

Estimation of Insect and Disease
Losses and Pest Management
Opportunities in the Soo T.S.A.

D. G. Heppner
P. M. Wood

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Forward

In developing the pest management component of a T.S.A. plan, there are two essential preliminary steps.

Firstly, the forest value losses attributable to pests (predominantly timber volume losses) must be quantified. Timber volume losses from each pest must be expressed as being either incorporated in the predicted timber supply (i.e. anticipated losses), or detracting from the predicted timber supply (i.e. unanticipated losses).

Secondly, benefits accruing from pest management must be quantified. Mitigation of volume losses already incorporated in the timber supply (anticipated losses) can be viewed as opportunities for enhancing the productivity of the Timber Supply Area. Mitigation of losses detracting from the timber supply (unanticipated losses) can be viewed as basic protection, or maintenance, of the forest resource.

Each pest management opportunity has its associated costs of implementation, and each can be expressed as an option for consideration relative to other forest management options. Pest management opportunities involving the reduction of unanticipated losses, like forest fire losses but unlike most other forest management options, have a very real associated cost if they are not implemented.

This report quantifies current estimates of pest losses in the Soo T.S.A. and identifies pest management opportunities for reducing these losses. It must be emphasized, however, that these estimates are extrapolations based on imprecise data. The currently imprecise nature of pest loss estimates is characteristic of all the T.S.A.s in the Vancouver Region. This is largely due to the extreme difficulty of accurately surveying for insidious and unhomogeneous patterns of disease and plantation pest infestations, being the major pests in this region. The Soo T.S.A., in fact, has one of the least well quantified pest inventories in this region.

The imprecision of these current pest loss estimates, however, underscores the need for an inventory and assessment of pest losses as the essential preliminary phase toward implementing an effective pest management program in the Soo T.S.A.

It is intended that the loss and management opportunity estimates in this report will be updated periodically as more refined quantifications are developed in the course of the Squamish District Pest Management Program.

This report establishes the format for similar estimates to be reported for each of the Timber Supply Areas in the Vancouver Region.

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Estimation of Insect and Disease Losses and
Pest Management Opportunities in the Soo T.S.A.

1. Introduction

An estimation of expected annual losses from insect and diseases in the Soo T.S.A. along with forest management opportunities to help mitigate these losses are discussed in this report.

These estimates were produced in response to the development of the Soo T.S.A. Plan. They utilize information from the Squamish Forest District's pest survey summaries, Planning Branch's Resource Planning Lists, VACs and net land base information, and Vancouver Forest Region Pest Management's preliminary estimates of volume losses to root disease and hemlock dwarf mistletoe.

The types of losses encountered fall into four categories.

- 1) mortality: losses caused by the death of trees.
 (e.g. unsalvaged lodgepole pine stands
 killed by mountain pine beetle)

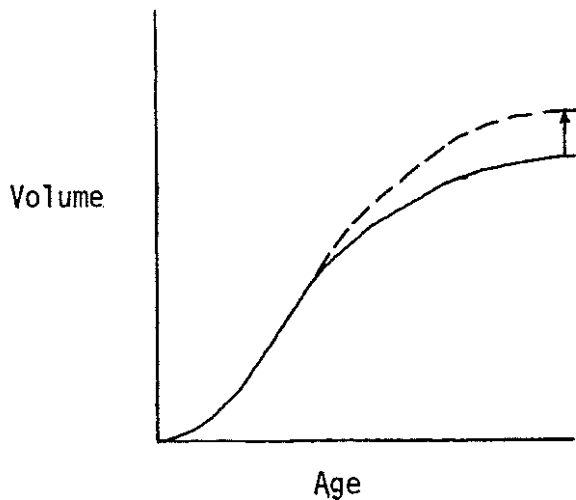
- 2) incremental: losses caused by a reduction of annual
 growth (height and diameter). (e.g. annual
 growth reductions caused by the parasitic
 Hemlock Dwarf Mistletoe)

- 3) form distortion: losses due to damage to bole form.
Are losses in useable, or net
merchantable, volume (e.g. leader weevil
damage to sitka spruce resulting in forks,
crooks and distorted growth; severe
defoliation in Douglas-fir from western
budworm resulting in dead tops, crooks and
forks)
- 4) opportunity loss: often overlooked losses in potential
timber production. (e.g. non-productive
holes in Douglas-fir stands caused by
Phellinus root disease)

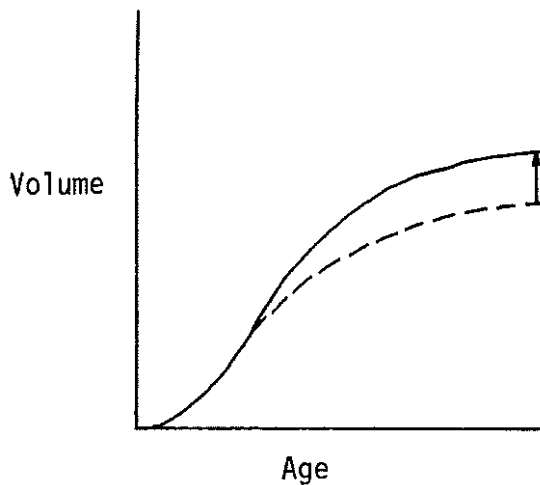
Some of these losses are accounted for in VACs and therefore any
increase in timber volumes resulting from management actions
aimed at reducing these losses is a real increase in
productivity (e.g. Hemlock Dwarf Mistletoe). However, many of
these losses are not accounted for in VAC calculations (e.g.
mortality from mountain pine beetle). In these cases any timber
volumes gained from pest control or management actions will only
raise the productivity to the assumed or predicted levels.

Schematic example

Mistletoe Management
(productivity enhancement)



Spruce Weevil
Management (protection)



↑ = pest management

Losses included in this report contain all the above four categories and are presented as; 1) losses included in VACs, and, 2) losses not included in VACs.

2. Insect and Disease Losses in the Soo T.S.A.

2.1 Losses included in VACs

2.1.1 Hemlock Dwarf Mistletoe Losses

The total area of hemlock dominant forest types were summed excluding low sites, and poor sites of height class 3 and lower to give 26,000 ha.⁽¹⁾ This area was then multiplied by an estimated volume loss of 1.8 m³/ha/yr.⁽²⁾

$$26,000 \text{ ha} \times 1.8 \text{ m}^3/\text{ha}/\text{yr} = \underline{47,000 \text{ m}^3/\text{yr}} \times .365 \approx 17000$$

2.1.2 Western Budworm Losses

There was no significant budworm damage in 1982; the infestation cycle of the past ^{decade} seems to have subsided. However, a new cycle of infestation can be expected to start in 15-20 years or sooner. No data is currently available to determine volume losses.

-
1. Planning Branch, Resource Planning Lists for the Soo T.S.A.
 2. Vancouver Region Pest Management, estimates of volume losses to hemlock dwarf mistletoe.

2.2 Losses not included in VACs

2.2.1 Mountain Pine Beetle Losses

An estimated 900 ha of lodgepole pine were attacked in 1982.⁽³⁾ Using an estimated average volume for ages 80-280 of $129 \text{ m}^3/\text{ha}$ ⁽⁴⁾ and assuming that only 60% of the volume in the attacked area was killed, the calculated volume loss is estimated to be $70,000 \text{ m}^3$.

$$900 \text{ ha} \times 129 \text{ m}^3/\text{ha} \times .6 = 70,000 \text{ m}^3$$

Assuming that the 900 ha in 1982 is much larger than average, the annual loss is estimated to be $12,000 \text{ m}^3/\text{yr} = 154 \text{ ha}$ for a 5 year average.

2.2.2 Spruce Beetle Losses

An estimated 20 ha of spruce were attacked in 1982.⁽³⁾ Using an average volume of $734 \text{ m}^3/\text{ha}$ ⁽⁴⁾ and assuming that only 60% of the volume in the attacked area was killed, the calculated volume loss is estimated to be $8,800 \text{ m}^3$.

$$20 \text{ ha} \times 734 \text{ m}^3/\text{ha} \times .6 = 8,800 \text{ m}^3$$

Again assuming that the 20 ha in 1982 is larger than average, the annual loss is estimated to be $1,000 \text{ m}^3/\text{yr}$ for a 5 year average.

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3. Squamish Forest District, pest survey summaries, 1982
 4. Planning Branch, VACs of aggregated timber classes for the Soa T.S.A. (FC, Etc.; FPL, Etc.; SB; PL, Etc.)

2.2.3 Balsam Bark Beetle Losses

An estimated 25 ha of balsam were attacked in 1982. ⁽³⁾

Using a volume of $734 \text{ m}^3/\text{ha}$ ⁽⁴⁾ and assuming that only 30% of the volume in the attacked area was killed the calculated volume loss is estimated to be $5,500 \text{ m}^3$.

Vol. too
high

Use 25 m³/ha

$$25 \text{ ha} \times 734 \text{ m}^3/\text{ha} \times .3 = 5,500 \text{ m}^3$$

Again assuming that 25 ha of attack in 1982 was larger than average the $5,500 \text{ m}^3$ was rounded to an even $5,000 \text{ m}^3/\text{yr}$ for the 5 yr average.

2.2.4 Douglas-fir Beetle Losses

An estimated 10 ha of Douglas-fir were attacked in 1982. ⁽³⁾ Using an average volume of $363 \text{ m}^3/\text{ha}$ ⁽⁴⁾ and assuming that only 60% of the area was killed the calculated volume loss is estimated to be $2,000 \text{ m}^3$.

$$10 \text{ ha} \times 363 \text{ m}^3/\text{ha} \times .6 = 2,200 \text{ m}^3$$

For Douglas-fir beetle this volume loss was thought to about equal the annual loss; $2,000 \text{ m}^3/\text{yr}$.

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3. Squamish Forest District, pest survey summaries, 1982
 4. Planning Branch, VACs of aggregated timber classes for the Soo T.S.A. (FC, Etc.; FPL, Etc.; SB; PL, Etc.)

2.2.5 Root Disease Losses

The area for each age class for fir types was multiplied by the corresponding volumes.⁽⁴⁾ These numbers were then multiplied by the estimated percentage of loss to root rot for each age class.⁽⁵⁾ The products of the preceeding multiplications were then divided by the average for each age class to give the average loss per year for each age class (i.e. weighted average). These quotients were then summed to give the total average annual loss to root disease.

example:

Age Class	Forest Type	Area (ha)	Volume (m ³ /ha)	% Loss	Average Age	Weighted Average Annual Loss
3	FC, Etc.	4353	x 148	x .03	÷ 50 yr.	= 387 m ³ /yr

Total annual loss to root disease = 12,000 m³/yr

Tabulated calculations of the preceeding are listed in Appendix 5.1

2.2.6 Spruce Weevil

Spruce plantations 5 years and older in the Soo T.S.A. were surveyed for weevil and no significant infestations were found.

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4. Planning Branch, VACs of aggregated timber classes for the Soo T.S.A. (FC, Etc.; FPL, Etc.; SB; PL, Etc.).
 5. Vancouver Region Pest Management, preliminary estimates of volume losses to root disease

2.3 Summary of Losses

Losses included in VAC's:

	<u>Annual Losses, 5 Year Average</u>	<u>1982 Losses</u>
Hemlock Dwarf Mistletoe	47,000 m ³ /yr.	47,000 m ³
Sub Total	<u>47,000 m³/yr.</u>	<u>47,000 m³</u>

Losses from VAC's

Mountain Pine Beetle	12,000 m ³ /yr.	70,000 m ³
Spruce Beetle	1,000	8,800
Balsam Bark Beetle	5,000	5,500
Douglas Fir Beetle	2,000	2,200
Root Diseases	12,000	12,700
Sub Total	<u>32,000</u>	<u>99,000</u>
<u>Total Pest Losses</u>	<u>79,000 m³/yr.</u>	<u>146,200 m³</u>

3. Management Opportunities

3.1 Hemlock Dwarf Mistletoe

Of primary importance in the reduction of losses to Hemlock Dwarf Mistletoe is the maintenance of the 3 meter knockdown clause at the time of harvest. This will effectively eliminate most significant sources of infection over the long term and provide potential volume gains of up to 47,000 m³/yr. Residual falling of hemlock over 3 meters in height on previously harvested stands would speed up the attainment of these volume gains.

There is currently no feasible method to eliminate mistletoe from mature stands. However, the removal of mistletoe infected trees during juvenile spacing and commercial thinning should be attempted.

3.2 Root Disease

The planting of resistant species in root disease infection centers should be the first treatment considered when attempting to eliminate root disease losses. Resistant species are western red cedar, western white pine and deciduous species. Spruce and western hemlock are more resistant than Douglas-fir.

Much of the Soo T.S.A. is rugged and rocky with few "good sites", therefore, there are presently few areas where stumping (physical removal of infected stumps) could be conducted economically without damaging the site. However, with the prospect of greatly improved technology, stumping of infection centers may become much more feasible.

Planting western white pine in root disease pockets is considered to be the single best management opportunity for root disease control in the Soo T.S.A.

The potential gains from root disease management are approximately 8,000 m³/yr.

3.3 Bark Beetles

Bark beetle losses in this T.S.A. are almost all non-recoverable. The infestations are often in inaccessible timber, scattered about in small pockets and are generally unattractive for harvesting. However, where possible, salvage and/or sanitation harvesting should be encouraged. An attempt should also be made to promptly remove felled timber and reduce slash deposits in areas susceptible to Douglas-fir and spruce bark beetles.

Significant volume loss reductions are not anticipated in this report. One reason for this is due to the age class distribution of Douglas-fir in the Soo T.S.A. There is a lack of intermediate age classes. Much of the existing ^{immature} fir are located in FPl or PlF types and these forest types are also the ones frequently infested by Mountain Pine Beetle. The necessity to protect these immature fir types renders the treatment of pine for Mountain Pine Beetle by sanitation and salvage harvesting undesirable.

3.4 Western Budworm

The prioritization of damaged stands for sanitation and salvage logging should be the first consideration when attempting to reduce budworm losses. A number of environmentally acceptable biological control agents are currently being tested and show promise for use in the near future as effective methods of budworm control. (e.g. Nuclear Polyhedrosis Virus, Bacillus thuringiensis, Beauveria basiana).

Potential volume gains from budworm management range from 1000 m³/yr. plus.

3.5 Summary of Volume Gains Anticipated from Pest Management in the Soo T.S.A.

In addition to VACs (i.e. above LRSY):

Hemlock Dwarf Mistletoe	47,000 m ³ /yr.
Budworm Salvage	1,000 m ³ /yr.

In mitigation of losses from VACs:

Root Disease Control	8,000
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Total annual pest management

Volume gains in Soo T.S.A.	<u>56,000 m³/yr.</u>
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(These are long term average annual wood volume gains)

4. Acknowledgements

For their assistance in obtaining numerical values for insect and disease losses the authors would like to acknowledge:

J. Beale, Pest Management Pathologist, Vancouver Forest Region

L. Mitchell, Protection Resource Assistant, Squamish Forest
District

5. Appendices

5.1 Root Disease Losses Calculations

Age Class	Timber Type	Area (ha)	Volume (m ³ /ha)	% Loss*	Average Age	Weighted Average Annual Loss m ³ /yr
1	FC, Etc.	14353	X 8	X .01	÷ 10	= 114.8
2	" "	4354	X 39	X .02	÷ 30	= 113.2
3	" "	4353	X 148	X .03	÷ 50	= 386.6
4	" "	5543	X 246	X .04	÷ 70	= 779.2
5	" "	6196	X 340	X .045	÷ 90	= 1033.3
6	" "	6655	X 415	X .055	÷ 110	= 1380.9
7	" "	4114	X 481	X .06	÷ 130	= 913.3
8	" "	2714	X 530	X .07	÷ 150	= 671.3
9	" "	2714	X 553	X .075	÷ 170	= 662.1
10	" "	2714	X 588	X .0775	÷ 190	= 650.9
11	" "	2714	X 589	X .08	÷ 210	= 647.0
12	" "	2714	X 595	X .09	÷ 230	= 613.9
13	" "	4483	X 586	X .10	÷ 250	= 1050.8
14	" "	6258	X 590	X .11	÷ 270	= 1504.2
15	" "	6258	X 590	X .1175	÷ 290	= 1496.0

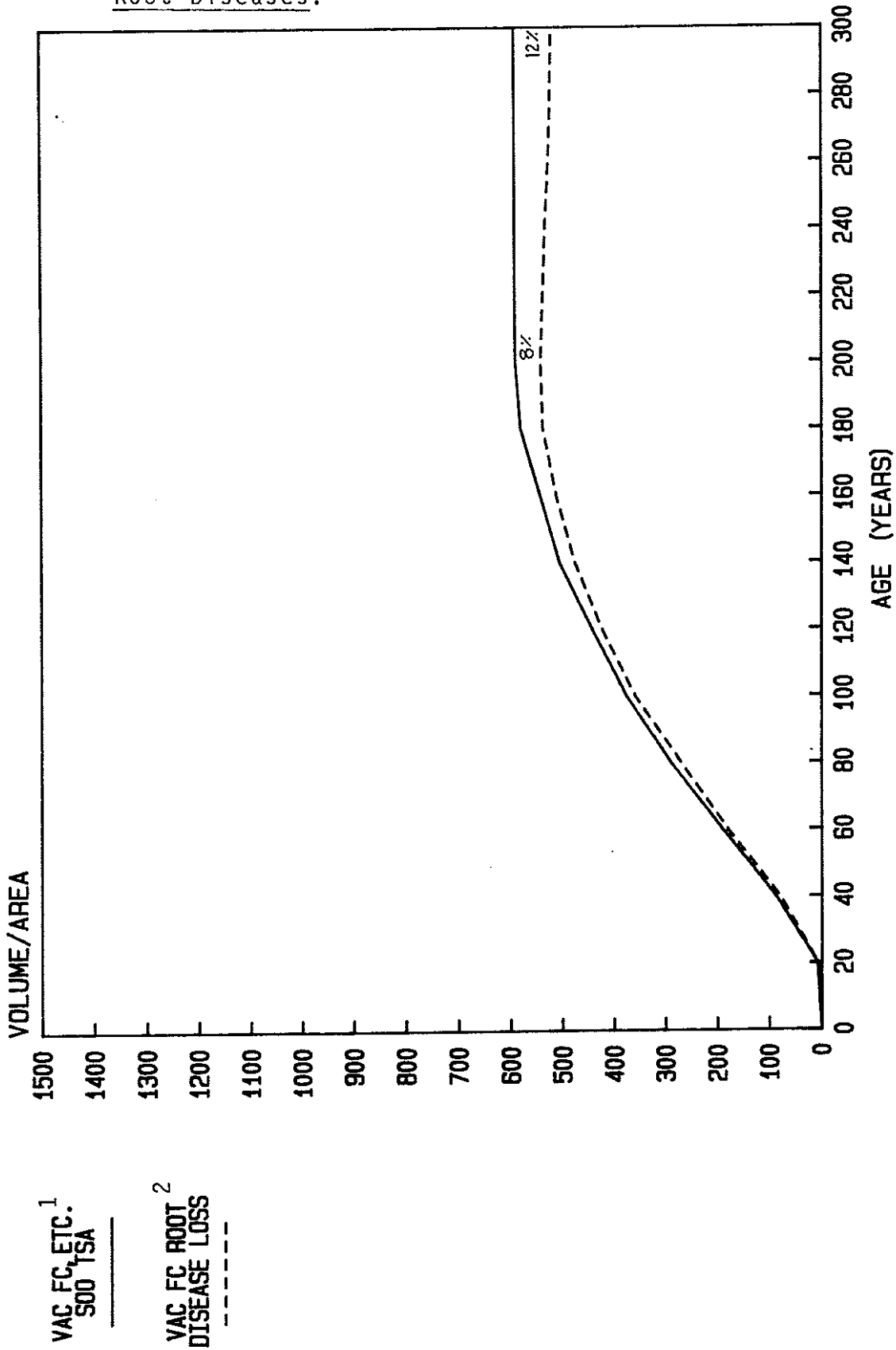
Sub Total 12,055.6 m³/yr

*See Appendix 5.2, Soo T.S.A. Volume/Age Curves Showing Estimated Losses to Root Disease

Age Class	Timber Type	Area (ha)	Volume (m ³ /ha)	% Loss*	Average Age	Weighted Average Annual Loss m ³ /yr
1	FPL, Etc.	1659	X 6	X .01	÷ 10	= 10.0
2	" "	894	X 21	X .02	÷ 30	= 12.5
3	" "	1595	X 97	X .03	÷ 50	= 92.8
4	" "	1616	X 172	X .04	÷ 70	= 158.8
5	" "	1514	X 240	X .045	÷ 90	= 181.7
6	" "	785	X 296	X .055	÷ 110	= 116.2
7	" "	228	X 330	X .06	÷ 130	= 34.7
8	" "	23	X 356	X .07	÷ 150	= 3.8
9	" "	23	X 380	X .075	÷ 170	= 3.9
10	" "	23	X 412	X .0775	÷ 190	= 3.9
11	" "	23	X 410	X .085	÷ 210	= 3.8
12	" "	23	X 397	X .09	÷ 230	= 3.6
13	" "	13	X 406	X .10	÷ 250	= <u>3.1</u>
Sub Total						<u>627.8 m³/yr</u>
Total						<u>12683.4 m³/yr</u>

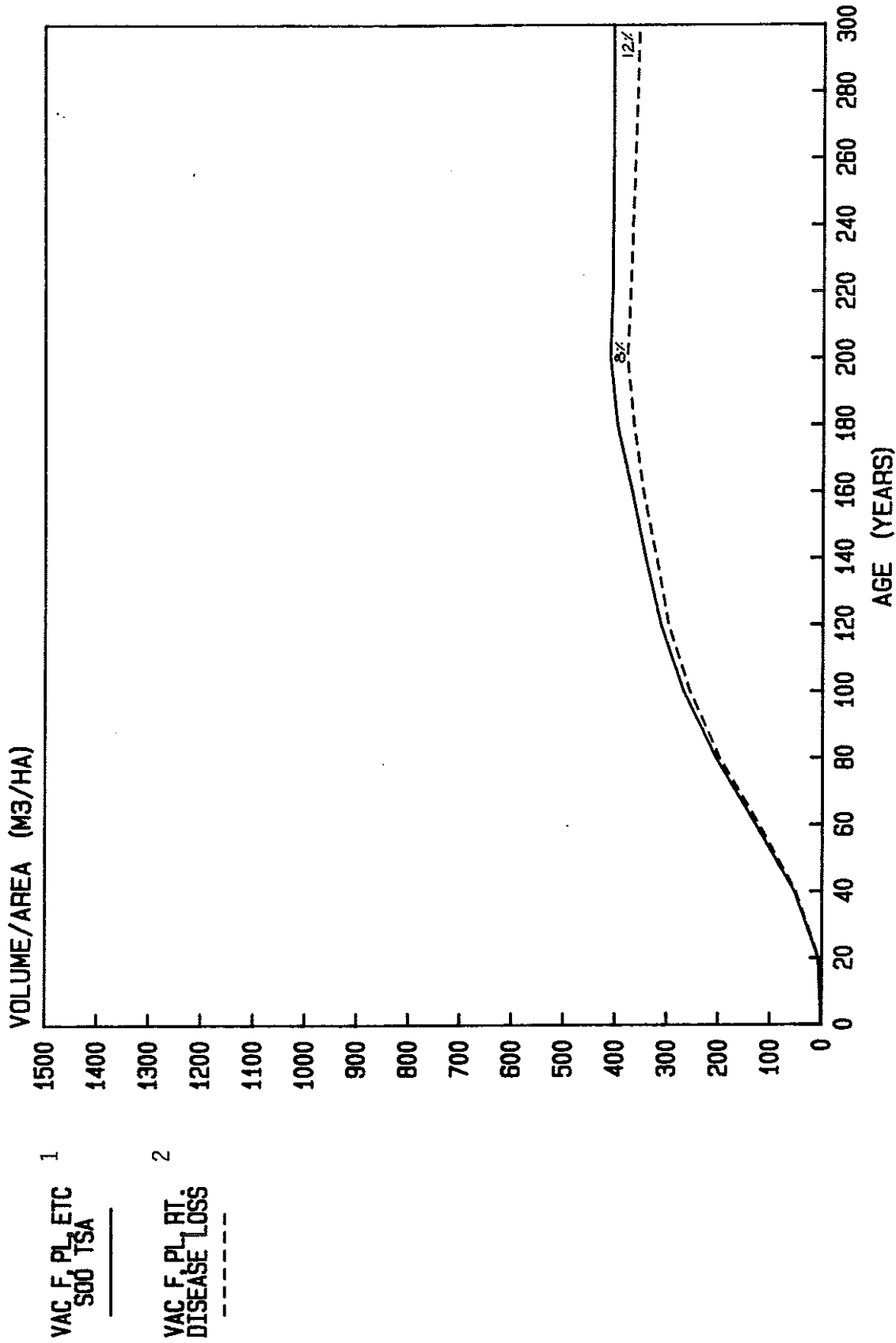
*See Appendix 5.2, Soo T.S.A. Volume/Age Curves Showing Estimated Losses to Root Diseases.

5.2 Soo T.S.A. Volume/Age Curves Showing Estimated Losses to Root Diseases.



1. Aggregated volume over age curves for FC, Etc. forest types, Soo T.S.A., Planning Branch, B.C.M.F.
2. Preliminary volume over age curves, as above, minus root disease losses as estimated from Root Disease Analysis Surveys, Vancouver Forest Region, Pest Mgmt, 1982. (see Pest Mgmt Progress Vol 1.1, p. 12, May 1982)

Soo TSA VOLUME/AGE CURVES ESTIMATED LOSSES TO ROOT DISEASE



1. Aggregated volume over age curves for F, Pl, Etc. forest types, Soo T.S.A., Planning Branch, B.C.M.F.
2. Preliminary volume over age curves, as above, minus root disease losses as estimated from Root Disease Analysis Surveys, Vancouver Forest Region, Pest Mgmt., 1982.
(see Pest Mgmt. Progress Vol. 1.1, p. 12, May, 1982)