm" populations apparently collapsed through much of the central interior, alpine fir-spruce stands over 90,000 ha northwest of Prince Rupert were lightly defoliated by a budworm. This was previously identified as a 2 year cycle budworm but is now predominantly on a 1 year cycle. Efforts to correctly identify this budworm are continuing, as is the expected defoliation in 1983.

The western false hemlock looper severely defoliated douglas fir over 1,150 ha in the Salmon Arm area which is about three times the area defoliated in 1981, the first year of the current outbreak. This was a common associate with douglas fir tussock moth during 1974-76 outbreak.

Another defoliator which again became obvious this year was the larch sawfly which moderately defoliated about 12,000 ha in the Nelson Region. More severe defoliation occurred in the Dutch Creek area, the only area of an expected decline. There are a few encouraging statistics--larch casebearer populations continued to decline with only localized areas of very light defoliation. Also, larch needle casts and needle blight declined dramatically since 1981.

Another defoliator which again is active is the western hemlock looper which lightly defoliated 6,500 ha near Revelstoke, including this hemlock-cedar stand near Red Rock Harbour on McNaughton Lake. Egg counts were high and fall parasitism was low. A previous infestation collapsed in spring 1974.

Black army cutworm also reoccurred, killing or damaging more than 32,000 newly planted seedlings in the Kamloops, Prince George and Prince Rupert Regions. Herbaceous plants such as fireweed are preferred foods but in their absence, conifers such as lodgepole pine, or white spruce, can be severely defoliated. Currently, populations are predicted to continue in 1983 but overwintering predation and parasitism are often very high.

Several needle cast fungi were very conspicuous in the Cariboo, Kamloops and Nelson Regions following the recent wetter than normal spring and summers. Dothistroma (red skirt disease) affected white pine in the Slocan

valley and also young lodgepole pine east of Creston. Rhabdocline needle cast resulted in some Douglas fir selections in a seed orchard being culled, while Lophodermella affected a lodgepole pine seed orchard as well as forest trees such as these along the Tranquille north of Kamloops.

Root rots continue as a perennial problem not only in coastal stands but also in the interior such as this black stain and Armillaria mortality (average 50%, 80% in pockets) of lodgepole pine. Northern and wet belt regions do not escape for Polyporus tomentosus is common in spruce even as young as this 35 year old tree.

With generally light to moderate cone crops, seed and cone pests caused significant losses in many areas. Cone moth and cone worm populations were very high in Douglas fir in the Nelson Region, while cone maggots and cone seedworms infested 31 to 59% of the spruce cones examined from several of the interior regions.

Cone rust, however, was much less common this year with a maximum of 25% of the cones affected in a Prince Rupert stand. Unfortunately, the list of pests is still longer, including:

Western oak looper on Garry oak and Douglas fir on Saltspring Island;

Spruce weevil damage is widespread but sometimes confused with Sirococcus damage;

Red belt winter injury occurred south of Dawson Creek and in Prince George Region including the Red Rock seed orchard;

Animal damage is common and scattered;

Stem rusts (Cronartium comptoniae) and cankers continue to be a concern in young, spaced pine stands, as do gall rusts and dwarf mistletoes;

These are not the best advanced regeneration or residuals to be left in bark beetle salvaged stands.

We do not have slides of gypsy moth, because no feeding occurred but 10 male moths were trapped in North Vancouver - Langley area. Aside from a major trapping program to delineate possible infestations in 1983, no major action is planned. Possible quarantine restrictions are a greater current concern than any possible defoliation.

In summary, the insect and disease pests of young and mature forests are apparently not sharing in the present forestry recession.

PAPER NO. VIII

PESTICIDES, PEST MANAGEMENT
AND PARTNERSHIP

by

R.F. DeBoo
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Ministry of Forests
Victoria, B.C.

Paper presented on behalf of the Professional Pest Management Association of B.C. to the Canadian Agricultural Chemicals Association Meeting at Vancouver, B.C., 29 November 1983.

PESTICIDES, PEST MANAGEMENT
AND PARTNERSHIP
by R.F. DeBoo

Introduction

Later this afternoon, at the meeting of the Expert Committee on Weeds, three expert speakers representing the forestry sector will be addressing issues related to "Weeds and Forestry," "Forestry and Herbicides," and "Herbicides and Research." This is a particularly timely occasion to discuss forestry affairs, especially in B.C., as many concerned individuals - including a large number of foresters - are uncertain about the future of the pesticide option for control of forest weeds, insects and diseases.

I am pleased to have this opportunity to be with you today. I am here first and foremost as a member of a professional association dedicated to the establishment of sound pest management prescriptions and practices. Perhaps, therefore, it might be useful to review the B.C. forest pesticide situation with particular reference to the role and responsibilities of our respective Associations. Perhaps some old-fashioned partnership and collaboration is required to help separate facts from myths and misunderstanding, especially for our respective colleagues and fellow members, and with particular regard to their responsibilities for public awareness.

Forestry, Forest Pests and Pesticides in B.C.

You will likely receive basic statistics on forest inventories and values from the guest speakers this afternoon. It would be adequate to say at this point that B.C.'s forest industry generates up to \$7 billion revenue annually based on the harvest of up to 75 million m³. Export value currently approaches about \$85/m³ of wood volume.

Losses due to insects and diseases are conservatively estimated at about 30 million m³ annually. Currently, more than 2 million ha of forest land are covered in undesirable vegetation (weeds), much of which could be exceptionally productive for forest crops. Growth losses due to competition for space, moisture and nutrients are only partially documented at this time. Perhaps losses due to the impact of forest weeds surpass those of insect pests and diseases. In any case, billions of dollars worth of forest products are lost every year in B.C. due to weeds, insects and diseases.

British Columbia forest pest control operations to date have not included either continuous or extensive use of forest pesticides even though the first aerial applications were made in 1929 and over 60,000 ha were treated with DDT for control of blackheaded budworm in 1957. Current projections for herbicide use suggest that between 5,000 and 20,000 ha will be treated annually in B.C. during the balance of this decade. This limited projection is largely a reflection of the availability of operational funding rather than a statement of the scale of the vegetation management problem.

Some key factors regulating or affecting herbicide applications in B.C. include:

- Limited choice of effective registered herbicides,
- Small, remote and expensive treatment locations often near environmentally sensitive water bodies,
- Provincial legislation and regulations which require site-specific permits and applicator certification, and which may require the preparation of extensive support documentation should the project be appealed.

- Over 100 environmentalist organizations constituting a vocal and aggressive opposition to the use of chemical pesticides in forestry.

Forest Pesticides and Public Perceptions

Ken Howard of Chemagro, in his report to the Canadian Pulp and Paper Association two years ago, stated:

"I believe that pesticides make a valuable contribution to the production of pulp and paper. They are important and perhaps vital. I also think that the use of pesticides in forests is scientifically sound from an ecological and human health standpoint.

You should know, however, of the strong objections we have to the unwarranted controversy associated with the use of pesticides in the forest. You should be aware of the burden and cost that has been placed on pesticide manufacturers: responding to over-zealous environmental groups and to the media and the need to react to unsubstantiated claims and fragmentary laboratory data which is far removed from the real world that has become far too great. It could become unacceptable.

I tell you these things and suggest that in light of these difficulties, you should go back to your companies and confirm or deny that pesticides are important to your industry. If they are important, I think, you.....should be in the forefront in defending their use in forestry."

More recently, in a letter to the Editor of Toronto's Globe and Mail, a reader wrote: "I am profoundly disappointed by the reaction of the media and most letter writers to the recent decision in the Nova Scotia herbicide case." So are we in the PPMA. Does this reaction, as perceived by this concerned writer to a newspaper and as implied in Dr. Howard's address to the

CPPA, signal that the end might be near for pesticide applications in the forest? Is forestry registration a type of "kiss of death" for product development? According to British Columbia's Chief Forester: "I sincerely believe that a public that is not knowledgeable of, or is apathetic to, the subject of timber supply management is the worst news possible for "forestry" in British Columbia." In other words, if the largely urban "public" doesn't want it, forget it.

Partnership in Public Relations

Many organizations, including ours (CACA, PPMA), have acknowledged the looming crises should an ill-informed or apathetic urban "public" continue to dominate and question the use of pesticides even when used according to strict regulations, well-conceived plans and professional site-specific prescriptions. I agree with B.C.'s Chief Forester, and I also perceive that we have likely misdirected our separate efforts to inform and advise. Instead of offering information to school teachers, wildlife associations, consumer and community groups, for example, we have wasted valuable time and effort by either talking to ourselves - the proponents of discreet applications - and the entrenched opposition - those unalterably against chemicals in the environment. Thus, my suggestion to collectively review this dire situation and to consider the following proposal for getting on with the job we may have been evading til now.

I am convinced that professional pest managers - whether farmers, foresters or public health officials (i.e. those conducting pest control operations) - could and should do much to explain reasons for the pesticide option. However, it is you, the association of manufacturers, distributors

and technical experts, who must assume the lead role in generating public awareness and public involvement. Groups such as the Professional Pest Management Association of B.C. and the Canadian Pulp and Paper Association would then have a much better reason to become involved in an assertive and positive fashion. Together, perhaps on an informal but coordinated basis, and armed with factual information and a wealth of expertise, we might begin to provide the right information to the prime audience at long last. Perhaps the media also might begin to accept this factual information to develop a balanced approach (if this is possible) in reporting on issues concerning pesticides.

Therefore, I invite your association to contemplate a cooperative approach, perhaps using the current forestry scenario as a focal point. Should you wish to further the credibility of the pesticide option, and should you concur that the linkage of our associations would be worthwhile, then I am sure a list of priority assignments and activities could be developed. The PPMA of B.C. will be holding its annual meeting here in Vancouver during February 1984. Your chairman would be most welcome to attend our meeting and to present the CACA response. What do you say, partners?

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PAPER NO. IX

A SURVEY TO DETERMINE ROOT DISEASE LOSSES
IN COASTAL BRITISH COLUMBIA FORESTS

by

P.M. Wood
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Presented at the 74th Western Forestry Conference, December 1983, at Portland,
Oregon.

A SURVEY TO DETERMINE ROOT DISEASE LOSSES
IN COASTAL BRITISH COLUMBIA FORESTS
by P.M. Wood

Summary

Preliminary results from an extensive, computer assisted root disease survey in south coastal British Columbia point to root disease management as an excellent opportunity to enhance forest productivity. The stratified, random survey indicates an average infection level of over ten percent visible damage on an area basis for Douglas-fir stands of culmination age. The blending of forest management options, including root disease management, to meet production targets and to forestall potential timber supply shortage, is discussed.

Introduction

The British Columbia Ministry of Forests is now nearing the completion of an extensive, two year root disease survey project. The preliminary results are impressive. This paper discusses the design and results of this survey and the implications for forest management in B.C. But first, in order to place this survey in context, some important background is required.

In the past five years, the emphasis and directions in forest pest management have been rapidly changing in British Columbia.

The first major change was in 1978 when the provincial government enacted new forest legislation. Of particular significance to pest management was a requirement for the B.C. Ministry of Forests, being the proprietor of 95% of the productive forest land in B.C., to periodically complete a

comprehensive Resource Analysis. The first Resource Analysis, in 1979, pointed to large volumes of wood being lost to forest pests.

The second major change was in 1980. As a response to a recognition of alarming pest losses, the Ministry of Forests appointed a staff of pest management specialists in the Victoria headquarters and pest management coordinators in each of the province's six forest regions. Although the Ministry had responded to pest problems in the past, this marked the beginning of an intensive and officially recognized pest management program.

A third major change has been developing less perceptibly, but no less forcibly: namely, an increasing emphasis on the quantification of losses due to pests and the potential benefits that can be realized from pest management.

This latter change is important for two reasons.

Firstly, the magnitude of forest pest losses are often not apparent. In the past, forest managers responded to "dramatic" pest problems such as a hillside suddenly turning red or brown from a defoliator or bark beetle attack. These types of losses are still of concern, but more precise quantification of pest losses is now demonstrating that some of our biggest problems are due to the insidious pests such as the dwarf mistletoes and the root diseases. In fact, in coastal B.C. we now realize that one of the largest opportunities for enhancing forest productivity is through the management of root diseases. In other words, an emphasis on quantification of pest losses is changing our perception of pest management opportunities.

Economics is the second reason that quantification is important in pest management. In order to meet established production targets in the short

and long terms, harvest rates and utilization standards must be regulated, denuded areas must be reforested, preferably with the best species and provenance for the site and with superior genetic stock, young stands must be tended for stocking density, brush encroachment, nutritional requirements and stem quality, and losses to fire, insects and diseases must be minimized. There are many things we can do to maintain or enhance forest productivity and thereby meet our production targets. But we cannot do them all on every hectare of forest land; it costs too much. The challenge is to optimize the blend of forest management options to meet our objectives with the least cost. In British Columbia, this task, the Yield Analysis Process, is assisted by several computer models. To some extent, it becomes a number crunching exercise. The importance for pest management is that the losses to pests and the potential benefits from pest management must be weighed, on a quantitative basis, using credible data, against other forest management options. This is a significant change in emphasis from the "react to visible drama" approach to pest management. Pest management now has to demonstrate its cost effectiveness, and cost effectiveness is a central principle of forest economics.

It is in this context that the root disease survey outlined in this paper came to life.

Survey Design

In the spring of 1982, the Ministry of Forests, in cooperation with colleagues in the Canadian Forestry Service (Bloomberg, 1983), began an extensive, computer assisted survey to determine the distribution and impact of laminated root rot, Phellinus weirii (Murr.) Gilbertson, and several other

root diseases¹ in coastal Douglas fir timber types. To date, the field work has been recently completed and the survey data are undergoing intensive analysis.

Although the survey may later be expanded to other timber types and to other areas of the province, so far it has been limited to coastal Douglas fir for two reasons:

1. Judging from reports prepared by Canadian Forestry Service colleagues (Wallis, 1976; Morrison, 1979; Hunt and Morrison, 1980; and Morrison, 1981) and from the B.C. Ministry of Forests 1979 Resource Analysis report, root diseases in Douglas fir stands, largely due to laminated root rot in particular, were estimated to be one of the largest pest concerns in coastal forests. Before a treatment program could be organized, let alone justified, a detailed and intensive survey was required.²
2. Second growth stands are best for root disease surveys, and the south coast of B.C. has extensive stands of second growth Douglas fir. It is possible to survey for root diseases in old growth forests, but the characteristic disease centres, or pockets, are less distinct. Besides, treatment for root diseases involves the prevention of disease losses in second growth stands. For old growth stands, it is too late to treat.

When the survey project was being designed, it was recognized that root diseases could not be surveyed from the air with the required degree of

¹Other root diseases surveyed: Armillaria mellea Vahl. ex Fr., Fomes annosus (Dr.) Cke., Verticicladiella wagenerii Kend., Phaeolus schweinitzii (Fr.) Pat.

²Wood, P.M. 1982: Vancouver Forest Region Five Year Pest Management Plan. B.C. Ministry of Forests, unpubl. rept.

precision. The only recourse, therefore, was to survey from the ground. Yet with more than one million hectares (two and a half million acres) of Douglas fir timber type in the south coast of B.C., the feasibility of surveying all of that area from the ground was impossible. A sampling system had to be devised.

The final choice of design was a series of randomly selected survey plots. Each plot was twenty hectares (fifty acres) in size, and approximately three hundred plots were surveyed for a total of six thousand hectares (fifteen thousand acres) of intensive surveying. The random plots were stratified to proportionally sample the following types of Douglas fir stands:

1. pure Douglas fir (F), and Douglas fir - western hemlock (FHw) stands,
2. four age classes of second growth stands ranging from twenty to one hundred years old,
3. good, medium and poor site qualities, and,
4. the above types of stands in two biogeoclimatic units: the Wetter Maritime Coastal Douglas-fir (CDFb) and the Drier Maritime Coastal Western Hemlock (CWHa), being the predominant Douglas fir producing areas of coastal B.C.

In each of the twenty hectare survey plots, specially trained forestry crews recorded the incidence and type of root disease, using a survey method called the Intersection Length Method of surveying for root diseases (Bloomberg, et al, 1980). The crews also conducted inventory plots to confirm the timber typing and recorded ecological data for later studies to determine correlations between root disease incidence and eco-associations.

Data from each plot was later analyzed by computer to provide the percentage of area visibly affected by each species of root disease.

Preliminary Results

Further data analysis is required to verify the levels of disease recorded and to determine if there are significant differences among the various types of fir stands examined.

Preliminary results, however, indicate an unexpectedly high level of root disease. Eighty-seven percent of pure Douglas fir and seventy percent of Douglas fir - western hemlock stands contain some amount of Phellinus weirii. The average infection level (above ground, visible damage, percent area) for Douglas fir stands nearing rotation age is over ten percent. Infection levels in fir-hemlock stands are only slightly lower. It also appears that good and medium sites have higher levels of infection than poor sites.

Other root diseases were also observed, but at lower levels. Average infection levels for Armillaria mellea, Fomes annosus and Verticicladiella wagnerii are each less than two percent.

Implications for Forest Management

The concept of root disease control, as one of the best opportunities for coastal forest management in general, is the overwhelming implication resulting from this survey. Until fairly recently root diseases were generally considered to be an unfortunate but rather minor fact of life. This survey has now confirmed our suspicion that root diseases are a major problem, or rather, a major opportunity.

Incidentally, this question of whether root diseases are a "problem" or an "opportunity" is not merely semantics. We are not certain if our forest

inventory has already accounted for root disease losses. If not, then the results of our survey point to a serious overestimate of predicted forest growth. Our current opinion, however, is that inventory figures do account for most root disease losses, which means that any effort to fill in future root disease pockets will be a direct enhancement of forest productivity.

In this latter context, the figures generated from the survey can be used in yield analysis models which will compare the opportunities available from root disease management against those from other forest management options that enhance productivity. This will provide the basis for selecting an optimum blend of options to meet established production targets and to help mitigate anticipated problems such as projected future timber supply shortages.

To illustrate these ideas, the Quadra Timber Supply Area, from south coastal B.C., can be used as an example. This Timber Supply Area has four hundred thousand hectares (one million acres) of productive forest land, thirty-five percent of which is forested in Douglas fir predominant timber types. At the current rate of harvest and if no intensive forest management were practised, it is possible that a timber supply shortage could be manifested in thirty to forty years. Intensive forest management is being practised in this Area, however, and root disease control is one of the options. Using preliminary figures from our root disease survey, we have been able to project a potential long term productivity enhancement of four percent for the entire Timber Supply Area. An added advantage is that this additional wood volume could be delivered when it is most needed: at the time of potential timber supply shortfall.

It is likely that similar scenarios could be developed in other areas of the province, especially in the interior regions.

The only remaining problem is how to control root diseases. And there is the rub. Present techniques are problematic. Early rotation and commercial sanitation thinning may recover some losses, but will not reduce disease levels. Removal of infected stumps from the ground is possible on some sites but is expensive and tends to damage the soil structure. The potential use of fumigants is still in the experimental stages. Our most feasible option is to plant resistant or less susceptible species of trees in the disease pockets. In B.C. we are particularly interested in the use of western white pine for this purpose.

Given the current state of the art in forest root disease management, the results of this survey will likely provide a strong impetus for continued research.

In British Columbia we are optimistic. This survey has demonstrated that large volumes of wood are being lost to root diseases. Rather than wringing our hands in worry, we view the prevention of future losses as an excellent opportunity to enhance forest productivity and to help alleviate anticipated wood supply shortages in the future. Our root disease survey has been a critical first step.

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PAPER NO. X

THE 1980'S: THE DECADE OF KEY PROGRESS
IN INTEGRATED FOREST PEST MANAGEMENT
IN BRITISH COLUMBIA

by

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Paper presented at the Media Centre, Vancouver, B.C., at the Fourth Annual Meeting of the Professional Pest Management Association, February 24, 1984.

THE 1980'S: THE DECADE OF KEY PROGRESS
IN INTEGRATED FOREST PEST MANAGEMENT
IN BRITISH COLUMBIA
by: H.G. Doerksen

First of all, for those of you who don't know me, I am not an entomologist or a pathologist. I am a layman who, as Director of Forest Protection for the British Columbia Ministry of Forests, has the primary responsibility for forest pest management. We have built up within the Branch, however, the cadre of an expert manager, entomologist, pathologist and pesticide specialist who I will call upon today if it get into expert difficulty.

Secondly, becoming a speaker due to other commitments by lead speakers allows one a certain latitude which I plan to use.

Third, taking this allowed latitude immediately, I would remind your group that you have had my money and application for membership for some time. I hope the contents of my paper will not be detrimental to my admission to your group. Seriously, I will consider it an honour and a privilege to be associated with your organization.

It is critical early in any address to establish a tone and I am going to use one I read recently in a 1930 cookbook of my mother's. Quote: "An optimist is wrong as often as a pessimist, but the optimist has a hell of a lot more fun." I am going to be the optimist.

Before anyone can go charging off into progress in the 1980's, it is worthwhile to briefly review the history of the Ministry of Forests and pest management in British Columbia.

The British Columbia Forest Service was established in 1912 for two primary purposes. To sell timber and to protect the forests from the ravages of forest fires. Forest fires were dynamic and even the early settlers who saw a province full of never ending timber recognized the disasters that fire could cause. It is quite easy to understand that forest management practices such as reforestation and pest management would be of little concern when it appeared as though British Columbia was a vast sea of never ending forests. It is probably fair to say that the true biology of these massive forests was really not that well understood until relatively recently and we still have a lot to learn.

Early efforts at pest management were left primarily to the federal government under the Canadian Forestry Service. Some specific provincial problems such as the eastern spruce budworm were dealt with by the provinces.

The decades of the 1960's and 1970's began to alarm and shock many in the forestry professions into the realization that our forests were indeed finite and unless basic and intensive forestry practices were implemented quickly, we would face early drastic shortfalls in timber supply in some areas. It became abundantly clear that our forests could no longer stand man's depletion in addition to that caused by nature in fire, insects and disease and drastic early corrective action was required. This meant an urgent emphasis on basic and intensive forestry practices which included strong integrated pest management programs.

Up until 1978 when new forestry legislation was enacted, the B.C. Ministry of Forests continued to rely heavily upon the Canadian Forestry Service for advice on insect and disease problems. This organization has

always responded extremely well, but are also severely restricted in manpower and transportation resources. The total provincial full time staff assigned to pest management was one forester and a part time assistant.

As Mr. Paul Wood pointed out in a recent address to the 74th Western Forestry Conference, the 1980's decade of key progress in pest management in British Columbia began in 1980. "It was in 1980 as a response to a recognition of alarming pest losses, the Ministry of Forests appointed a staff of pest management specialists in the Victoria Headquarters and Pest Management Coordinators in each of the Province's six forest regions. Although the Ministry had responded to pest problems in the past, this marked the beginning of an intensive and officially recognized pest management program." Dedicated staffing then was increased to 12 people from the one lonely forester and his assistant. This also established provincial leadership in Canada in attempting to dedicate sufficient staff to begin to practice good integrated pest management at a provincial level.

It is also very important to recognize and appreciate the task and problems that faced this cadre of pest management specialists at this time and remember we are only talking about 1980. Every task they had was red rush tagged number one priority. I am sure that some days Dr. DeBoo must have thought we held the marketing concession for red tags. Indeed one staff member became affectionately referred to as red tag Henigman. What were some of the priorities?

1. There was no official policy or guidelines. Priority was to get it done without any good models to work from.

2. Pine, which had been considered a weed species until relatively recent years, had reached an overmature state in most regions and was being subjected to epidemic attacks of mountain pine beetle.
3. Spruce stands in the interior and northern areas of the Province were being hit by large-scale outbreaks of spruce beetles.
4. Foresters were being faced with severe plantation brushing problems and a lack of registered chemicals for treatment.
5. A vast variety of other problems such as tussock moth epidemics, black army cutworm in plantations, root diseases, mistletoes and you name it.
6. Lack of a data bank to quantify what had happened or what to expect.

The staff has made remarkable progress, in my opinion, in addressing many of these key priority areas while remaining almost fully engaged in the various brush fire actions required because of emergency pest situations.

Our progress has not been without some major problems. We are trying to build an effective pest management organization right into the teeth of what has been a major world, Canadian and provincial economic downturn. It is important to recognize, however, that throughout the various restraint measures, we have been able to maintain our key pest management core staff. A core staff, however, is not sufficient to solve our multitude of problems in pest management. More Ministry staff resources will be required at the district levels to be dedicated to pest control. More contract control efforts will be required. The costs of this increased emphasis on pest management are insignificant when compared to the economic losses our limited forests are suffering from insects and disease. Consider, for example, that we log perhaps 150,000-200,000 ha per year and the pine beetle is currently

harvesting over 400,000 ha in one region. Consider end product value losses of \$370 million a year to insects and disease. The benefits of an aggressive integrated pest management program become obvious.

Currently each Regional Protection Branch staff will now have a Pest Management Coordinator and a qualified professional pathologist and entomologist. Preliminary indications are that at least an additional 17-20 FTE's will also be dedicated at the district levels. For those of you uninitiated into current staff terminology, an FTE is a full time equivalent or 1 person for 12 months.

Those of us in this room and those of us in the Ministry are aware of the priorities and the tremendous workload ahead to accomplish what is required to make the 1980's the decade that brings pest management charging into the rightful position in forest management. Before I gaze into the crystal ball to predict what I see happening in the 1980's, I would like to suggest to you some responsibilities your entire association has to ensure we reach our goals.

I used to have discussions with my brother who was a member of your profession and he always commented on the lack of public understanding of your profession as a whole. This continues to be true to this day. Public education is a problem and your profession must become very active in solving this problem. It is time for many of you to stop being almost apologetic about your profession and ensure you get your rightful position and hearing in forest management. Ask yourselves some questions.

1. Have you tended to live in a closet atmosphere, preaching to the already converted such as this audience?

2. A Mount St. Helens created international notoriety partly because of timber loss. Have you ever tried to compare what the mountain pine beetle has done in the U.S.A. and British Columbia? Although Mt. St. Helens was dramatic, the timber lost in comparison to that lost to mountain pine beetle alone, regardless of other pests, is peanuts.
3. Do you tend to produce tidy scientific publications and let them die without ensuring the public has the full meaning of the impact? Factual data such as 43.7 million pine trees were killed over 462,150 hectares in 1983 alone. That's over two Mt. St. Helens in one year and can you envision 43.7 million pine trees? How many houses would that build? Ask yourselves the question if you can deliver these messages more forcefully.
4. Do you entomologists really believe that British Columbia will escape the migration of the gypsy moth? Should we be preparing the public, not in panic, but in reality for what may be expected and what controls will be effective?
5. What are the impacts of the spruce bark beetle, weed complexes, the black army cutworm, the dwarf mistletoes, various root diseases, and other damaging agents on forest values?

You have a professional responsibility to step out and become positive and aggressive with your other colleagues in forest management and ensure that the public becomes educated in layman terms with the pest management problems.

Now what are some of the things I see in my crystal ball that will happen in this key decade.

1. Integrated pest management will become a reality. That is, integrated into forest management plans in all timber supply areas will be total pest management as it impacts annual allowable cuts, aesthetics, parks, wilderness areas and British Columbia as a province.
2. We will have a detection, initial attack and suppression system for pest management not unlike the system that currently exists for fire suppression.
3. Instead of pest management by crisis, we will be managing on a predictive system. Instead of suddenly finding ourselves in the middle of a tussock moth epidemic, we will be predicting it two years in advance, perhaps seeding virus at the appropriate time and perhaps eliminating the need for chemical control except for the preservation of isolated aesthetic values.
4. The public will become educated to the reality of what massive insect outbreaks such as the mountain pine beetle can do to an overmature pine forest. They will accept our recommendations for harvest over areas such as the Akamina and Kishinena are based on a predicted loss of the stand and not industry's hunger for more timber.
5. The public will be educated to expect that if you create large reserves of wilderness or parks involving mature pine, you must expect it to be eventually harvested by the pine beetle unless we discover some new control method. This natural harvest will then be followed by a cleansing fire. The key is that we must predict these events so the public can be aware of what to expect and not blame us for mismanagement.

6. Plantation protection from other vegetation will be developed into acceptable practices by a range of publicly accepted chemicals and alternative site treatments.
7. A data bank of pest problems and history will be established to allow full predictive capability and integrated forest planning.

In closing, I would repeat a statement I made to your colleagues at the Western Forestry Conference two years ago. The era of true forest pest management in British Columbia has arrived. The decade of the 80's is your opportunity. Your group can and will face the challenges and take its rightful place as a full-fledged partner beside key forestry activities such as harvesting, silviculture and fire suppression.

PAPER NO. XI

PEST MANAGEMENT: ITS CONTRIBUTION TO
THE FUTURE OF FOREST MANAGEMENT IN B.C.

by

P.M. WOOD, R.P.F.*

*Representing Association of B.C. Professional Foresters. Presented at Annual General Meeting of Professional Pest Management Association of B.C., 24 February, 1984, Vancouver, B.C.

PEST MANAGEMENT: ITS CONTRIBUTION TO
THE FUTURE OF FOREST MANAGEMENT IN B.C.
by: P.M. Wood

Our forests are in trouble. A week ago, the Association of B.C. Professional Foresters met at the Holiday Inn in Vancouver for its annual general meeting. The theme of the three day meeting was: "Our Forests in Crisis." We had speakers talk about marketing and world competition, the economics of wood supply, the availability of people to do a competitive job, and the outcome of future capital investments, we had competitors from the southern U.S. pine region, Sweden, and New Zealand talk about what they are doing. "Our forests in crisis" is a topic of great concern to foresters in B.C. and the reason largely boils down to timber supply.

Timber supply is the central issue in forest management in B.C. As we continue to harvest our heritage of old growth timber, and attempt to replace it with successive crops, foresters can foresee a number of problems. For example, second growth timber, rotated on 60 to 100 year cycles, cannot be expected to have the same wood volumes as the 300 or 400 year old stands of old growth that we are currently logging. Not all the old growth that is being logged is being replaced with new crops. There are already 1,000,000 hectares of not satisfactorily restocked (NSR) forest land in the province and that area is increasing.

The forest land base upon which the annual allowable cut is predicated, is shrinking at an alarming rate due to urban expansion, highway corridors, parks and hydro reserves. And in some timber supply areas, the old

growth is being liquidated faster than expected because of bark beetle epidemics.

The net result of these problems is that there is a projected timber supply deficit in the near future in almost every area of the province. This is what we call the "falldown effect." It threatens jobs, community stability, industrial investment, and the government revenue upon which this province is dependent.

But: There are a number of options available to help mitigate the falldown effect. My main point in this presentation is that pest management is one of the best of those options, and that its full potential has not yet been generally recognized.

For the purpose of this discussion, I would like to divide forest pests into three categories:

1. The big epidemic pests which mostly attack old growth, such as the mountain pine beetle, the spruce beetle and some of the defoliators.
2. The pests that damage young second growth stands such as the leader weevils, the root collar weevils, some of the gall rusts, and competing vegetation.
3. The insidious and continuous pests which pervade most young and old growth stands, such as the root diseases and the dwarf mistletoe.

1. Large Epidemics of Old Growth Pests:

Perhaps the best examples in this category are the recent (and current) epidemics of mountain pine beetle and spruce beetle in the interior regions. The extensive mortality of pine and spruce has effectively

written the future of some timber supply areas. There are going to be timber supply shortages because there won't be enough old growth available before the second growth comes of age.

The A.B.C.P.F., in a forest memo to the Province's M.L.A.'s, stated:

"Between them, the mountain pine beetle and the spruce beetle have destroyed hundred of thousands of hectares of prime B.C. forest and threaten many more. They have infested an area almost five times as large as the total area logged in the Province last year. If all of the wood they have destroyed since 1979 could have been exported instead, the total value would have exceeded \$6 billion.

They are the number one forestry problem in the B.C. interior."

In all fairness, there is probably no one in the province who could have predicted that the problem would become as large as it has. Nevertheless, the Government, as the proprietor of 95% of the forest land in the Province, has been slow to react to this emergency situation. In 1981, the Provincial Government committed \$11.4 million for emergency bark beetle control. This was largely to be used for road construction to access infested stands so that they could be sanitation logged.

It was also to be used for detection and mapping efforts. Unfortunately, for the most part, this effort was too little, too late. And then, under the umbrella of restraint, the Government removed \$4 million partway through the project. In the same forest memo to the M.L.A.'s, the A.B.C.P.F. wrote:

"Professional foresters in B.C. recognize the need for restraint. It is possible to mark time with some aspects of forest management. Spacing and fertilizing programs, for example, can and have been put on hold for awhile."

"But marking time with pest control is akin to trying to save money by not calling the fire department to put out a fire. It is an economy we simply cannot afford."

The technology for effective bark beetle control is already in place. Inadequate funding is the main limiting factor. In a brief to Hugh Curtis, the Minister of Finance, presented exactly one month ago on the 14th January, the A.B.C.P.F. outlined four areas that require the highest priority for forestry expenditures in B.C. Pest management is one of them, largely because of the interior bark beetle problems. In the same brief, the A.B.C.P.F. recommended:

1. That a new federal/provincial agreement is needed for forestry expenditures in B.C.
2. That Section 88 financing (which is the Provincial Government's credit to stumpage method of reimbursing forest companies for their investments on Crown forest land), be given some flexibility to allow for redistribution of stumpage revenues within the Province.
A lack of flexibility in the past has created severe limitations to expenditures in areas where they are most needed.
3. That in special employment programs such as E.B.A.P. and Canada Works, forestry programs be specifically included.

4. That new methods of funding are required. The A.B.C.P.F. is in the process of coming up with some new ideas.

I don't mean to leave you with the impression that lack of funding is the only limitation to effective bark beetle control.

In another forest memo to M.L.A.'s, the A.B.C.P.F. said that:

"Industry must be directed immediately into currently infested areas, resulting in wholesale changes to logging plans. All agencies must work together to give quick approvals to revised plans. Poor lumber markets cannot be allowed to stop sanitation and salvage logging. Government incentives such as reduced stumpage rates or marketing assistance may be required. Detection and mapping efforts must be increased to allow for the most effective planning. Coordinated research in Canada and the United States into alternative methods of control must be stepped up. Reforestation capabilities (increased nursery capacity, planting budgets, training of forestry personnel) have to be intensified."

What this all means is that the ability to be able to effectively respond to epidemics of bark beetles and some defoliators is going to be one of the biggest future challenges to forest pest management in B.C.

2. Plantation Pests:

The second category of pests are those that damage young plantations. The importance of young plantations cannot be overemphasized. Not only do we depend on them for future wood supplies, but the current rates of harvest (i.e. the annual allowable cuts) are predicated on the expected rates of growth of these younger stands.

The maintenance of productivity on these stands, I believe, is about to become the subject of the single largest effort and challenge in forest pest management in B.C. One only has to look at the damage the sitka spruce weevil has done to thousands of hectares of sitka spruce on the coast and then at the millions of spruce seedlings that are being planted in the interior, to realize that we are sitting on a potential bomb.

3. The third category of pests, the insidious root diseases and dwarf mistletoes that don't wipe out, but slowly erode the productivity of stands, have less obvious implications. For the most part, the losses due to these pests are already incorporated in our forest inventories. They have always been with us as "background losses." The root diseases, for example, with their characteristic "pockets" or holes in the forest cover, have always produced "swiss cheese" forests. But we've never expected anything more than swiss cheese forests. We are now beginning to realize that with careful manipulation of forest cover and conscientious stand tending practices, we can significantly reduce the incidence of these pests and, thereby, actually enhance the productivity of our second growth stands. This opens a whole new dimension in forest pest management; we can grow more wood than we ever expected to grow.

Finally, I would like to draw attention to a very significant change that is occurring in forest pest management. Namely an increasing emphasis on quantification of losses due to pests and the potential benefits that can be realized from pest management.

This change is important for two reasons.

Firstly, the magnitude of forest pest losses are often not apparent. In the past, forest managers responded to "dramatic" pest problems such as a hillside suddenly turning red or brown from a defoliator attack. As I have pointed out, these types of losses are still of great concern, but more precise quantification of pest losses is now demonstrating that some of our biggest problems are due to the less obvious plantation and second growth pests that I was just mentioning. In other words, an emphasis on quantification of pest losses is changing our perception of pest management opportunities.

Economics is the second reason that quantification is important in pest management. In order to meet established timber production targets in the short and long terms, harvest rates and utilization standards must be regulated, denuded areas must be reforested, preferably with the best species and provenance for the site and with superior genetic stock, young stands must be tended for stocking density, brush encroachment, nutritional requirements and stem quality, and losses to fire, insects, and disease must be minimized. There are many things we can do to maintain or enhance forest productivity and, thereby, meet our production targets. But we cannot do them all on every hectare of forest land; it costs too much. The challenge is to optimize the blend of forest management options to meet our objectives with the least costs. To some extent this becomes a number crunching exercise. The importance for pest management is that the losses to pests and the potential benefits from pest management must be weighed, on a quantitative basis, using credible data, against other forest management options. And this is precisely the point where, I believe, pest management will begin to show its true colours. When all the numbers are in, pest management will prove to be one of the best options to avert a crisis in our forests.