ROOT DISEASE SURVEY METHODS
PHASE III

APPLICATION OF THE MULTISTAGE SURVEY METHODOLOGY OUTLINED IN THE PHASE II REPORT TO THE OKANAGAN TIMBER SUPPLY AREA

by

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(The contents of this report may not be cited in whole or part without the written approval of the Director, Protection Branch, Ministry of Forests, 31 Bastion Square, Victoria, British Columbia V8W 3E7)

FOREWORD

This report is one of a series of internal reports distributed by Forest Protection Branch, B.C. Ministry of Forests, to record accomplishments and interim or provisional results for the information of staff, colleagues, and others.

In the Canada-British Columbia Forest Resources Development Agreement (FRDA) 1985 to 1990, over 100 pest control projects were directly funded by the province and administered by protection staff. To facilitate application of the results, and development of improved forest health management strategies, the contractors reports have been edited and distributed as internal reports. Accordingly, any opinions and recommendations expressed are those of the contractor, and not necessarily those of the ministry or the FRDA management committee.

For details or more information about the report or project, please contact forest health staff at Protection Branch or at the forest region offices.

J. Muir, RPF
Acting Manager
Forest Health
Forest Protection Branch

The guidelines for internal reports outlined in the Protection Manual were adhered to as closely as possible. All manuscripts were altered to comply with a common format, but entire reports were not rewritten to conform to a standardized outline.

Most Executive Summaries were the work of Graham Hawkins of MoF Inventory Branch (formerly with Pacific Coast Forest Biology). All word processing was accomplished by Catriona Kaufman of Top Kat Services. Will Gordon of R. White Woods inc. prepared all maps and figures.

R. White, editor
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March 4, 1986

File: 1609

Dr. J. Muir, Pathologist
B.C. Ministry of Forests
Protection Branch
1450 Government Street
Victoria, B.C.
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Dear Sir:

Re: Phase III of Our Proposal to Review Root Disease Survey Methods

I have attached two copies of our report entitled, "Application of the Multistage Survey Outlined in the Phase II Report to the Okanagan Timber Supply Area."

In preparation for this third report of root disease survey methods, we continued our examination of literature and our interviews with key personnel in the Ministry of Forests (MOF) and the Canadian Forestry Service (CFS). We amalgamated the required maps and forest data necessary for the application of the proposed methodology.

We would like to acknowledge and express our thanks to those MOF and CFS staff who provided comments and information in the preparation of this report. Our report lists these people.

Our test application of the proposed methodology indicates the procedure should work successfully. We propose that you consider an operational test of this methodology this year. We feel the Okanagan Timber Supply Area is an excellent area for fine tuning of the proposed procedure and to proceed with a field test.

The scope of this contract work was not sufficient to verify the scales of aerial photography recommended, to test the field sampling of aerial photo stratification and to establish the required sample sizes necessary to achieve an acceptable level of accuracy.

Dr. G. Wallis, Forest Pathologist, and Mr. E. Vaughan, R.P.F., along with myself, contributed in the writing of the Phase III report.

..... cont'd

We have enjoyed working on this project. We would be pleased to participate in any further work such as a field testing of this proposed methodology.

Yours very truly,

T. M. THOMSON & ASSOCIATES LTD.

Per:

B. T. Wallis, R.P.F. FOR
Senior Forester, Silviculture

BTW:jl

Enc.

EXECUTIVE SUMMARY

A multistage sampling methodology suitable for defining root disease timber volume losses in large areas of timber in a Timber Supply Area (TSA) was developed in Phase II of this project. This report (Phase III) demonstrates how the methodology could be applied to the Okanagan TSA.

The multistage sampling procedure is applied, stage by stage, to Supply Block No. 6. Application of a similar procedure to each of the other supply blocks would provide loss estimates for the TSA. A description of each stage of application is provided, together with example support appendices showing the type of information which is available. A field test of the multistage sampling methodology will be necessary before operational application of the method is attempted.

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1 INTRODUCTION

In Phase I of the contract (PM-PB-63), "Critical Review and Assessment," it was determined that current root disease survey methodology worked well for small areas of forest where the disease occurred in discrete centres. However, because of cost and time constraints, it was not suitable to define losses present over large tracts of forest.

In Phase II of the contract (PM-PB-64), "A Proposed Multistage Survey Methodology for Defining Root Disease Losses in Timber Supply Areas," a multistage root disease survey method was developed that will be suitable for defining losses in these large tracts of timber (Figure 1).

The objective of Phase III of this contract is the application of the methodology developed in Phase II to a candidate Timber Supply Area (TSA). The candidate B.C. interior TSA selected as a test area for the multistage sampling methodology is the Okanagan.

Past research has shown that some B.C. interior forest associations are more susceptible to root disease infection than others; for example, dry- and wet-belt Douglas-fir and wet-belt western redcedar and western hemlock species mixtures. Selective logging has aggravated the problem of root disease infection in these forest associations.

The two primary pathogens in these B.C. forest associations are *Phellinus weirii* and *Armillaria ostoyae.*

This report will outline the application of the proposed multistage sampling methodology to the Okanagan TSA and will provide detailed descriptions and support appendices as examples of the actual application. Appendices are not included with the distributed copies of this report, but are kept with the original report in the Forest Health Section, Protection Branch, MoF, Victoria.

2 PREPARATION FOR APPLICATION

2.1 Consultations

The application of the proposed multistage methodology was reviewed with the following agencies and personnel:

- B.C. Ministry of Forests
  - Planning and Inventory Branch

Mr. B. Hall	-	Supervisor, CAM Data Input
Mr. I. Spandli	-	Forester, Statistics Officer
Mr. M. Blyth	-	Manager, Computer-Assisted Mapping
Mr. J. McLellan	-	Forest Classification and Sampling Officer
Mr. J. Kiss	-	Decay and Waste Officer
Mr. J. Nemeth	-	Remote Sensing Officer

  - Kamloops Regional Office

Mr. D. Lloyd	-	Regional Research Ecologist

- Canadian Forestry Service, Pacific Forestry Centre

Dr. J. Lee	-	Research Scientist
Dr. D. Morrison	-	Research Scientist

2.2 Literature Review

An in-depth review of the literature listed in the references section of this report was completed. Particular attention was paid to those articles describing multistage sampling.

2.3 Data Collection

The following information was accessed and reviewed or obtained in order to complete the application of the proposed multistage sampling methodology:

- MoF Data Bank
- Okanagan TSA key map
- Okanagan TSA biogeoclimatic subzone key map
- Public Sustained Yield Unit region-compartment area statements
- MoF forest cover maps for Supply Block No. 6, Okanagan TSA
- projected map attribute lists for forest cover maps
- map polygon area lists (HEC reports) for forest cover maps
- available aerial photography
- disease ratings found in available literature.

2.4 Selection of Test Area

The Okanagan TSA was selected because it is known to have large timber volume losses from root disease. For administrative purposes, the TSA is subdivided into nine supply blocks.

Supply Block No. 6 was selected for an example application of the multistage sampling methodology because the supply block contains species/site types of known susceptibility to root disease. Application of the methodology to the remaining supply blocks would provide the root disease loss factors for the TSA as a whole.

3 STAGES OF APPLICATION

The multistage root disease survey methodology has been applied to the Okanagan TSA in the following sequence:

STAGE 1

Obtain an Okanagan TSA key map (Appendix A) showing supply block boundaries. Mark PSYU boundaries in the demonstration supply block (No. 6).

STAGE 2

Obtain a biogeoclimatic subzone (BGCS) key map for the TSA (Appendix B) showing subzone boundaries.

STAGE 3

From the BGCS key map, prepare a map of Supply Block No. 6 demonstration area, identifying risk and non-risk subzones (Appendices C and F). Mark the known root disease infection areas on this map. Delete supply blocks within non-risk subzones.

STAGE 4

From the BGCS key map, prepare a map of Supply Block No. 6 demonstration area, identifying risk and non-risk compartments (Appendices D and F). Delete non-risk compartment areas (nil for this demonstration area). Fourteen compartments are fully or partially within risk subzones: R.37 - C.2, C.3, C.4, C.12, C.13; R.38 - C.2, C.3, C.12, C.13, C.14, C.15, C.16, C.17, and C.18.

STAGE 5

Identify all risk compartment areas on 1:20 000 forest cover maps (Appendix E). At least 20 of these are required to cover Supply Block No. 6. One map, 82L064, was chosen for demonstration purposes.

STAGE 6

Identify susceptible species/site types (dry- and wet-belt types leading in Douglas-fir, and wet-belt types leading in western redcedar and western hemlock) and non-susceptible species/site types in compartment areas on the 1:20 000 forest cover maps (Appendix E). Portions of Compartment Nos. 2, 3 and 13 of Region 37 on map 82L064 were chosen for demonstration purposes. Delete non-susceptible species/site types.

STAGE 7

Designate which susceptible species/site types cover more than 10% of the compartment area (Appendix E). Sample areas will be selected from these strata. Delete susceptible species/site types comprising less than 10% of the compartment area.

STAGE 8

Select from the "10%" susceptible group the areas to be sampled. At least 5% of these strata should be selected for aerial photography sampling. It will now be possible to determine large-scale photography requirements.

Lay out flight lines over the selected susceptible types so that adequate 1:10 000 to 1:15 000 photography coverage is obtained (Appendix E). True-color photos will be the most suitable.

STAGE 9

Conduct the photography some time between May and September, preferably in June or July.

STAGE 10

Using the large-scale color photos, stratify the forest areas into four root disease classes: Absent, Light (< 2%), Medium (2 - 15%) and Heavy (> 15%) (Appendix J).

STAGE 11

Field check (ground sample) at least 10% of the area of medium and heavy classes identified on the large-scale color photos (Appendix E). Use the length intersection or line plot methods for ground-truth surveys.

STAGE 12

Compile root disease loss factors for the supply blocks by combining area information from the photo and ground sampling with MoF regional volume and yield table data.

Repeat the sampling procedure for each supply block to obtain loss factors for the TSA.

4 DISCUSSION AND EVALUATION

The multistage sampling procedure outlined in this report provides a satisfactory means of assembling the data required for sampling to ascertain root disease losses in a TSA, but resources did not permit verification of suggested aerial photography scales and sample size, and ground survey intensity relative to desired accuracy.

Obviously, the successful application of the multistage sampling methodology as developed in Phase II and described in Phase III will depend on extensive field testing.

Training schedules must precede test programs and should include not only training in photo sampling and ground survey technology, but also the use of the MoF Data Bank and computer mapping facilities. These services are available in MoF branch offices in Victoria, the regions and the districts. Canadian Forestry Service personnel have been leaders in root disease research programs, and their expertise and assistance must also be included in the training schedules.

It was neither possible nor necessary to repeat the application procedure for each supply block of the Okanagan TSA. Neither was it necessary to include the entire area of the demonstration supply block (No. 6) in the procedure, as the description of the process for a selected portion of the supply block of one map represented an adequate model of the multistage methodology.

In actual practice, risk compartments on all maps for each supply block would be sampled to accomplish a complete survey of a TSA.

Appendix J provides an area summary of each susceptible species/site type for all risk compartments in Supply Block No. 6. This table shows that approximately 63 000ha of susceptible species/site types are present in the supply block. Over 55 000ha of this total are in the wet-belt Douglas-fir risk types. Using the proposed 5% photo sampling intensity, it would be necessary to examine, on the aerial photos, approximately 2 800ha. For example, this would mean sampling five areas of approximately 550ha each (Appendix E).

Ground truthing will be required to establish the reliability of the aerial photography estimation. Ground checking of 10% of each area photographed (approximately 55ha) will determine if the photo estimates are sufficient to provide the desired accuracy.

Either the length intersection method or a line plot method now being used experimentally by the MoF and CFS in the Merritt TSA will be used for ground survey operations.

This sampling procedure will provide the area of root disease openings for each susceptible species/site type in the supply block. The same sampling procedure must be repeated for the other supply blocks to obtain complete coverage for the TSA.

The area estimates will be combined with volume and yield information from MoF region and district sources to compile root disease loss factors for the TSA.

Aerial photography of the required scale (1:10 000 to 1:15 000) and in true color is not available for most areas. However, to keep costs within acceptable levels, the procedure recommended has reduced the area requiring photography to a minimum. Aerial photography samples can be reduced further where similar species types within a similar biogeoclimatic subzone overlap adjacent supply blocks.

5 COST ESTIMATES

Total multistage sampling costs for a TSA will depend primarily on the extent of risk subzones and susceptible species/site types in the TSA. The Okanagan TSA contains nine supply blocks, but detailed costs have been estimated for the demonstration supply block (No. 6) only. However, since the supply blocks are roughly the same size and "similar" in species association content, costs to sample the entire TSA would be roughly nine times those for Supply Block No. 6.

COSTING DETAILS FOR SUPPLY BLOCK No. 6

	MANDAYS	COST
Preliminary analyses	10	$ 3 750
Aerial photography		2 000
Aerial photography analyses	10	3 750
Ground truth operations (including field expenses)	16	7 600
Final analysis	10	3 750
Maps		150
Data Bank material		150
Computer	—	200
	46	$21 200

Plus cost of final TSA report:	$ 10 000
TSA cost (9 x $21 200)	190 000
TOTAL FOR TSA	$200 800*

* Costs of fine-tuning the sampling procedure, training crews, etc. are not included in this estimate.

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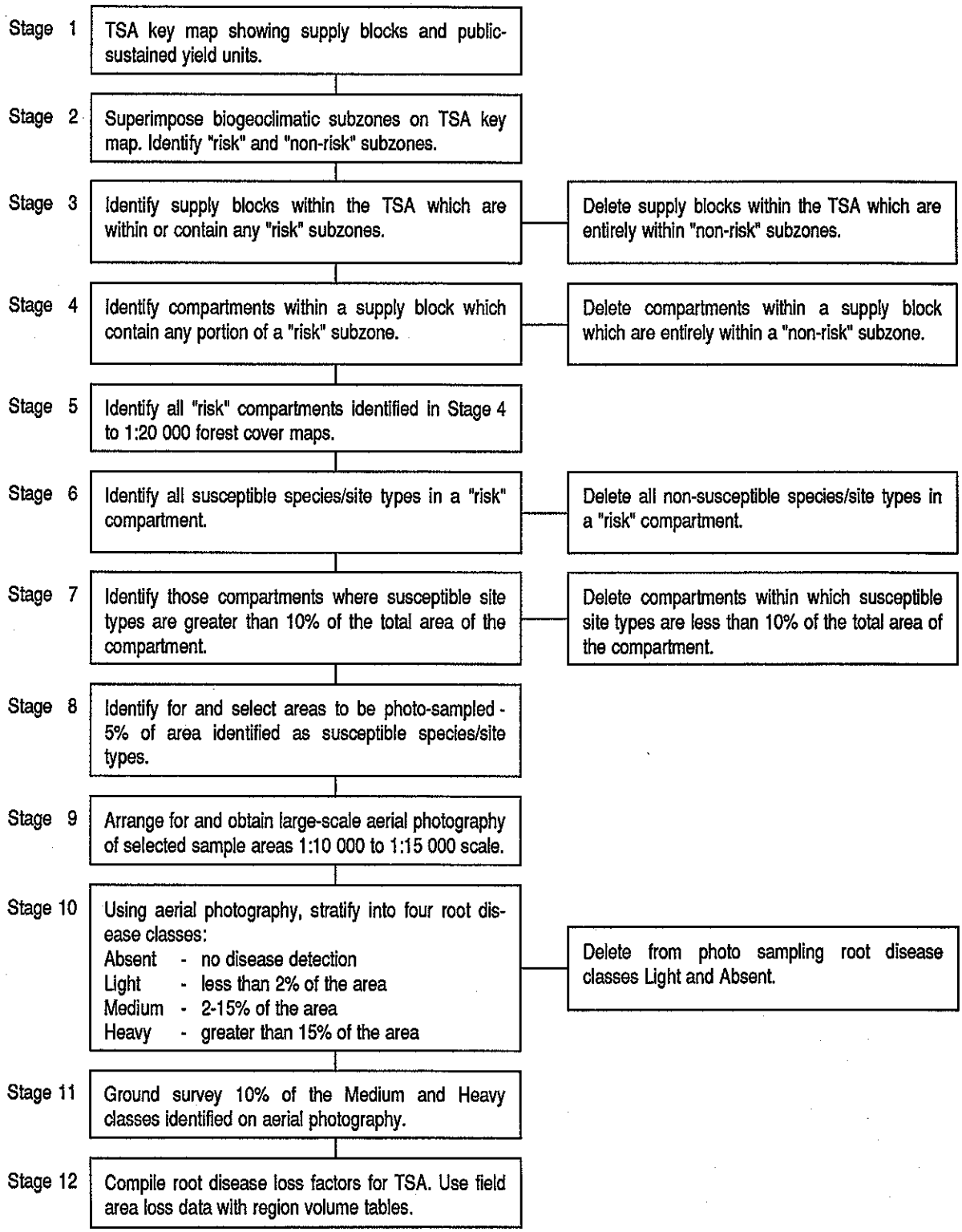
FIGURE 1 FLOWCHART OF MULTISTAGE SAMPLING METHODOLOGY