

INTERIM GUIDELINES
FOR THE MANAGEMENT OF SITKA SPRUCE WEEVIL
IN THE VANCOUVER FOREST REGION

By

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SUMMARY

Infestations of the spruce weevil have become so severe in many areas of high value Sitka spruce sites in the Vancouver Forest Region that successful crop growth may not be possible if control efforts are not immediately pursued. The interim guidelines presented in this report are an attempt to assist forest managers to meet the need to act quickly on the spruce weevil problem by outlining the potential alternatives and decision making criteria required to manage weeviled stands. The guidelines are presented in the form of a flow chart on page 8 which outlines the procedures and steps required to ensure natural productivity on sites threatened by spruce weevil attack.

Prior to any consideration of weevil control, the guidelines stipulate that each stand must be assessed for the acceptability of growing stock and whether the acceptable stock meets at least the minimum stocking standards.

Although leader clipping of weevil infested stems is the major control referred to in the guidelines, there are several situations where it is not suitable for attaining the required objectives of basic forest management. Insecticide treatments have some potential

SUMMARY (Cont'd)

for success and the forest manager is urged to consider operational control trials in high priority areas where leader clipping is either not feasible or infestation intensities are such that it would not be effective.

INTRODUCTION

The spruce weevil*, Pissodes strobi (Peck) is a destructive insect pest of young Sitka, white and Englemann spruces in British Columbia. The terminal shoots of young trees are the primary targets of weevil attack where broods from a single female can effectively kill 2 years of height growth. Trees repeatedly weeviled develop into multi-topped, crooked, bushy shrubs of little or no economic value (Belyea and Sullivan 1956), thereby eliminating the preferred qualities of prodigious growth and excellent structural characteristics of our native spruces. Since weeviled trees are not killed, they continue to occupy the site, competing with and suppressing other potential crop trees.

The risk of weevil attack in high value Sitka spruce sites in the Vancouver Forest Region has become so severe that successful crop growth in many areas may not be possible without sound control and/or preventive measures. Approximately 20 000 ha of spruce regeneration in the Vancouver Forest Region are either being attacked or are in danger of attack by the spruce weevil. Young even-aged Sitka spruce stands, either currently infested or at a high risk of becoming so, occupy 25% of this area and may be lost to the weevil if management efforts are not immediately pursued. The remaining spruce stands are either still too young to be attractive

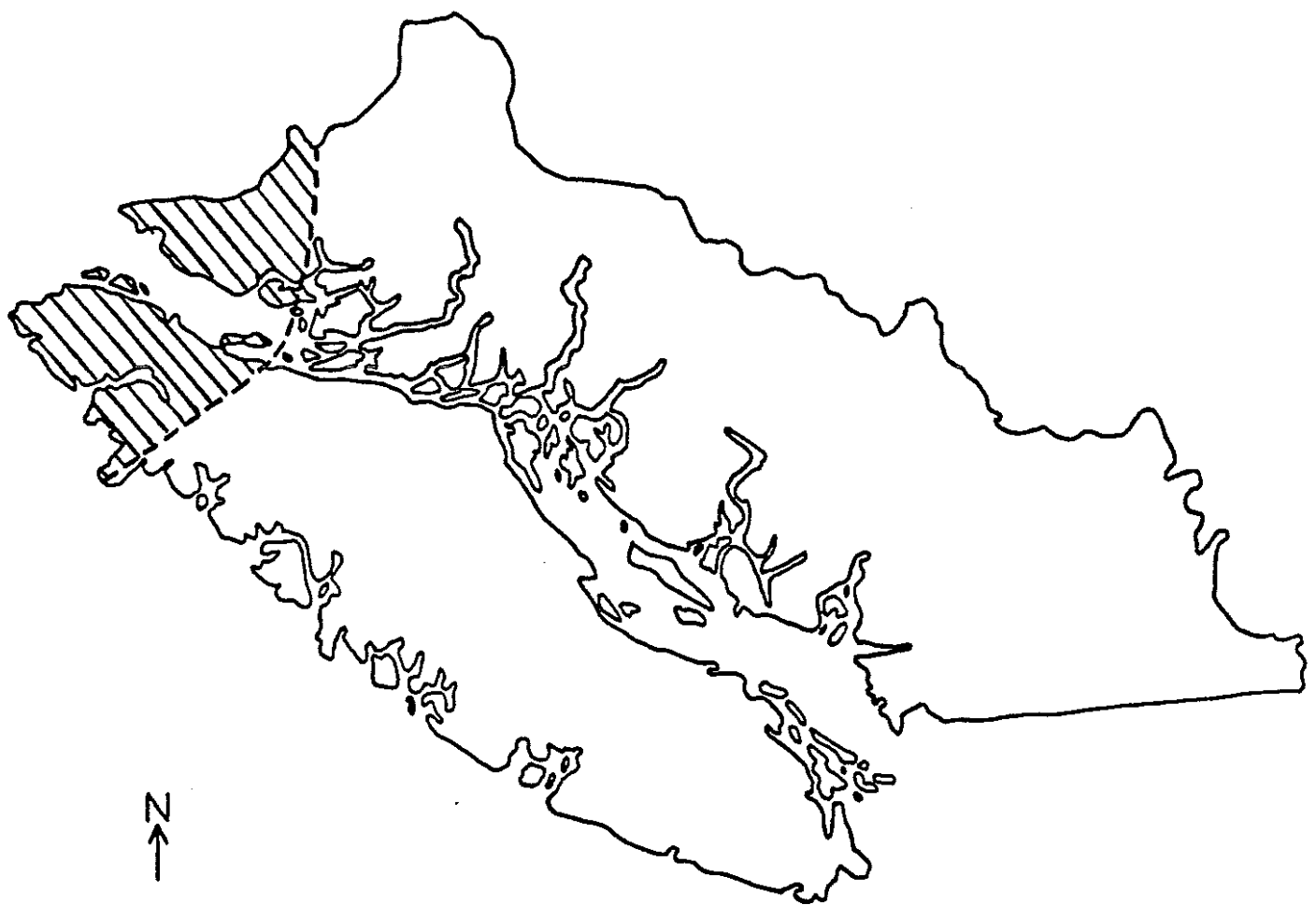
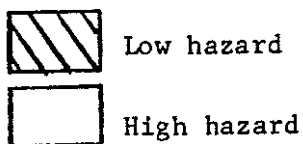
* Spruce weevil is the popular common name for Pissodes strobi in British Columbia. White pine weevil is its common name in eastern Canada where its major host is eastern white pine.

to the weevil or are in cool, coastal zones which appear, at present, to be outside the weevil's preferred range. This report attempts to meet the need to act quickly on the spruce weevil problem by incorporating the available information on the management of weeviled spruce stands in a set of interim guidelines.

The alternatives and decision making criteria presented in these guidelines are designed for the management of spruce weevil in existing areas of Sitka spruce regeneration. The initial requirement for their use is a stand assessment survey, such as a regeneration survey, which supplies information on species composition, stocking density and growth appraisal. The Vancouver Forest Region has developed a survey system for spruce weevil (see Appendix 1) which consists of a 10 m wide strip sample covering a minimum of 5% of the area to be surveyed. This survey also requires the regular placement of 1/100 ha circular plots to determine the stocking if not already done.

The purpose of the survey is to establish a strong data base which includes individual stand characteristics and information regarding the threat of weevil damage. The weevil survey was initially performed region-wide in 1982-1983 with the hope of establishing a correlation between site factors and weevil incidence to devise a hazard rating system for future spruce plantings. The hazard map, Figure 1., was prepared from the preliminary analysis of the survey

Figure 1: Map showing hazard ratings for risk of spruce weevil attack, Vancouver Forest Region



Note: Mid Coast District has not been surveyed
Verbal reports indicate low hazard on
coastal (west) portion of District and
high hazard on transitional (east)
portion of district.

data. This data base is essential and must be continuously updated if effective and optimal allocations of future expenditures are to be made when funds become available.

MANAGEMENT OBJECTIVES

This report has selected as the target objectives for managing spruce weevil in Sitka spruce, that the stand must meet at least the minimum stocking standards and that the spruce component must consist of non-weeviled, well spaced dominants and co-dominants greater than 10 m in height. Prior to the attainment of this 10 m height objective, stands are considered to be in jeopardy of becoming not satisfactorily restocked (NSR) due to weevil damage. The minimum stocking densities referred to are those shown on the stocking guides for biogeoclimatic zones in which Sitka spruce may be a major stand component (see Appendix 2). The 10 m height objective is based on inferences from several years of spruce weevil research which suggest weevil attack incidence dramatically falls off once the stands reach this height (McMullen 1976, Marty and Mott 1964, Overhulser and Gara 1975). The 10 m of weevil-free stem should also provide an acceptable merchantable product at stand rotation. Another purpose for the 10 m objective is infested stands over this height are more difficult and costly to treat by leader clipping, the major control technique currently available for use. The major objective of the leader clipping option is to buy time, by holding the weevil population in check until other more effective control measures are developed. The leader clipping experience of

the Ministry of Forests on Nootka Island, started in 1979 (Jeklin 1980), has shown that this technique alone can limit weevil damage to acceptable level, for 'basic' management objectives, up the point where the stand reaches 10 m in height.

The 'basic' stand management objective as determined by the B.C.M.F. is to ensure the "maintenance of the natural productivity of accessible forest sites" (W. Young, Chief Forester, in 1982 memorandum). Natural productivity is the historic growth performance modelled by empirical volume over age curves. Basic forest management refers to the responsibilities of forest land managers in attaining the goal of natural productivity. It is estimated, for the purpose of these interim guidelines, that future weeviling will not significantly affect the natural productivity of Sitka spruce stands which are satisfactorily stocked at 10 m in height.

STAND COMPOSITION

These guidelines have initially been developed for application to the many hectares of pure, even-aged Sitka spruce regeneration susceptible to weevil attack. This does not, however, exclude their application to mixed stands. On its preferred sites, Sitka spruce will quickly outperform its associates, but if any weeviling is present the resulting bushy growth will further impede the performance of other potential crop tree species. The attainment of natural productivity over an acceptable or optimal rotation may be

jeopardized by the persistence of weeviled Sitka spruce trees even if other species satisfy the stocking requirements.

Weevil management is not required in mixed stands that are satisfactorily stocked with non-spruce species. Other management procedures in these stands, however, should carefully consider weevil activity to avoid falsely relying on any Sitka spruce stock present within the stand. In addition, mixed stands with minor Sitka spruce components often support large numbers of weevils which may be a threat to any adjacent Sitka spruce stands. Juvenile spacing or sanitation thinnings with priority removal of Sitka spruce may aid in ensuring basic management objectives by promoting non-spruce crop trees to the upper canopy classes with a minimal delay.

Some weeviled trees may appear to recover and become potential crop trees. Past documentations, however, suggest that these trees are not suitable for commercial purposes. Marty 1959, reports serious lumber degrade and major losses in recoverable volume due to weevil attack. Belyea and Sullivan 1956, reported large knots and brittle, badly checked compression wood associated with weeviling. Morrow 1965, estimated a 60-70% loss in potential height growth with each weevil attack and Brace 1972, calculated a 25% reduction in commercial value of the lumber recovered from weeviled stands. These findings, plus suggestions by individuals who have many years of experience working with Sitka spruce, influenced the decision to exclude all weeviled trees from the satisfactory stock used in

these guidelines. In addition, the Minimum Stocking Standards for Crown Forest Land (Appendix 2) are such that a weevil attacked tree would not meet the requirements for acceptable regeneration.

MANAGEMENT GUIDELINES

The flow chart for spruce weevil management on page 8 is the focal point of this report and presents a guide for managers to aid in decision making and priority assessment of operations in Sitka spruce stands. The following is a description of the use of the flow chart and a discussion of the decisions required to proceed through it.

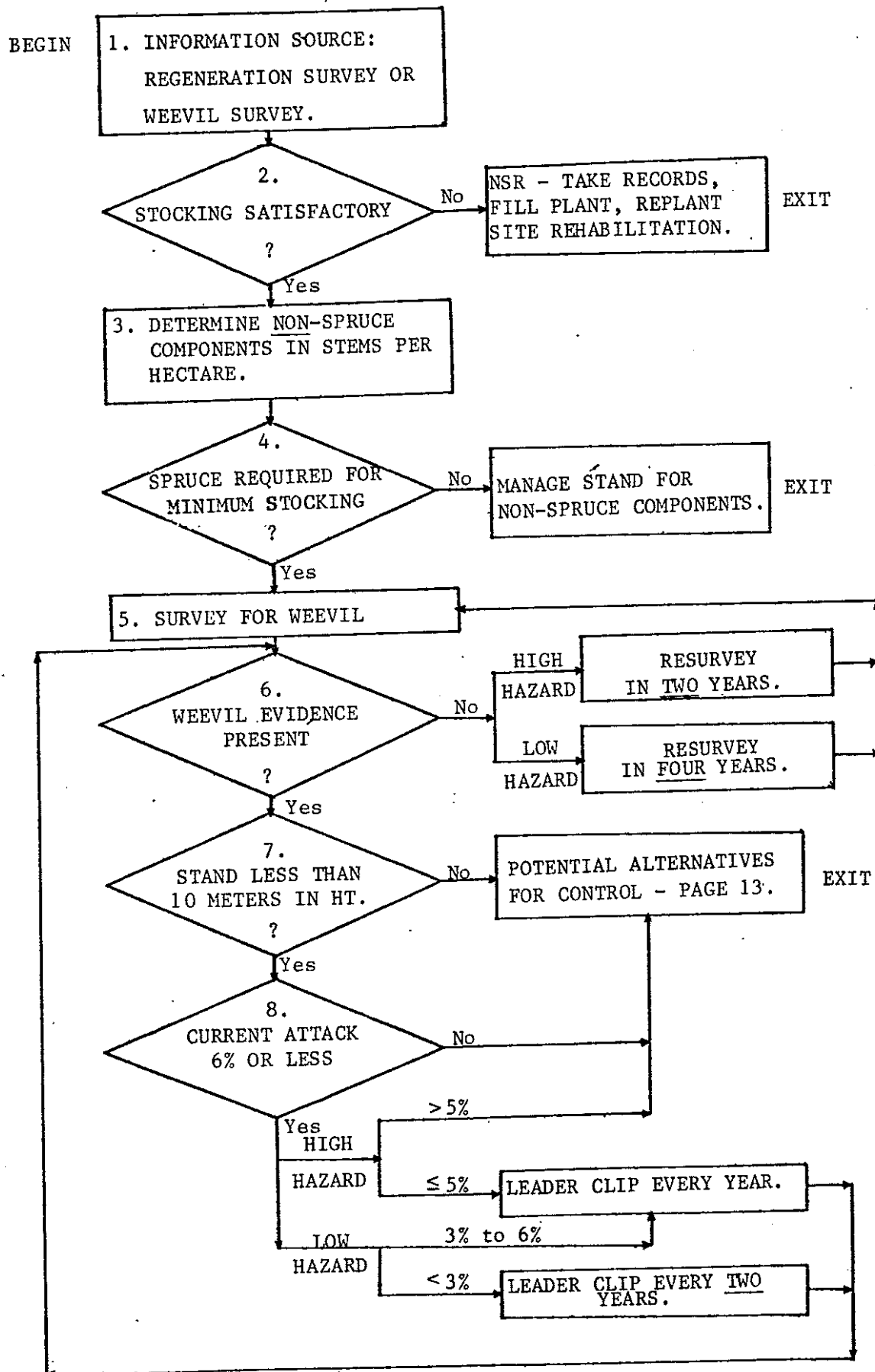
1. INFORMATION SOURCE

The primary requirement for use of the flow chart is stand characteristics information of the type contained in regen survey (or weevil survey) reports.

2. STOCKING SATISFACTORY

The minimum stocking standards for each biogeoclimatic zone are listed in Appendix 2 and refer to acceptable well-spaced and free-to-grow trees only. The requirements for acceptable trees as presented in the Minimum Stocking Standards for Crown Forest Land are included at the back of Appendix 2. Refer to these guides and proceed with your answer to the stocking question; NO or YES.

Figure 2: A flow-chart outlining the management guidelines for Sitka spruce stands threatened by spruce weevil attack.



NO: Stocking is not satisfactory, NSR, and the flow-chart exits here to other management options not within the scope of this report. It should be noted here, however, that good records of NSR sites are essential for informed decisions on backlog reforestation or site rehabilitation with regard to any potential threat from spruce weevil activities to future stands.

YES: Stocking is satisfactory
proceed to step 3.

3. DETERMINE NON SPRUCE COMPONENTS

Subtract the number of spruce, in stems per hectare, from the total stock to determine the non-spruce component and compare this value to the minimum stocking guide. Proceed to 4.

4. SPRUCE REQUIRED FOR MINIMUM STOCKING?

With the stocking guide determine whether the spruce component is required to meet the minimum stocking standard and proceed with answer attained; NO or YES.

NO: The site is satisfactorily stocked regardless of spruce performance and management decisions can be based on the other species present. The forest manager must be careful here not to jeopardize the natural productivity of the site by falsely relying on weevil susceptible spruce during any future actions planned for the site. Remember weeviled spruce trees

do not die, but continue to occupy the site and impede the development of other potential crop trees.

YES: The spruce component is required for satisfactory stocking and an evaluation of potential damage and/or loss to the stand from the spruce weevil is required. Proceed to 5.

5. SURVEY FOR WEEVIL

Conduct a weevil survey, as described in Appendix 1 to determine the threat of weevil activity to stand development. Proceed to 6.

6. WEEVIL EVIDENCE PRESENT?

Are there any trees at the site which exhibit the symptoms of recent spruce weevil attack? Proceed with answer as determined; NO or YES.

NO: Stands which do not exhibit evidence of weevil attack are to be periodically monitored until the 10 m height objective is reached. Refer to the hazard map on page 3 and determine the rating for your stand. For high hazard areas, where the potential for weevil attack and rapid population expansion is high, new survey data is needed every second year. Stands in low hazard areas need only be surveyed every fourth year.

YES: The stand is threatened by weevil activity which must be evaluated to determine management options. Proceed to 7.

7. STAND less than 10 m HT?

Calculate the average height of the satisfactory stock and determine if this value is less than or equal to 10 m. Proceed with answer obtained; NO or YES.

NO: Satisfactorily stocked, weeviled stands over 10 m in height do not require any further action. There may be situations, however, where the stand manager feels stocking levels are too low when there is still some threat of significant loss due to further weevil damage. Refer to POTENTIAL ALTERNATIVES FOR CONTROL on page 13 if alternatives to do-nothing are required.

YES: Use the spruce weevil survey data to calculate the ratio of currently weeviled spruce to all spruce and convert the result to a percentage of stems attacked. Proceed to 8.

8. CURRENT ATTACK less than 6%

Is the percentage of spruce stems attacked less than or equal to 6%? Proceed with answer; NO or YES.

NO: There are no currently proven controls available for stands with infestations greater than 6%. Nevertheless, some insecticide treatments suitable for operational trials in these stands are discussed in the POTENTIAL ALTERNATIVES FOR CONTROL on page 13.

YES: Determine from the hazard map on page 3 whether the stand is in a high or low hazard area.

High Hazard: Leader clip stands in high hazard areas which are currently harbouring spruce weevil infestations with less than 5% current attack by systematically clipping, removing, and destroying the recently attacked terminals prior to adult weevil emergence. Consult with M.O.F. district or regional office regarding method and timing. The leader clipping option must be performed every year until the stand reaches the 10 m height objective. Stands with greater than 5% current attack are not suitable for leader clipping and the manager is directed to the POTENTIAL ALTERNATIVES FOR CONTROL on page 13.

Low hazard: Leader clip every second year stands with less than 3% of the stems currently weeviled. Stands with infestations between 3% and 6% current attack rate require leader clipping every year in order to maintain the site's natural productivity.

Note: The hazard map on page 3 is only a subjective guide based on a preliminary analysis of the Vancouver Region Weevil Survey. Good knowledge of weevil attack may be able to refine the map.

POTENTIAL ALTERNATIVES FOR CONTROL

A. CHEMICAL CONTROL

The following is a priority listing of situations in which chemical insecticide treatments could be beneficial to weevil management;

- (1) Well stocked stands, with promising growth characteristics at an early age, in which weevil infestations exceed 6% current attack.
- (2) Stands with infestations greater than 5%, despite having received leader clipping treatments.
- (3) Stands greater than 10 m in height but with stocking close to the minimum acceptable level.
- (4) Where site specific conditions such as excessive brush, poor access or high stand density prohibit leader clipping.

Although there are not, are present, any insecticides specified for control of spruce weevil on Sitka spruce, there are four currently registered in the Woodlands Category use which may have some potential and should be investigated. Methoxychlor, carbaryl, chlorpyrifos, and acephate may all be effective and warrant use in operational trials as pre and/or post ovipositional sprays.

Chemical insecticides would be a very useful and promising tool for stand managers dealing with spruce weevil damage and as such there is a need for testing their operational use in the Vancouver Forest Region.

B. BIOLOGICAL, SEMIOCHEMICAL, AND HOST RESISTANCE CONTROLS

The Vancouver Forest Region is actively pursuing the development of these alternative control methods in conjunction with other M.O.F. groups, the University of B.C., Simon Fraser University and the Canadian Forestry Service. Biological control investigations are centering on the enhancement of predators and parasites and the field use of a pathogenic fungus Beauveria basiana. Semiochemical research has not, at present, been able to produce any operationally effective repellants or attractants although work is continuing in this regard. There are some promising indications for developing genetically resistant Sitka spruce trees. At present, none of the above mentioned investigations is suitable for operational trials.

- Belyea, R.M. and C.R. Sullivan. 1965. The white pine weevil. A review of current knowledge. For. Chron. 32:58-67.
- Brace, L.G. 1972. Weevil control could raise value of white pine by 25%. Can. For. Ind. 92:42-45.
- Jeklin, E.M.J. 1980. Management procedures for control of spruce terminal weevil on Nootka Island. M.O.F. internal report. Vancouver forest region. 21pp.
- McMullen, L.H. 1976. Spruce weevil damage. Ecological basis and hazard rating for Vancouver Island. Can. For. Serv. Info. Rep BC-X-141.
- Marty, R.J. 1959. Predicting weevil caused volume loss in white pine. For. Sci. 5:269-274.
- Marty, R. and D.G. Mott. 1964. Evaluating and scheduling white pine weevil control in the northwest. NE. For. Exp. Sta. Upper Darby, Penn.
- Morrow, R.R. 1965. Height loss from white pine weevil. J. For. 63:201-203.
- Overhulser, D.L. and R.I. Gara. 1975. Spring flight and adult activity of the white pine weevil on Sitka spruce in western Washington. Can. Ent. 107:251-256.

APPENDIX 1

Vancouver Region Spruce Weevil Survey

1. The survey area is to be sampled by using a 10 m wide transect line (5.0 m each side of line). Transects are to be located at 200 m intervals. Minimum sampling intensity is to be 5% on an area basis.
2. All spruce greater than or equal to 1.0 m in height shall be tallied and all current and previous year attacks are to be tallied. Tallied data is to be recorded every 100 m along the transect line.
3. Where current (less than or equal to 3 years old) regeneration data is not available, a 3.99 m radius stocking survey plot is to be established. Plots, located at 100 m intervals on transect lines, are to tally all acceptable dominants and co-dominants. Minimum sampling intensity 0.25%.

APPENDIX 2

Minimum Stocking Requirements

Note: The stocking standards described on the following pages are interim standards only. New standards and new Ministry of Forests policy regarding stocking standards are being drafted and will be included in this report when available.

SILVICULTURE PROGRAM
MINIMUM STOCKING STANDARDS
CROWN FOREST LAND

Rationale

To satisfy the requirements of Basic Silviculture, newly denuded forest land has to be brought back into production within an acceptable time frame with a sufficient number well spaced and free-to-grow trees.

The minimum stocking standards presented here will serve for administrative purposes on a provincial level. If stocking on a particular area is less than the minimum stocking standard, the area will be considered NSR. The most appropriate basis for these standards are the biogeoclimatic zones.

Objective

Set minimum stocking standards for the various biogeoclimatic zones of the province for areas either clear-cut or destroyed by fire or another natural cause.

The stocking standards should include:

- a list of acceptable species for each biogeoclimatic zone,
- the minimum acceptable number of free-to-grow trees per ha,
- the height at which trees can be expected to be free-to-grow,
- the average time lapse from germination or plantation to the free-to-grow height,
- definitions of technical terms and explanations for using the standards.

Purpose

Stocking standards provide an administrative framework for determining whether a previously denuded forest area is stocked with a sufficient number of well spaced and free-to-grow trees at the conclusion of the regeneration establishment period to meet defined end product objectives while maintaining options for various silvicultural systems.

The stocking standards outlined below represent an absolute minimum and apply to clear-cuts only. For more intensive management practices higher standards or "target numbers" should be aimed for. These will be developed at a later date.

For the same biogeoclimatic zone spanning several Forest Regions it is important that all the Regions concerned use the same minimum standards.

A list of biogeoclimatic zones and their occurrence by Forest Regions is presented below.

Definitions

1. Basic Silviculture

Basic Silviculture is an obligation of forest land managers (Forest Service and Licensees alike) to maintain the natural productivity of accessible forest land by:

- (a) Applying ecologically based site-specific prescriptions to harvesting, site preparation and regeneration treatments.
- (b) Satisfactorily restocking newly denuded, accessible forest sites within an acceptable time frame with a specified minimum number of well spaced trees (either naturally regenerated, planted or seeded) of ecologically acceptable species and of acceptable quality.
- (c) Ensuring that these trees are free-to-grow at the end of the regeneration establishment period.

2. Acceptable Species

A tree species is acceptable if it has potential commercial value and occurs naturally in the area under consideration, either at an early or late successional stage. Exotics, such as noble fir, might be included at a later date, once their value for British Columbia silviculture has been determined.

In the case of a mixture of species, the preference for one species or another can be influenced by end production objectives and local experience. With the provincial objective of a softwood sawlog economy, hardwood species are generally not acceptable at the present time, with minor exceptions eg. cottonwood plantations in the Fraser Valley, or red alder on wetter sites on the coast.

3. Free-To-Grow Tree

A tree is considered free-to-grow, if

- (a) it is of acceptable species and quality,
- (b) it has overcome competition and other establishment problems,
- (c) it has reached a well defined free-to-grow height,
- (d) it has attained a rate of annual height growth characteristic¹ for the species and the biogeoclimatic (sub)zone².

¹ Height growth standards will be developed as a result of Regeneration Performance Assessment (RPA), see Chapter 4.5 of the Silviculture Manual.

² The present standards are for biogeoclimatic zones. Where more detailed information is available, i.e. at the subzone level, and approved by the Regional Manager, it should be used.

Free-to-grow trees can be either naturals or planted trees or have originated from a seeding operation, or be advance regeneration, providing the latter meet the strict requirements outlined below.

For administrative purposes, stands qualify as free-to-grow, if the minimum number per hectare of well spaced trees specified in the Minimum Stocking Standards have ~~reached the free-to-grow height~~.

4. Acceptable Advance Regeneration

Advance regeneration is acceptable if the individual tree meets all of the following requirements³.

- (a) good form: straight stem, basal sweep is less than 30 horizontal cm.,
- (b) good vigour: leader growth since release is acceptable i.e. characteristic for the species and the biogeoclimatic (sub)zone, foliage is healthy looking,
- ~~(c) no open wound or unhealed injury of any kind,~~
- (d) no unacceptable damage* or disease,
- (e) live crown length equals at least one third of tree height,
- (f) total height of tree at release was less than 2 metres,
- (g) tree has reached free-to-grow height, i.e. it does not seriously suffer from competing vegetation of any kind.

5. Acceptable Quality

Quality standards for trees of acceptable species:

- (a) straight stem (no permanent deformation nor multiple leaders without expression of dominance),
- (b) freedom from injury, insect or fungal attack of severe consequence,
- (c) healthy foliage colour (slight discoloration is acceptable if it is likely that the young tree will overcome it),
- (d) leader growth acceptable for that species and biogeoclimatic (sub)zone.

³ For more details see the following papers:

- (a) Research note 80, 1977 by L.J. Herring: Studies of advance subalpine fir in the Kamloops Forest District (E.P. 754.01) Forests, Province of British Columbia, Victoria, B.C.
- (b) Regeneration Survey Standards for advance amabilis fir in the Vancouver Forest District, by Vancouver District Reforestation Staff, undated, 15 pages.

* See RPA (section 4.5 of the Silviculture Manual)

6. Regeneration Establishment Period

The regeneration establishment period is the time lapse between germination or planting and the time when the area is stocked with an acceptable minimum number of well spaced and free-to-grow trees.

possibly put
The regeneration establishment period is expressed in number of years and varies with species and biogeoclimatic (sub)zone.

7. Free-To-Grow Height

Only one period /

Free-to-grow height is that height at which the tree leader can grow unimpeded by competition from any type of vegetation, including other trees.

Although this free-to-grow height varies from site to site, it will be a fixed height at the present time for administrative purposes. As more information becomes available on an ecological basis, site and species specific standard height curves will replace the heights presented in the Minimum Stocking Standards.

8. Well Spaced

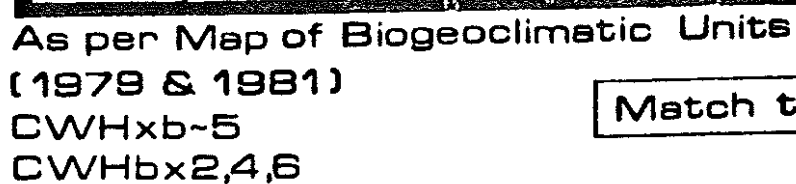
Trees are well spaced if they are at least a minimum distance away from the next acceptable tree. This minimum distance is a function of "target stocking standards" and tolerance level. Target stocking standards are higher than minimum stocking standards and will be presented at a later date. The tolerance level can be up to 40% of the target spacing except for extremely shade intolerant species. Follow the regeneration survey procedures (see chapter 4.2 of the Silviculture Manual) to determine which are the well spaced trees in a plot and compute the average number of well spaced trees per hectare.

9. Minimum Stocking Standards

red
Minimum stocking standards are an administrative standard which determines for each biogeoclimatic (sub)zone the minimum acceptable number per hectare of well spaced trees of acceptable species and quality ~~that are free-to-grow at the end of a defined regeneration establishment period.~~ Below this minimum the area is considered NSR and the obligation of Basic Silviculture is not met.

If an area has non-productive spots, as determined by the regeneration procedures, then the minimum stocking standard can be lowered accordingly. No further subtractions are permitted.

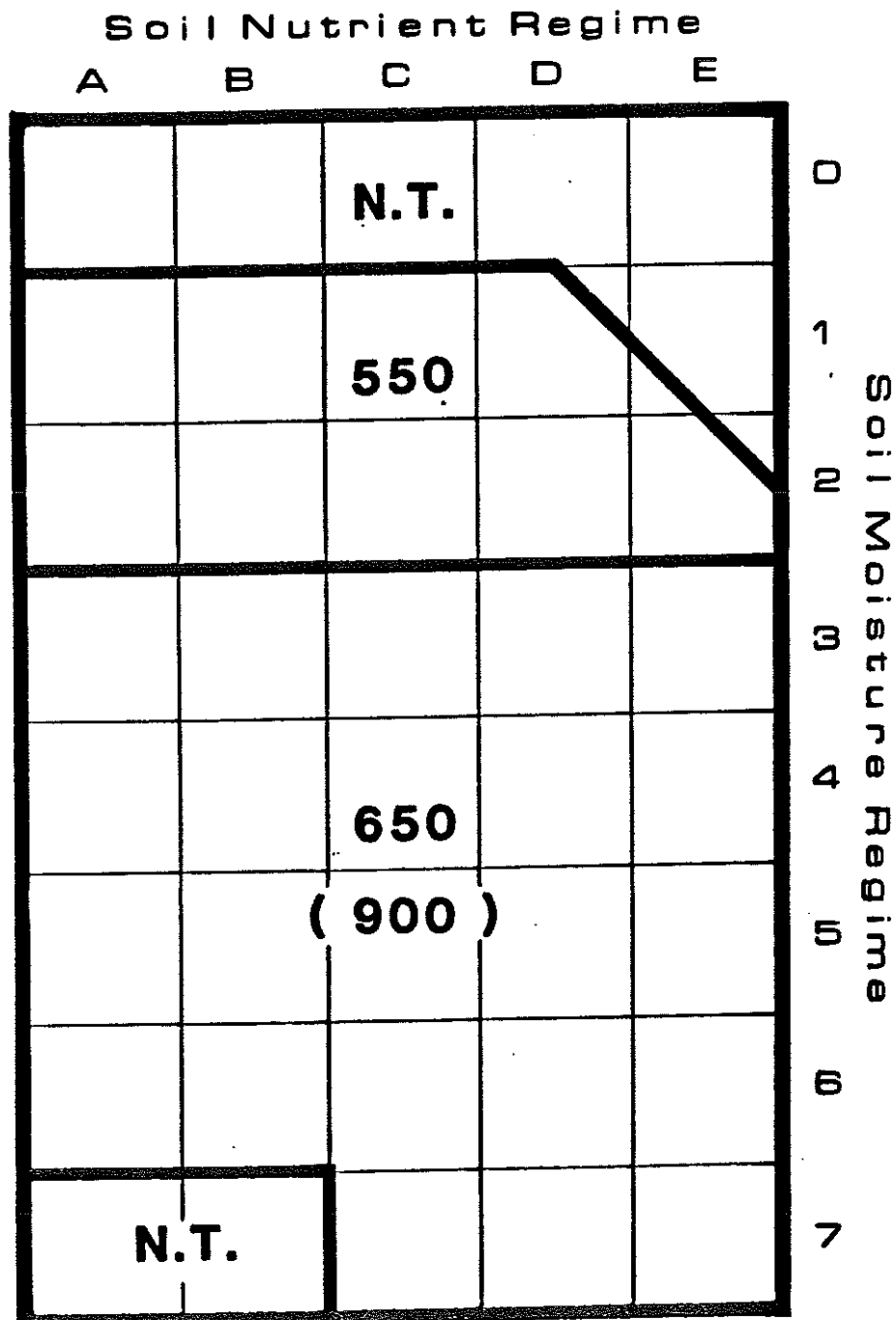
CWHb₁	Windward Submontane Wetter CWH Variant
CWHb₃	Leeward Submontane Wetter CWH Variant
CWHd	Hypermaritime CWH Subzone



Match to grid no.9,11&18

Stocking Standards for the Vancouver Forest Region for the :

CWHb₂	Windward Montane Wetter CWH Variant
CWHb₄	Leeward Montane Wetter CWH Variant

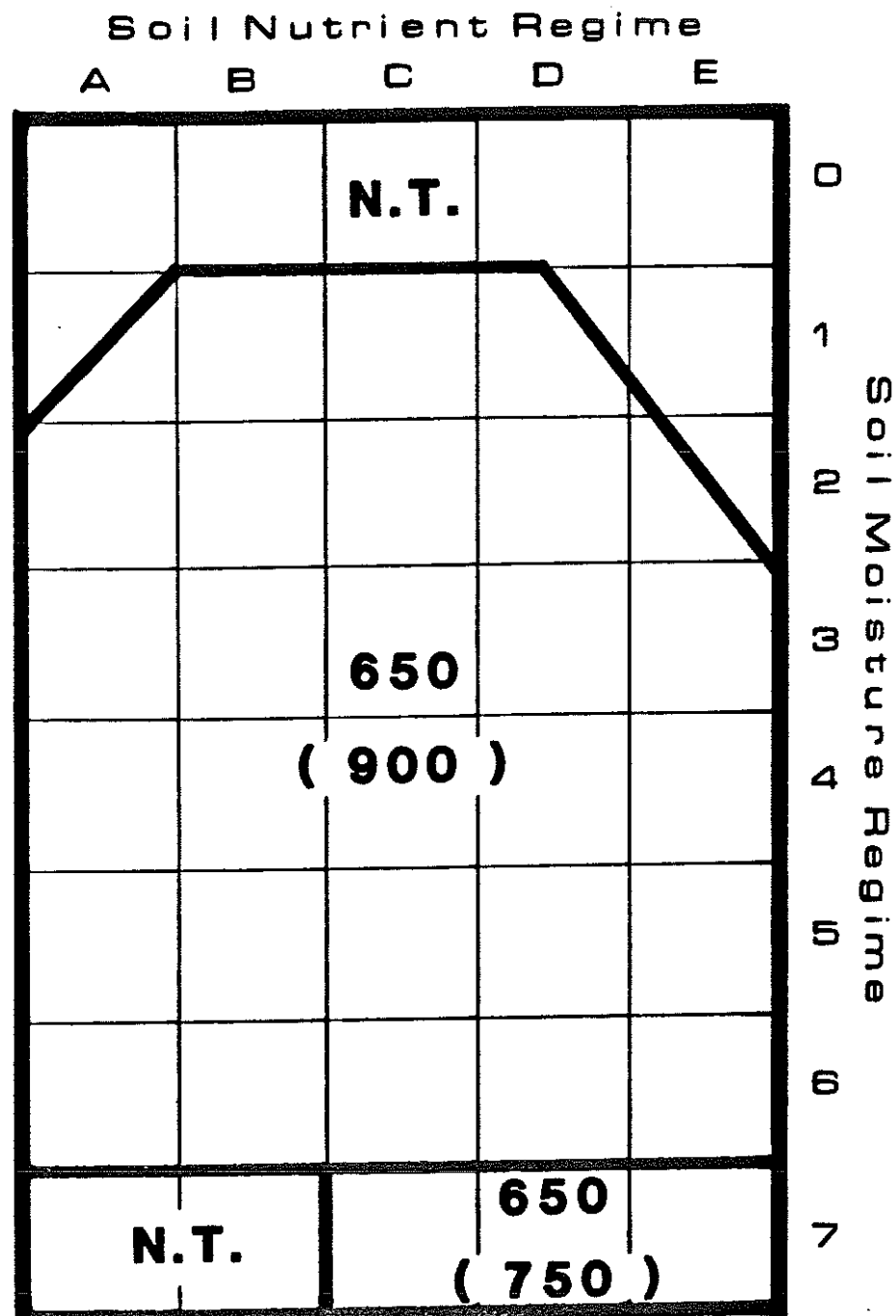


As per Map of Biogeoclimatic Units
(1979 & 1981)
CWHb3,5,7

Match to grid no. 10 & 12

Stocking Standards for the Vancouver Forest Region for the :

CWHb₅	Southern Submaritime Wetter CWH Variant.
CWHb₆	Central Submaritime Lower Wetter CWH Variant
CWHb₇	Central Submaritime Upper Wetter CWH Variant

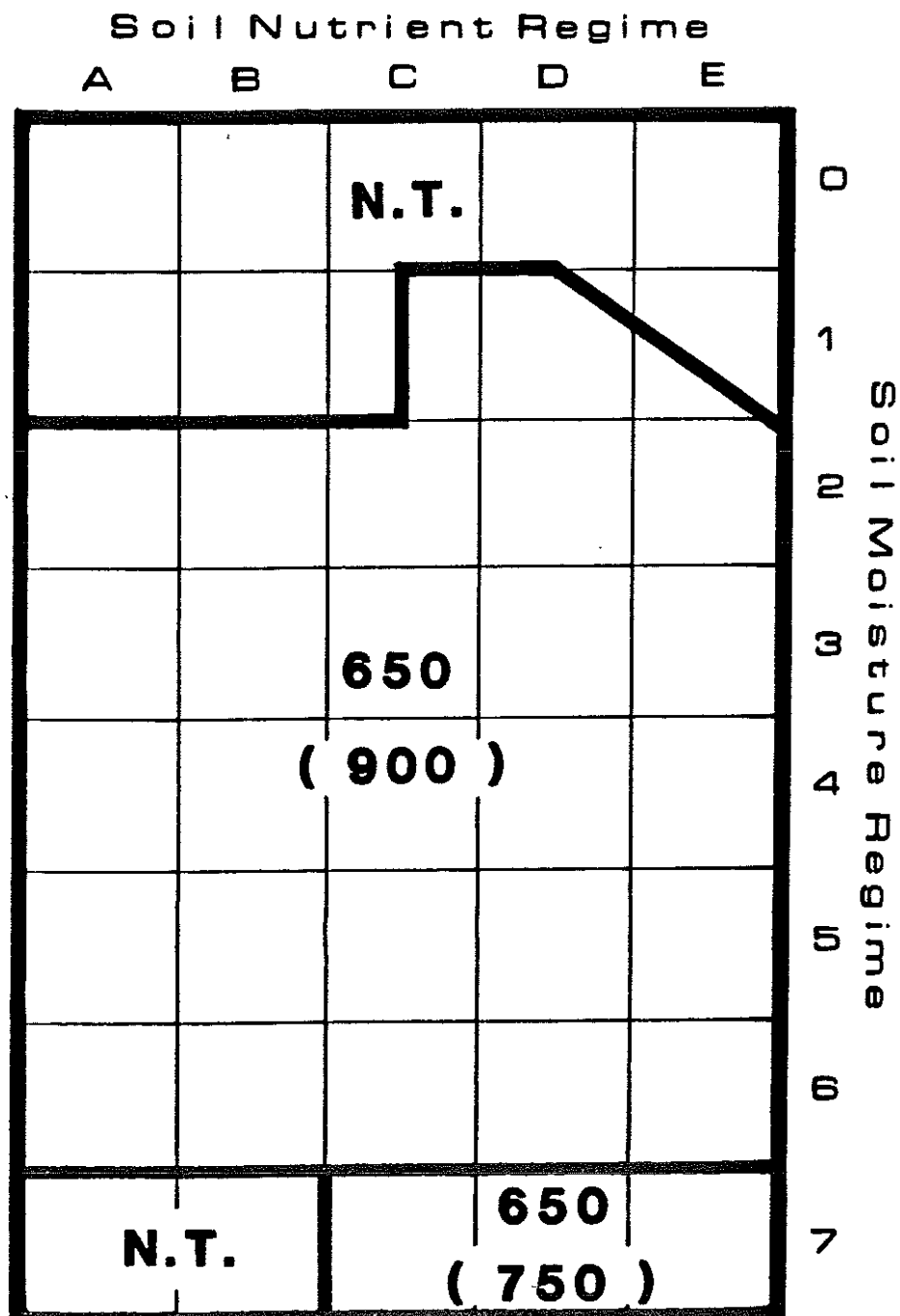


As per Map of Biogeoclimatic Units
(1979 & 1981)
CWHd

Match to grid no.13 & 14

Stocking Standards for the Vancouver Forest Region for the :

CWHc₁	Southern Drier Submaritime Variant
CWHc₂	Central Drier Submaritime CWH Variant



As per Map of Biogeoclimatic Units
(1979 & 1981)

Match to grid no.16 , 17