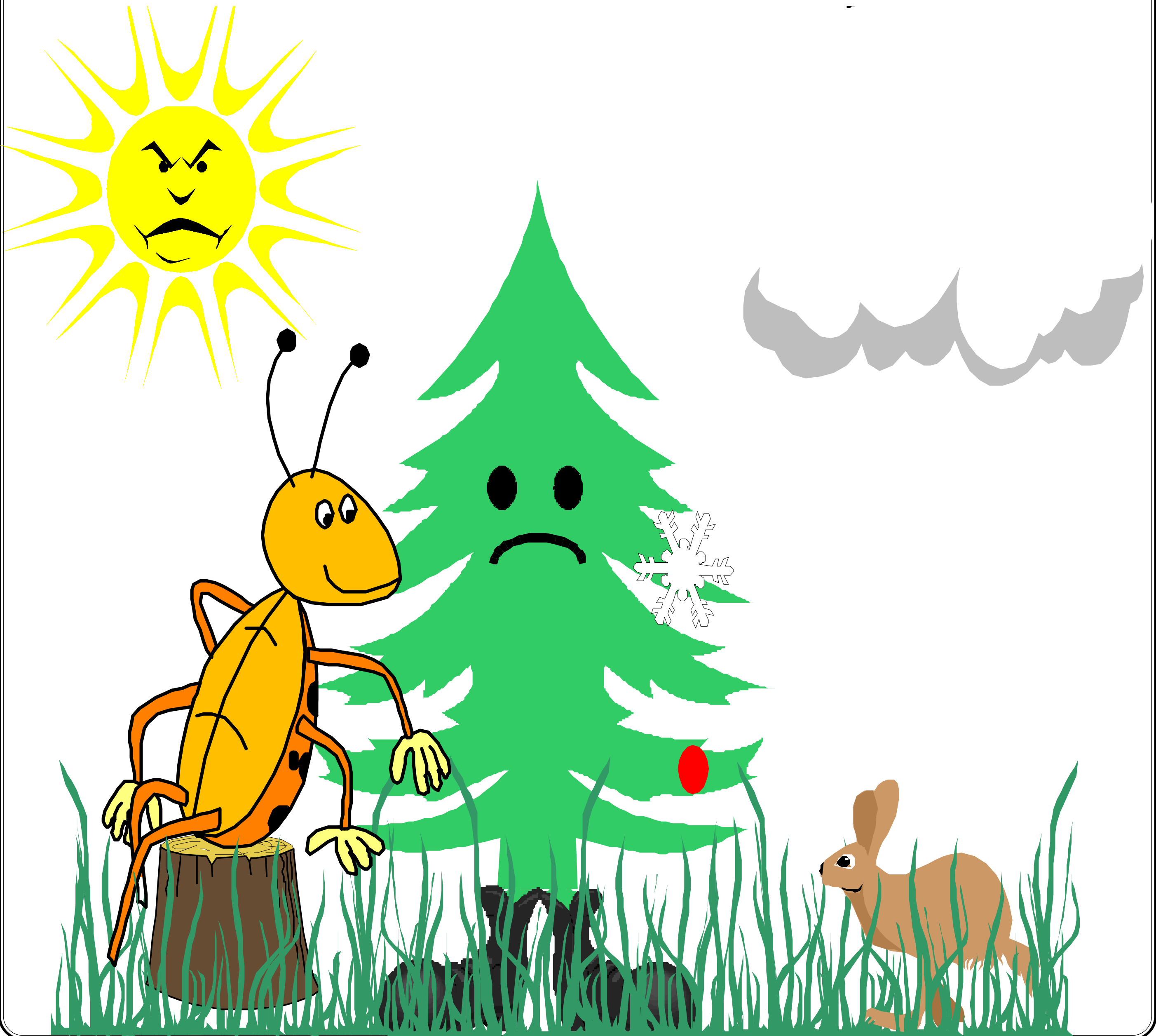




Forest Health

for Silviculture Surveyors





Acknowledgements

The Forest Health for Silviculture Surveyors Course was originally developed and produced by Larry McCulloch and the staff at Laing and McCulloch of Smithers, in 1995. The course was presented on numerous occasions over the following few years. As time progressed, the knowledge of forest health issues grew, making the format and content of the original course less valuable.

In January of 2000, an initiative directed by John Muir, RPF, of the Ministry of Forests, was undertaken to bring these materials up to date. The intent was to bring the course content up to the present day's level of forest health understanding. Course materials were revised based on the collection of new ideas presented by the participants, instructors and forest health professionals.

The successful restructuring of this course was possible only through the involvement of John Wallis (Wallis Environmental Consultants), and Joan Holt (Entopath Management Ltd.). This version of the course was developed by Allen & Sue Schaad and the team at Prifor Management Ltd., of Williams Lake.

Purpose

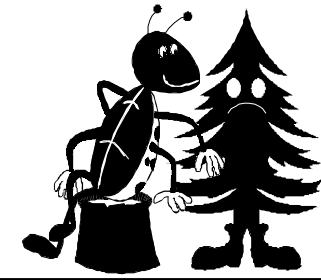
The primary purpose of this course is to provide silviculture surveyors with an opportunity to become more aware of:

- the importance of forest health issues
- methods employed in identifying major causes of mortality, growth and wood quality reduction
- the host(s), symptoms and impacts of forest pests
- the use of common reference material
- the approved methods for collecting forest health data
- how to apply the Free Growing Damage Criteria to silviculture surveys
- common treatment methods and the creation of treatment recommendations
- preparing for the forest portion of the Silviculture Survey Accreditation Examination

The course itself only provides an opportunity for participants to learn the methods of forest health identification and the options for treatment recommendations. It is expected that the participants will need to combine the knowledge gained in the course with their personal silviculture and forest health experience through field application over time to become fully proficient in the subject.



Forest Health for Silviculture Surveyors Participant's Workbook



Agenda

Today

Introduction

Importance of Forest Health

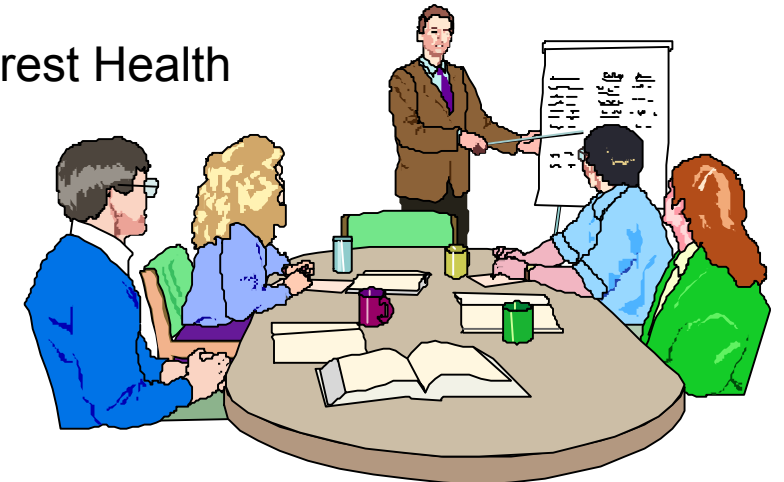
Foundation

Identification

Application

Free Growing Damage Criteria

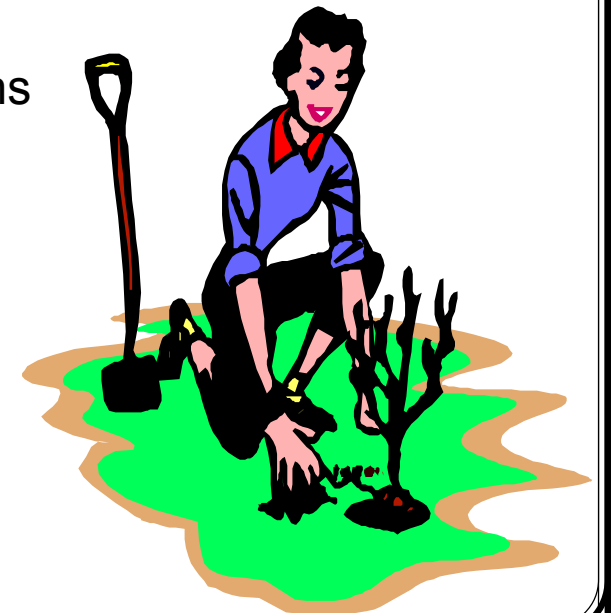
Treatment Recommendations



Tomorrow

Field Practice of the

concepts learned today



Principal Learning Objectives

Through this course participants will have the opportunity to.....

Learn the **importance of forest health** information,

Develop a foundation of terms, definitions and concepts,

Be introduced to the **identification, hosts and impacts** of the major causes of tree mortality and growth reduction,

Use common **reference material** to learn more about forest health factors,

Learn **data collection** methods and apply **free growing damage criteria**,

Become familiar with some of the common **treatments** and **recommendations**.



*It would be nice if we can have
some fun while we learn!*



Silviculture Survey Accreditation Exam...

2000 Performance Objectives;

1. Understand current legal requirements as they relate to silviculture surveys and **how to stay current**.
4. List the reasons (criteria) for **stratification**, and describe why good stratification is important for a silviculture survey.
5. Choose the survey, **timing of the survey**, the type of data to collect and the sampling method to effectively address on-site critical factors.
10. Understand the purpose of the **walk-through**.
17. Identify **critical factors** and explain how they affect the establishment, growth and development of the future stand and the achievement of stand objectives. This will include site limiting factors and management limiting factors such as:
 - Frost
 - Soil nutrients
 - Soil moisture
 - **Forest health factors**
 - Soil conservation hazards and sensitivities
 - Soil temperature
 - Non-timber management issues

The exam is tough without

thorough preparation.

It is offered in the spring and fall

in each Forest Region as the

demand dictates.

Silviculture Survey Accreditation Exam...

23. Collect and **record data** on MOF field form FS 657 and 658.
26. **Summarize data** on MOF forms FS 659 and FS 1138A.
27. **Use** information from **data** analysis on FS 659 and FS 1138A to make appropriate administrative recommendations (i.e., establish more plots, label as NSR, FG, etc.)
30. **Identify forest health damage, along with the major regional pest species (biotic and abiotic).**
31. **Describe potential impacts of major regional forest health factors on the future stand.**



Sections 25. (b) (v) and 26. (b)

(iii) of the Silviculture

Practices Regulation requires

that the incidence of damage

by forest health factors be

reported.

The section reference may

change as the regulations are

amended periodically.

Accurate identification of forest health factors during a stocking

survey is important because it is a precursor of what to expect during

the subsequent free growing survey.

Forest Health Legislation

Forest Practices Code of BC Act

Silviculture Practices Regulation

Operational Planning Regulation

Administrative Remedies Regulation

and....

although not legislation, but considered "best current practices"

8 forest health related Guidebooks



Guidebooks available at;

[HTTP://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/Guidetoc.htm](http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/Guidetoc.htm)



Annual Losses to Forest Pests....

Based on the 1994/95 Ministry of Forests Annual report table C-2p;

	Bark Beetles	Defoliators	Dwarf Mistletoes	Root Diseases	Total
Cariboo Region	439	471	350	221	1,481
Total of All Regions	2,459	1,679	1,640	1,367	7,145

That is about 10% of the total volume harvested

EACH YEAR!

Expresses in '000m³

This data is old, but it still

reflects relative volume loss.

Annual Losses to Forest Pests....

Based on the 1994/95 Ministry of Forests Annual report table C-2p;

	Bark Beetles	Defoliators	Dwarf Mistletoes	Root Diseases	Total
Kamloops Region	165	143	260	224	792
Total of All Regions	2,459	1,679	1,640	1,367	7,145

That is about 10% of the total volume harvested

EACH YEAR!

Expresses in '000m³



*This data is old, but it still
reflects relative volume loss.*

Annual Losses to Forest Pests....

Based on the 1994/95 Ministry of Forests Annual report table C-2p;

	Bark Beetles	Defoliators	Dwarf Mistletoes	Root Diseases	Total
Nelson Region	57	32	98	58	245
Total of All Regions	2,459	1,679	1,640	1,367	7,145

That is about 10% of the total volume harvested

EACH YEAR!

Expresses in '000m³

Annual Losses to Forest Pests....

Based on the 1994/95 Ministry of Forests Annual report table C-2p;

	Bark Beetles	Defoliators	Dwarf Mistletoes	Root Diseases	Total
Prince George Region	1,595	1,025	262	529	3,411
Total of All Regions	2,459	1,679	1,640	1,367	7,145

That is about 10% of the total volume harvested

EACH YEAR!

Expresses in '000m³



Annual Losses to Forest Pests....

Based on the 1994/95 Ministry of Forests Annual report table C-2p;

	Bark	Defoliators	Dwarf	Root	
Total	Beetles		Mistletoes	Diseases	
Prince Rupert Region	162	0	315	73	550
Total of All Regions	2,459	1,679	1,640	1,367	

That is about 10% of the total volume harvested

EACH YEAR!

Expresses in '000m³

This data is old, but it still

reflects relative volume loss.

Annual Losses to Forest Pests....

Based on the 1994/95 Ministry of Forests Annual report table C-2p;

	Bark	Defoliators	Dwarf	Root	Total
	Beetles		Mistletoes	Diseases	
Vancouver Region	41	8	355	262	666
Total of All Regions	2,459	1,679	1,640	1,367	7,145

That is about 10% of the total volume harvested

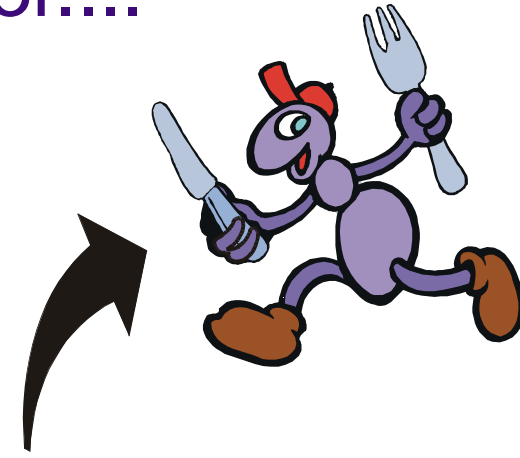
EACH YEAR!

Expresses in '000m³



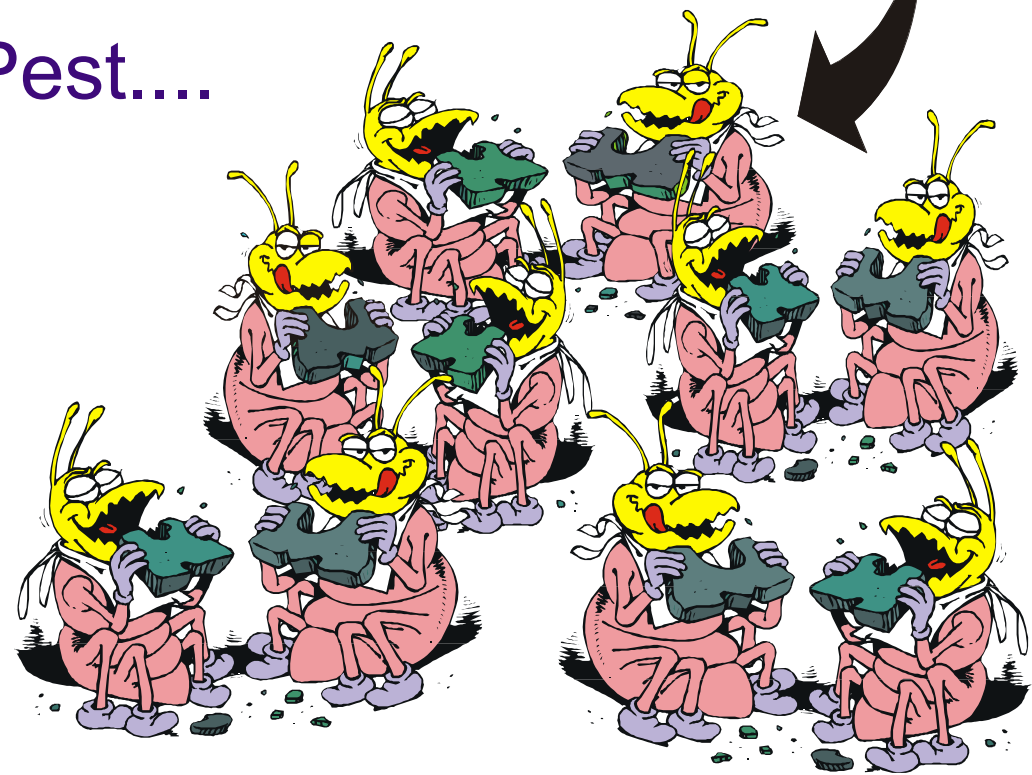
*The bugs, diseases, animals
and other causes of damage
are forest health factors until
they get out of control. When
they threaten the success of our
management objectives, they
are pests.*

Factor....



Endemic vs Epidemic

Pest....



Types of Forest Health Factors

Animal

deer, rabbits, squirrels...

Abiotic = 'non-living'

sun, wind, snow...

Diseases

root disease, stem disease, mistletoe...

Insects

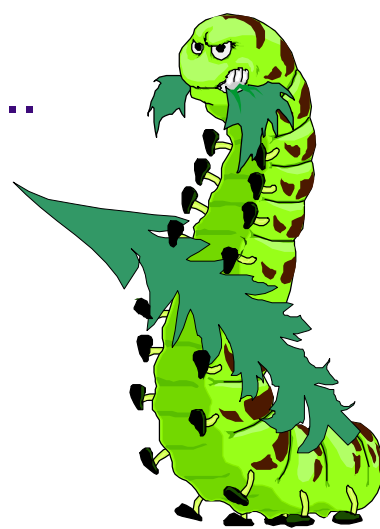
aphids, defoliators, weevils...

Treatments

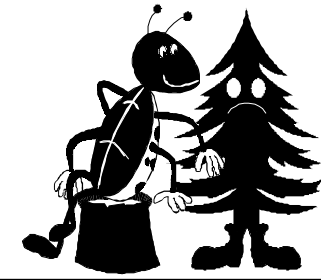
logging, planting, thinning...

Vegetation

herbs, shrubs, trees...



*Treatments and vegetation are a
bit of a stretch to be considered
"pests", but they are the causes of
damage to the crops we manage,
so we are interested in collecting
data about them too.*



This list is occasionally updated.

Look for the latest version....

....especially each spring.

Forest Health Abbreviation System

General to Specific

Disease **R**oot **A**rmillaria

General

Type of

Specific

Damage

Damage

Species

Type

The more common 160 are found on the FS 747

At last count there is a total of,

213

The complete list can be found in the appendix and at;

http://www.for.gov.bc.ca/isb/isis/user_guide/append_c/a_c_14.htm#f



Forest Health for Silviculture Surveyors
Participant's Workbook



BRITISH
COLUMBIA

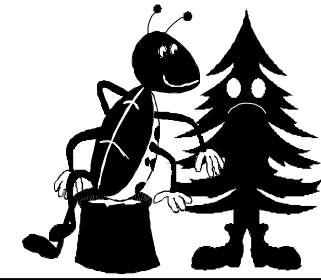


DAMAGE AGENT AND CONDITION CODES

FIELD CODES	DESCRIPTION	FIELD CODES	DESCRIPTION	FIELD CODES	DESCRIPTION
A	ANIMAL DAMAGE			DF	FOLIAGE DISEASES
AB	BEAR	AP	PORCUPINE	DFA	western pine aster rust <i>Coleosporium asterum</i>
AC	CATTLE	AS	SQUIRREL	DFC	large-spored spruce-labrador tea rust <i>Chrysomyxa ledicola</i>
AD	DEER	AV	VOLE	DFD	spruce needle cast <i>Lirula macrospora</i>
AE	ELK	AX	BIRDS	DFE	elytroderma disease <i>Elytroderma deformans</i>
AH	HARE OR RABBIT	AZ	BEAVER	DFH	larch needle cast <i>Hypodermella laricis</i>
AM	MOOSE			DFL	pine needle cast <i>Lophodermella concolor</i>
N	ABIOTIC INJURIES			DFM	larch needle blight <i>Meria laricis</i>
NB	FIRE	NN	ROAD SALT	DFP	fir-fireweed rust <i>Pucciniastrum epilobii</i>
ND	DROUGHT	NR	REDBELT	DFR	Douglas-fir needle cast <i>Rhabdocline pseudotsugae</i>
NF	FLOODING	NS	SLIDE	DFS	red band needle blight <i>Mycosphaerella(Scirrhia)pini</i>
NG	FROST	NW	WINDTHROW	PSS	sirococcus tip blight <i>Sirococcus strobilinus</i>
NGC	frost crack	NWS	windthrow-soil failure	PDT	cedar leaf blight <i>Didymascella thujina</i>
NGH	frost-heaved	NWT	windthrow-treatment or harvest related	DL	LEADER OR BRANCH DIEBACKS
NGK	shoot / bud frost kill			DLD	dermea canker <i>Dermea pseudotsugae</i>
NH	HAIL	NX	WOUNDING / RUBBING	DLF	red flag disease <i>Potebniamyces balsamicola</i>
NK	FUMEKILL	NY	SNOW, ICE, SNOW PRESS	DLP	phomopsis canker <i>Phomopsis lokoyae</i>
NL	LIGHTNING	NZ	SUNSCALD	DLS	sydowia tip dieback <i>Sclerophoma pithyophila</i>
D	DISEASE			DLV	aspen-poplar twig blight <i>Venturia spp.</i>
DB	BROOM RUST			DM	DWARF MISTLETOES
DBF	fir broom rust <i>Melampsorella caryophyllacearum</i>			DMF	Douglas-fir dwarf mistletoe <i>Arceuthobium douglasii</i>
DBS	spruce broom rust <i>Chrysomyxa arctostaphyli</i>			DMH	hemlock dwarf mistletoe <i>Arceuthobium tsugense</i>
DD	STEM DECAYS			DML	larch dwarf mistletoe <i>Arceuthobium laricis</i>
DDB	birch trunk rot <i>Fomes fomentarius</i>			DMP	lodgepole pine dwarf mistletoe <i>Arceuthobium americanum</i>
DDD	sulfur fungus <i>Laetiporus sulphureus</i>			DR	ROOT DISEASES
DDE	rust-red stringy rot <i>Echinodontium tinctorium</i>			DRA	armillaria root disease <i>Armillaria ostoyae</i>
DDF	brown crumbly rot <i>Fomitopsis pinicola</i>			DRB	blackstain root disease <i>Ceratocystis wageneri</i>
DDH	hardwood trunk rot <i>Phellinus ignarius</i>			DRC	laminated root rot (cedar) <i>Phellinus weirii</i>
DDO	cedar brown pocket rot <i>Poria sericeomollis</i>			DRL	laminated root rot <i>Inonotus sulphurascens(Phellinus weirii)</i>
DDP	red ring rot <i>Phellinus pini</i>			DRN	annosus root disease <i>Heterobasidion annosum</i>
DDQ	quinine conk rot <i>Fomitopsis officinalis</i>			DRR	rhizina root disease <i>Rhizina undulata</i>
DDS	Schweinitz butt rot <i>Phaeolus schweinitzii</i>			DRS	schweinitzii butt rot <i>Phaeolus schweinitzii</i>
DDT	aspen trunk rot <i>Phellinus tremulae</i>			DRT	tomentosus root rot <i>Inonotus tomentosus</i>
				DS	STEM DISEASE (CANKER OR RUST)
				DSA	atropellis canker <i>Atropellis piniphila</i>
				DSB	white pine blister rust <i>Cronartium ribicola</i>
				DSC	comandra blister rust <i>Cronartium comandrae</i>

FS 747 HSP 99/1

FIELD CODES	DESCRIPTION	FIELD CODES	DESCRIPTION
DSE	sooty bark canker <i>Encoelia pruinosa</i>	IDS	conifer sawflies <i>Neodiprion spp.</i>
DSG	western gall rust <i>Endocronartium harknessii</i>	IDT	Douglas-fir tussock moth <i>Orgyia pseudotsugata</i>
DSH	hypoxylon canker <i>Hypoxylon mammatum</i>	IDU	satin moth <i>Leucoma salicis</i>
DSP	cryptosphaeria canker <i>Cryptosphaeria populina</i>	IDV	variegated cutworm <i>Peridroma saucia</i>
DSR	ceratocystic canker <i>Nectria galligena</i>	IDW	western spruce budworm <i>Choristoneura occidentalis</i>
DSS	stalactiform blister rust <i>Cronartium coleosporioides</i>	IDX	large aspen tortrix <i>Choristoneura confictana</i>
DST	target canker <i>Nectria galligena</i>	IDZ	western false hemlock looper <i>Nepytia freemani</i>
DSY	cytophora canker <i>Cytospora chrysosperma</i>	IS	SHOOT INSECTS
I	INSECTS	ISB	western cedar borer <i>Trachykele blondeli</i>
IA	APHIDS OR ADELGIDS	ISE	European pine shoot moth <i>Rhyacionia buoliana</i>
IAB	balsam woolly adelgid <i>Adelges piceae</i>	ISG	gouty pitch midge <i>Cecidomyia piniinopsis</i>
IAC	giant conifer aphid <i>Cinara spp</i>	ISP	pitch nodule moths <i>Petrova spp.</i>
IAG	Cooley spruce gall adelgid <i>Adelges cooleyi</i>	ISS	western pine shoot borer <i>Eucosma sonomana</i>
IAL	larch cone woolly aphid <i>Adelges lariciatus</i>	ISQ	Sequoia pitch moth <i>Synanthedon sequoiae</i>
IAS	spruce aphid <i>Elatobium abietinum</i>	IW	WEEVILS
IB	BARK BEETLES	IWC	conifer seedling weevil <i>Steremnius carinatus</i>
IBB	western balsam bark beetle <i>Dryocoetes confusus</i>	IWM	Magdalis sp.
IBD	Douglas-fir beetle <i>Dendroctonus pseudotsugae</i>	IWP	lodgepole pine terminal weevil <i>Pissodes terminalis</i>
IBI	engraver beetles <i>Ips</i>	IWS	white pine weevil (on spruce) <i>Pissodes strobi</i>
IBM	mountain pine beetle <i>Dendroctonus ponderosae</i>	IWW	Warren's root collar weevil <i>Hylobius warreni</i>
IBP	twig beetles <i>Pityogenes, Pityophthorus spp</i>	IWY	cylindrocopturus weevil <i>Cylindrocopturus spp.</i>
IBS	spruce beetle <i>Dendroctonus rufipennis</i>	IWZ	Yosemite bark weevil <i>Pissodes schwartzii</i>
IBT	red turpentine beetle <i>Dendroctonus valens</i>	M	MITE DAMAGE (TRISETACUS SPECIES)
IBW	western pine beetle <i>Dendroctonus brevicornis</i>	T	TREATMENT INJURIES
ID	DEFOLIATING INSECTS	TC	CHEMICAL
IDA	black army cutworm <i>Actebia fennica</i>	TH	HARVESTED
IDB	two-year budworm <i>Choristoneura biennis</i>	TL	LOGGING
IDC	larch casebearer <i>Coleophora laricella</i>	TM	OTHER MECHANICAL DAMAGE (NON-LOGGING)
IDD	western winter moth <i>Erannis vancouverensis</i>	TP	PLANTING
IDE	spruce budworm <i>Choristoneura fumiferana</i>	TPM	planting — poor microsite
IDF	forest tent caterpillar <i>Malacosoma disstria</i>	TR	PRUNING
IDG	greenstriped forest looper <i>Melanophila imatata</i>	TT	THINNING OR SPACING
IDH	western blackheaded budworm <i>Acleris gloverana</i>	V	VEGETATION PROBLEMS
IDI	pine needle sheath miner <i>Zelleria haimbachi</i>	VH	HERBACEOUS COMPETITION
IDL	western hemlock looper <i>Lambdina fiscellaria lugubrosa</i>	VP	VEGETATION PRESS
IDM	gypsy moth <i>Lymantria dispar</i>	VS	SHRUB COMPETITION
IDN	birch leaf miner <i>Fenusa pusilla</i>	VT	TREE COMPETITION
IDP	larch sawfly <i>Pristiphora erichsonii</i>		
IDR	alder sawfly <i>Eriocampa ovata</i>		



TOP TEN

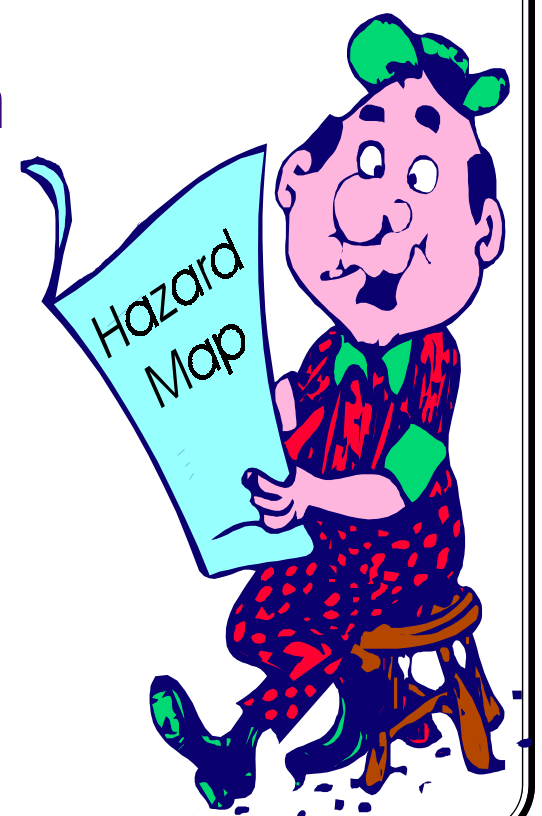
Most Important Forest Health Factors



...but which ten?

Hints...

- Establishment to Free Growing Guidebook (2000)
- Forest Health Guidebooks
- Regional BEC Books
- Hazard Maps
- Silviculture Prescription
- District & Region Staff
- Co-workers





What about the others?

All forest health factors present
on **All** trees in
All plots are recorded.

Missing one of the "TOP TEN" is a
serious error.

*This is different than page 20 of
the Silviculture Surveys
Guidebook. The procedure was
changed after the Guidebook
was published.*

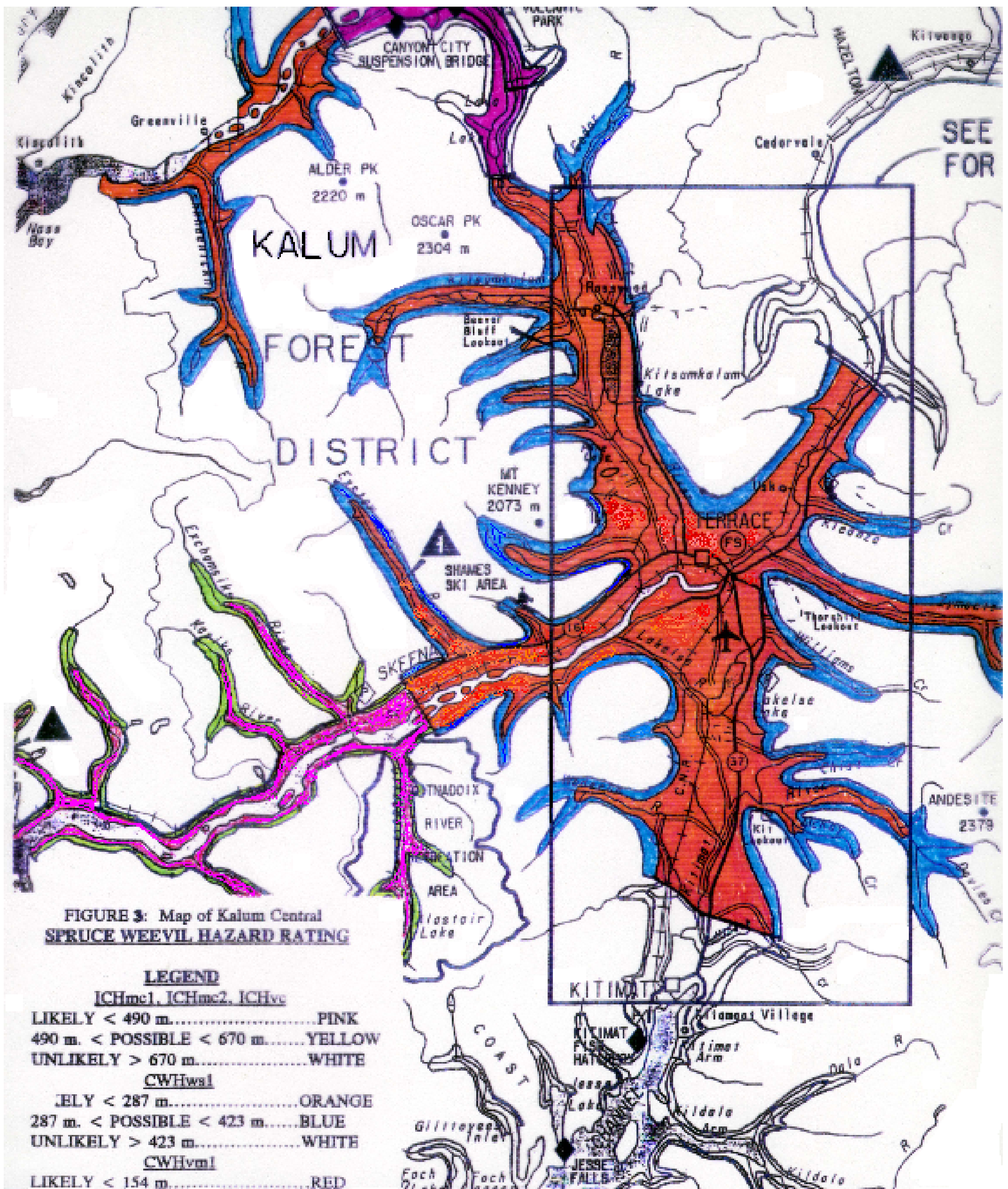
Hazard: the degree to which
the characteristics of the
sampling entity (usually a
tree or a stand) make it
vulnerable to damage. It is
equivalent to susceptibility.

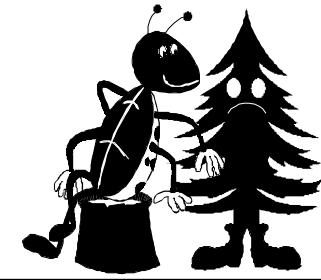
Hazard vs Risk

Risk: the probability and
expected severity of
sampling entity damage. It is
a function of numerous
components including
sampling entity, hazard,
sampling unit conditions,
proximity to damaging
agents and the incidence of
those agents.



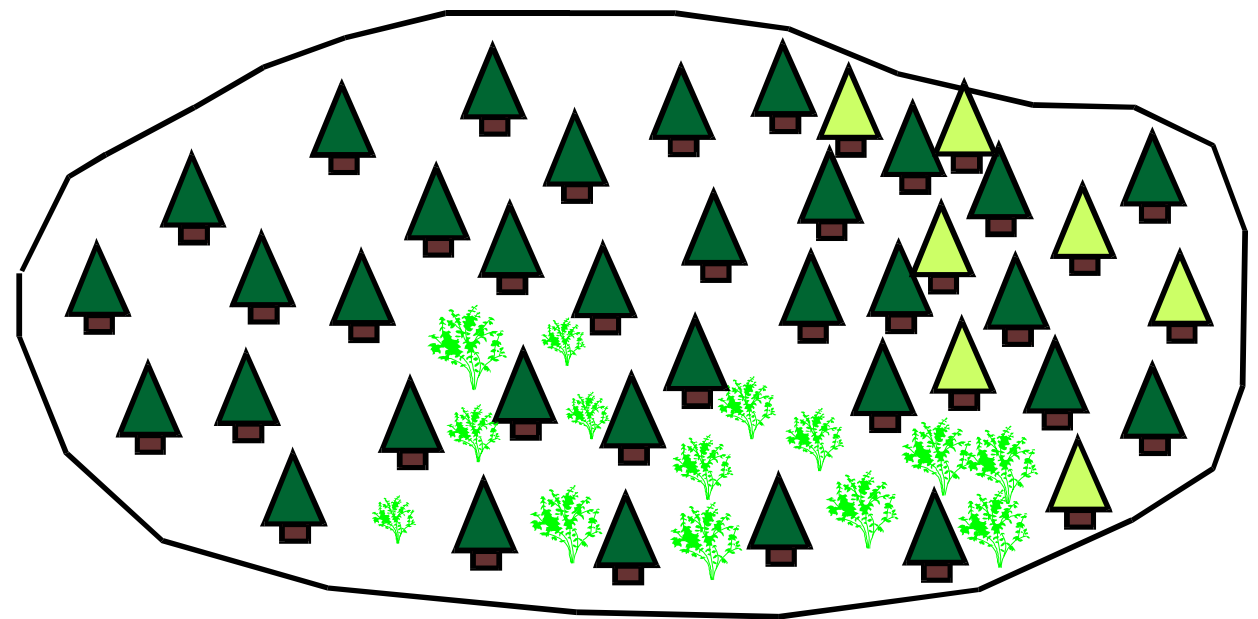
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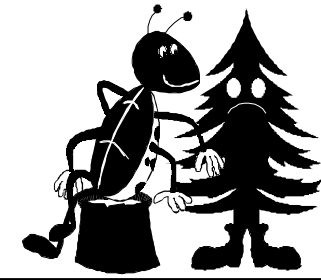




*But how different is different
enough?*

Stratification =
Separation of Different
and
Grouping of Similar





The **#1** Key to effective forest health
identification....



Observational Skills!

Sign: visible portion of a
fungus or insect, such as
conk or frass, seen on, in or
around the host



Sign vs Symptom



Symptoms: visible reaction of
a host to abiotic injury or
disease; for example chlorosis

Reproduced from; *Field Guide to Forest Damage in British Columbia*





	Sign	Symptom
Animal Damage	teeth marks droppings multiple vertical scratches hairs stuck in resin tunnels at ground level large sections of bark removed high on the tree	nipped off foliage and branchlets
Abiotic Injuries	mechanical slitting of bark at a young age	wide spread damage results evident early in the spring results evident following a major weather occurrence
Diseases	basal resinosis fruiting bodies	discoloration of foliage distress cone crop swelling shrinkage
Insects	frass entrance or exit holes black stain/blue stain	chlorosis mortality
Treatment Injuries	saw marks scars from machinery	open wound
Vegetation Problems	young trees crushed by grass and herbs foliage battered	poor vigor

A few examples are...



Forest Health for Silviculture Surveyors
Participant's Workbook

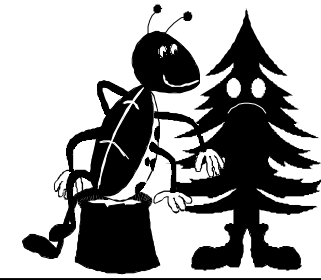


Survey Timing

AGENT	HOST	STAGE EVIDENT*	SEASON EVIDENT**	DURATION EVIDENT
ANIMALS				
Hare	All	up to 6 cm dbh	◆	several years (clipped seedlings evident ~1 yr)
Squirrel	PI (others)		◆ caused in spring & summer	several years
Vole	All		◆ caused in fall or winter	2 years with mortality several years without
Porcupine	PI, Spruce, Lw (Hw)		◆	several years
Ungulates	All (Ss)		◆	1 to several years
DISEASES				
Rusts	PI (other pines)		◆ gall rust ◆ other rusts	several years (stem rusts most easily seen in June)
Mistletoes	Hw, PI, Fd, Lw		◆ ◆	several years to several decades
Root Rots - annosus - armillaria - black stain - phellinus - tomentosus	Hw (True Firs, Ss) All Fd, PI (Hw) Fd, True Firs, (Lw) Sx (PI)	armillaria = all	◆ ◆ when snow free	several years to several decades
* STAGES				
Seedling 0 - 2 Yrs Regen. 3 - 10 Yrs Sapling 11 - 20 Yrs Pole 21 - 80 Yrs Mature 80+ Yrs All Ages				
** SEASONS				
Spring Summer Fall Winter All ◆				

Survey Timing

AGENT	HOST	STAGE EVIDENT*	SEASON EVIDENT**	DURATION EVIDENT
INSECTS				
Balsam Woolly Adelgid	True Firs		◆	1 year to several years
Warren's Root Collar Weevil	Sx, PI		◆	several years
Lodgepole Pine Terminal Weevil	PI		◆ most obvious in summer & fall of year attacked	several years
White Pine Weevil	Ss, Sx		◆ most obvious in summer & fall of year attacked	several years
ABIOTIC				
Frost	All		◆ ◆	1 to 2 years
Snow	All		◆	several years to several decades
* STAGES				
Seedling 0 - 2 Yrs Regen. 3 - 10 Yrs Sapling 11 - 20 Yrs Pole 21 - 80 Yrs Mature 80+ Yrs All Ages				
** SEASONS				
Spring Summer Fall Winter All ◆				



Let's try one...

Field Guide to Forest
Damage in BC

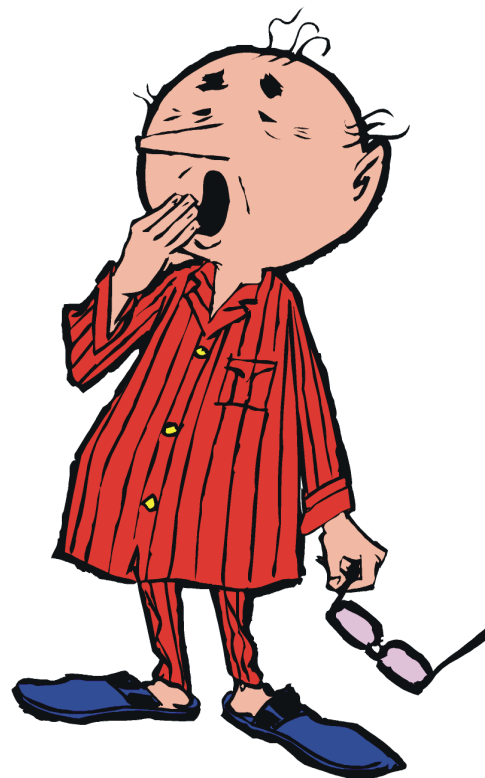
or

Field Guide to Pests of Managed
Forests in BC

replaced in 1999 by above publication

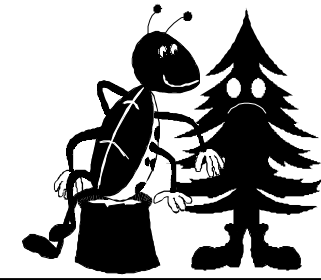


Did you say slide show?





Forest Health for Silviculture Surveyors Participant's Workbook



Other sources of help...

Co-workers

Supervisors

Internet

Ministry of Forests District Staff

Ministry of Forests Region Staff

Universities, Colleges and

<http://www.forestry.ubc.ca/fetch21/fetch21/FETCH21.html>

Forestry Canada Staff and

http://www.fcmr.forestry.ca/fhn/ma/insect_e.htm

<http://www.pfc.forestry.ca/nursery/>

Hints for sending a specimen to Canadian Forestry Service

Read the instructions on the back of the form.

Include good, clear **photographs** from various angles.

Package moist samples in **paper** rather than plastic.

Whole samples are better than fragments (where practical).

Film containers with a tissue are good for insect samples.

Animal droppings and debris from suspected animal damage is also useful.

Ship the samples as soon as they are collected.

Expect three weeks or more for a reply.

A sample form is located in the Appendix.





Forest Health for Silviculture Surveyors Participant's Workbook



Collection and identification of forest insects and fungi are essential for effective forest management. Legal, scientific and historical benefits of expert identification and archiving include records for quarantine and regulatory issues, substantiation of current outbreaks and previously undetected pests, and documentation of research results.

SPECIMENS ACCEPTED

Please submit only the following types of specimens:

- insects, diseases and fungi from forest habitats or wood products (not from agricultural, garden or ornamental plants, or stored products);
- pests causing new or major outbreaks;
- field identifications by contractors, only by prior arrangement by Ministry regional or district staff;
- materials to document special studies, surveys, research and publications;
- unusually severe damage by known or unknown factors, for future reference.

REPORT INFORMATION

All specimens sent to the Canadian Forest Service (CFS) must include a FS 466 form or equivalent with the following minimum data (letters correspond to those on front of this form):

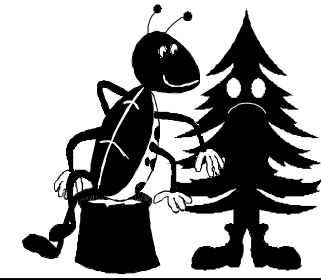
- A** Geographic location of collection (reference the collection location to a recognized locality on 1:100 000 or 1:250 000 map sheet), and either UTM grid or latitude/longitude.
- B** Date of collection (year-month-day, e.g., 96 06 04).
- C** Name, affiliation, mailing address, telephone and fax numbers, and e-mail address of collector. Give name, affiliation, mailing address, telephone and fax numbers, and e-mail address of individual requesting identification, under "Remarks", if different from "C".
- D** Host/substrate information (host species, age, condition, number of hosts similarly affected, location of damage on host, or type of substrate, if not a plant).
- E** Description of area (e.g., non-forest, natural forest, plantation, bog, urban).
- F** Damage intensity and occurrence.
- G** Note unusual conditions/contributing factors, e.g., heavy frost, drought, chemical applications, proximity to roads, etc. Attach extra sheet if needed for remarks.

SPECIMENS AND SHIPMENT

Special care must be taken to collect an adequate specimen and to prevent deterioration of material in transit. Inadequate or spoiled material cannot be processed. Ship live material by Priority Post or courier, and use crush-resistant containers (e.g., mailing tins). For labels on vials, notes and enclosures, use HB pencil or India ink to ensure permanency. Except for shipping defoliating insects, **NEVER USE PLASTIC BAGS OR WRAP**, and do not moisten specimens. For fresh disease or fleshy fungi collections, prevent mould contamination by using paper envelopes, paper wrapping and cardboard boxes for shipping.

- **Larvae of defoliators:** Ship 10-20 live larvae in a tied plastic bag with sufficient foliage for 3-5 days of feeding. Ship additional larvae in small screw-top vials containing 70-80% ethanol (preferred) or isopropyl (rubbing) alcohol. Vials must be well sealed and packaged with sufficient absorbent material and a waterproof wrap to prevent contamination or leakage if a container should break.
- **Larvae of bark beetles or woodborers:** Collect borers in small-diameter (<10 cm) stems or shoots. Ship larvae from larger material in alcohol, as above. Enclose a sample of typical damage, packaged separately.
- **Pupae and hard-bodied insects:** Ship live material in small containers with packing to protect during shipping. Place dead adult specimens between layers of tissue paper (no cotton) in a rigid container with sufficient packing to prevent any movement of material within the container.
- **Foliar diseases:** Collect 20 cm-length branches with leaves. Press flat between newsprint or, for bushy specimens, wrap in a paper bag. Include a cutting of healthy foliage (labelled) for comparison, and flowers or fruit of host plant, if identity unknown. For spring collections, include overwintered, old foliage from ground litter or on tree for possible mature fruiting bodies.
- **Stem and branch diseases:** For small-diameter material, cut a 20 cm-length of affected and adjacent healthy stem material. For larger material, cut a section of at least 10 x 10 cm from the edge of a canker. Include affected and healthy-appearing tissue. Include a section of bark with any apparent fruiting bodies.
- **Decay in wood, root disease and blowdown trees:** Determine tree species. Collect any conk or mushrooms closely associated with decay. At any fungal conks, areas of breakage or suspect decay, including decayed or diseased roots, cut a wood section of at least 15 cm x 15 cm x 15 cm that includes decayed, stained and apparently sound wood. Describe decay. For suspect root disease, select trees that were recently killed, fallen or declining (symptomatic), and avoid trees or roots that have been dead for one or more years. Sample fresh roots with disease features such as pitching, mycellia and/or stain. Package wood samples and conks separately. Label and wrap in newsprint.
- **Fleshy Fungi:** Collect several specimens, especially of varying maturity. For ground specimens, pry as much of the mushroom as possible out of the ground with a knife. For specimens on wood, also collect a specimen of any underlying wood decay, as described above. Dry all fleshy fungi before shipping. Air-dry small fragile specimens in a warm dry place, and for larger fungi, heat-dry at 50°C. Spore prints from fresh collections can be submitted with dried specimens. Package in dry material to protect in transit.

SEND SPECIMENS WITH WHITE COPY OF THIS FORM TO: **CANADIAN FOREST SERVICE**
Pacific Forestry Centre
506 West Burnside Road
Victoria, B.C. V8Z 1M5
Attention: Insectary/Herbarium
Tel.: 363-0600 Fax: 363-6005



*It tells others about your ability
to identify forest health factors.*

*It can not be entered into
computer compilation systems.*

*It should be used only until
you have correctly
identified the forest health
factors.*

What if I still don't know what it is?

General to Specific

Disease **R**oot ? Unknown

General
Damage
Type

Type of
Damage

Specific
Species

Use this with care.

Forest Health Data Collection

When and where does it apply?

Forest health data collection and analysis is an integral part of every silviculture survey.

**All the time,
every tree,
in every plot,
for every survey.**



*This is different than page 20 of
the Silviculture Surveys
Guidebook. The procedure was
changed after the Guidebook
was published.*



DATA ON THE TOTAL HEIGHT AND AGE OF WELL-SPACED TREES, MAIN COMPETING VEGETATION AND INVENTORY COMPONENT SHOULD BE RECORDED ON THE FIRST PLOT ESTABLISHED IN THE STRATUM, AND EVERY FOURTH PLOT THEREAFTER. PUT INVENTORY COMPONENT ON LINES BETWEEN PLOTS.



Field Descriptions for the FS 658

Field	Description
1	Total trees are recorded as usual. These values will be used in the subsequent calculations.
2	Total conifers are recorded as usual. These values will be used in the subsequent calculations.
3	Record the three letter pest code for each forest health factor found in the plot. Multiple rows will be required for multiple forest health factors in a single plot.
4	Record the number of trees that are alive and affected by the forest health factor.
5	Record the number of trees that are dead as a result of the forest health factor.
6	This space is left for comments related to the general health of the survey area. The comments here are not summarized. The comments are usually qualitative and based on visual observation.



PAGE OF

FILE ORIGINAL IN DISTRICT OFFICE ON OPENING FILE.



Field Descriptions for the
FS 659 - Front Side

Field	Description
1	The total tree value in this field is transferred to column 2 on the back of the FS 659.
2	The total conifer value in this field is transferred to column 3 on the back of the FS 659.
3	The percentages for each forest health factor will be used in column 6 on the back of the FS 659.



FS 659 - Back Side



BRITISH
COLUMBIA



SILVICULTURE
SURVEY SUMMARY

USE THIS FORM TO SUMMARIZE PLOT INFORMATION FROM THE FS 658 AND SUMMARIZE SILVICULTURAL

PAGE	OF
------	----

SUMMARY OF COMPETING VEGETATION										CHECK (✓) APPROPRIATE BOXES										PEST INFORMATION SUMMARY										
SPECIES (INCLUDE ONLY THE FOUR MAIN COMPETING SPECIES)	ESTIMATED % COVER	CURRENT			HT. INCREMENT	DISTRIBUTION			CURRENT				POTENTIAL			1	2	3	4	5	6	7	8	9						
		MINIMUM	MAXIMUM	AVERAGE		CONTINUOUS	PATCHY	SCATTERED	HIGH	MEDIUM	LOW	NIL	HIGH	MEDIUM	LOW	NIL	PEST	TOTAL (sum of Total Trees column)	TOTAL (sum of Total Conifers column)	LIVE TREES (sum of Live Trees Affected)	DEAD TREES (sum of Dead Tree)	HOST SPECIES (from Inventory Label) (expressed	% TOTAL TREES [(4)+(5)] x 100	% CONIFERS [(4)+(5)] x 100	% HOST TREES [(4)+(2x6)] x 100					
RECOMMENDED TREATMENTS																														
SITE PREPARATION (method, sensitivity, season, year)																														
REGENERATION METHOD (species, stock type, stock age, season, year)																														
BRUSHING (method, season, year)																														
STAND TENDING (method, season, year)															PEST MANAGEMENT (eradication, surveys)															
															10															
SURVEYS (type, season, year)															FISH AND WATER (spawning areas, buffer zones, water quality, potable water)															
PRIMARY TREATMENT RECOMMENDATIONS															ALTERNATE TREATMENT RECOMMENDATIONS															
															11															



Field Descriptions for the
FS 659 - Back Side

Field	Description
1	The three letter pest code recorded on the FS 657. One row per forest health factor.
2	The total tree value in this field is transferred from field 1 on the front of the FS 659
3	The total conifer value in this field is transferred from field 2 on the front of the FS 659
4	The total number of live trees affected by that forest health factor from each of the plots in the stratum.
5	The total number of dead trees killed by that forest health factor from each of the plots in the stratum.
6	Based on the inventory label
7	The sum of column 4 plus column 5, divided by the sum of column 2 plus column 5, then multiplied by 100
8	The sum of column 4 plus column 5, divided by the sum of column 3 plus column 5, then multiplied by 100
9	Column 4, divided by column 2 multiplied by column 6, then multiplied by 100
10	Where a treatment is required to reduce the impact of a forest health factor, descriptions should be entered here.
11	Alternate treatments should also be considered.

Incidence =

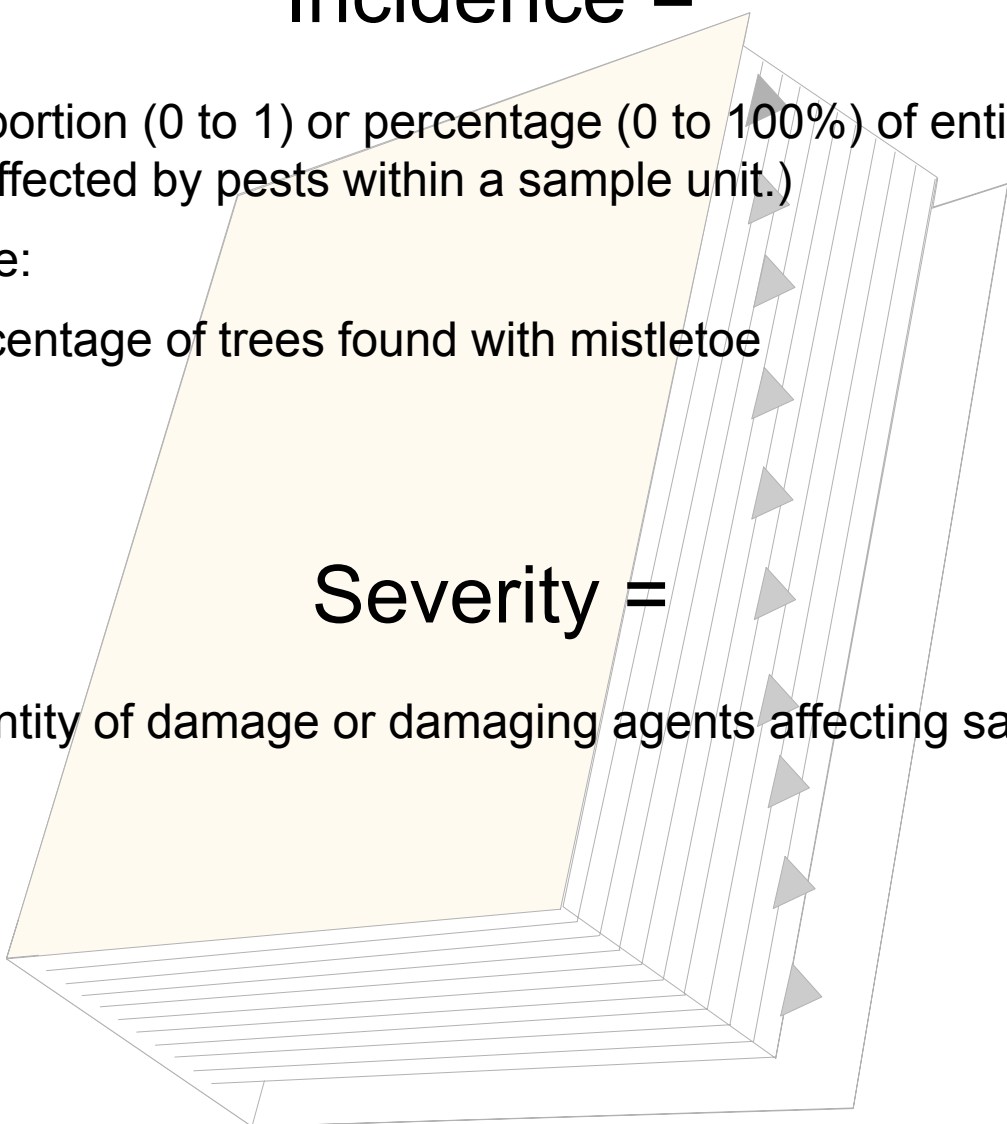
the proportion (0 to 1) or percentage (0 to 100%) of entities (trees affected by pests within a sample unit.)

Example:

the percentage of trees found with mistletoe

Severity =

the quantity of damage or damaging agents affecting sample



Incidence is a measure of

“how many” are affected.

Severity is a measure of “how

bad” are they affected.



Forest Health for Silviculture Surveyors Participant's Workbook



Location of damage	Type of damage	Tree being assessed is UNACCEPTABLE if:	Host species	Likely damage agents & damage agent codes	Comments
Stem	Wound (including sunscald and girdling)	<p>the tree has any wound which is greater than 33% of the stem circumference, or</p> <p>the tree has a wound which is greater than 20% of the total length of the stem, or</p> <p>the tree has a wound centred on an infection caused by a stem rust, canker, or dwarf mistletoe (See Note under Stem: Infection).</p>	All	squirrel AS, beaver AZ, vole AV, porcupine AP, hare AH, Warrens root collar weevil IWW, sequoia pitch moth ISQ, fire NB, windthrow NW, sunscald NZ, logging TL, mechanical TM.	A wound is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when the tree is damaged by sunscald). Healed over wounds (= scars) are acceptable. See Figure 1.
Stem	Insect mining at root collar	the tree is currently attacked by a bark-mining insect such as a weevil or a beetle and exhibits symptoms such as foliage discoloration, thinning, and/or reduced height growth increments	PI, Sx	root collar weevil IWW.	Only trees that are symptomatic should be checked for insect infestation or mining damage. Non-symptomatic trees are presumed to be unaffected by insect mining.
Stem	Deformation (including crook, sweep, fork, browse, and dead or broken top)	<p>the pith is horizontally displaced more than 30 cm from the point of defect and originates above 30 cm from the point of germination.</p> <p>the tree leader has been killed three or more times in the last five years (weevil only).</p> <p>the tree has two or more leaders with no dominance expressed after five years growth and the fork originates above 30 cm from the point of germination.</p> <p>the tree has a dead or broken top at a point that is >2 cm (>3 cm for the coast) in diameter.</p>	<p>For sweep, all except Cw and Hw</p> <p>Sx, Ss, PI</p> <p>All</p> <p>All</p>	<p>Defoliators ID, white pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP, northern pitch twig moth ISP, sequoia pitch moth ISQ, cattle AC, deer AD, elk AE, moose AM, frost NG, hail NH, snow NY, drought ND, logging TL, mechanical TM.</p> <p>White pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP.</p> <p>terminal weevils (IWS, IWP), frost NG, animal damage A.</p>	<p>For horizontal displacement see Figure 2.</p> <p>This criterion applies only for terminal weevil damage.</p> <p>Leader dominance occurs when the tallest leader is at least 5 cm taller than the second tallest leader. See Figure 3.</p>



Forest Health for Silviculture Surveyors Participant's Workbook



Location of damage	Type of damage	Tree being assessed is UNACCEPTABLE if:	Host species	Likely damage agents & damage agent codes	Comments
Stem	"Infection (including cankers and galls)"	any infection occurs on the stem.	All	comandra blister rust DSC, stalactiform blister rust DSS, white pine blister rust DSB, western gall rust DSG, atopellis canker DSA.	Note: Wounds caused by rodent feeding around rust cankers should have stem rust recorded as the causal agent.
Branch	"Infection (cankers)"	an infection occurs on a live branch less than 60 cm from the stem.	Pw, PI, Py	white pine blister rust DSB, comandra blister rust DSC, stalactiform blister rust DSS.	See Figure 4.
Branch	Galls	a gall rust infection occurs on a live branch less than 5 cm from the stem.	PI, Py	western gall rust DSG.	See Figure 4.
Branch	Gouting	any adelgid gouting occurs on a branch	Ba, Bg, BI	balsam woolly adelgid IAB.	Gouting is defined as excessive swelling of a branch or shoot caused by balsam woolly adelgid, and is often accompanied by misshapen needles and buds. It is most common on branch tips and at nodes near the ends of branches. Consult a recent distribution map to identify the geographic extent of this pest.
Foliage	Defoliation	>80% of tree foliage has been removed due to defoliating insects or foliage disease.	All	defoliators ID, foliage diseases DF.	
Stem or Branch	Dwarf mistletoe infection	any infection occurs on the stem or a live branch, or a susceptible tree is located within 10 m of an overtopping tree, which is infected with dwarf mistletoe.	Hw, PI, Lw, Fd	hemlock dwarf mistletoe DMH, lodgepole pine dwarf mistletoe DMP, larch dwarf mistletoe DML, Douglas-fir dwarf mistletoe DMF.	Note: To confirm infection, the surveyor must observe mistletoe aerial shoots or basal cups on regeneration or on live or dead fallen brooms. Overtopping tree is a tree that is three or more times taller than the median height of the trees being assessed.



Forest Health for Silviculture Surveyors Participant's Workbook



Location of damage	Type of damage	Tree being assessed is UNACCEPTABLE if:	Host species	Likely damage agents & damage agent codes	Comments
Roots	Root disease	sign(s) or a definitive combination of symptoms of root disease are observed.	All	armillaria root disease DRA, laminated root rot DRL, tomentosus root rot DRT, annosus root disease DRN, blackstain root disease DRB.	Signs are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. Symptoms include foliar chlorosis or thinning, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. An individual symptom is not sufficient to identify a root disease.
		infected tree found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRA is two, except in BEC zones PPdh1 and 2, IDFxh1, IDFdm1 and 2, MSdk1, and MSdm1 where the multiplier is one.	All	armillaria root disease DRA.	Note: All conifer species are considered susceptible. Broadleaf species are considered not susceptible for survey purposes only.
		infected conifer found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRL is four.	Fd, Sx, Se Lw, Ba, Bg	laminated root rot DRL.	Note: BI, Cw, PI, Pw, Py, and broadleaf species are considered not susceptible for survey purposes only.
		infected conifer or stump found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRT is two.	Se, Sx	tomentosus root rot DRT.	Note: Ba, BI, Cw, Fd, PI, Pw, Py and broadleaf species are considered not susceptible for survey purposes only.
		infected conifer found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRN is two.	Ba, Hw, Ss	annosus root rot DRN.	Note: Bg, BI, Cw, Cy, Fd, Hm, PI, Pw, Py, Sx and broadleaf species are considered not susceptible for survey purposes only.

Example: How to apply net down for root disease. If root disease-infected trees are found in the plot:

1.
In the first sweep, determine the total number of healthy, well-spaced trees using the prescribed minimum inter-tree distance (MITD) (e.g., 12 trees) ignoring the M-value;
2.
In a second independent sweep, determine the number of well-spaced infected trees (including dead infected trees and for DRT only, infected stumps) using MITD (e.g., one infected tree);
3.
Multiply the number from step 2 by the multiplier for the specific root disease and subtract this number from the number of susceptible healthy well-spaced trees found in step 1 (e.g., for DRA: $12 - 1(2) = 10$). The result is the maximum number of free growing trees tallied for the plot.

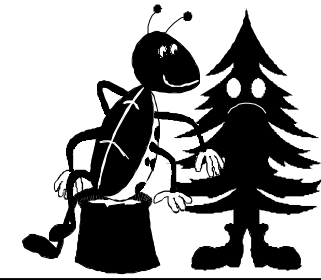
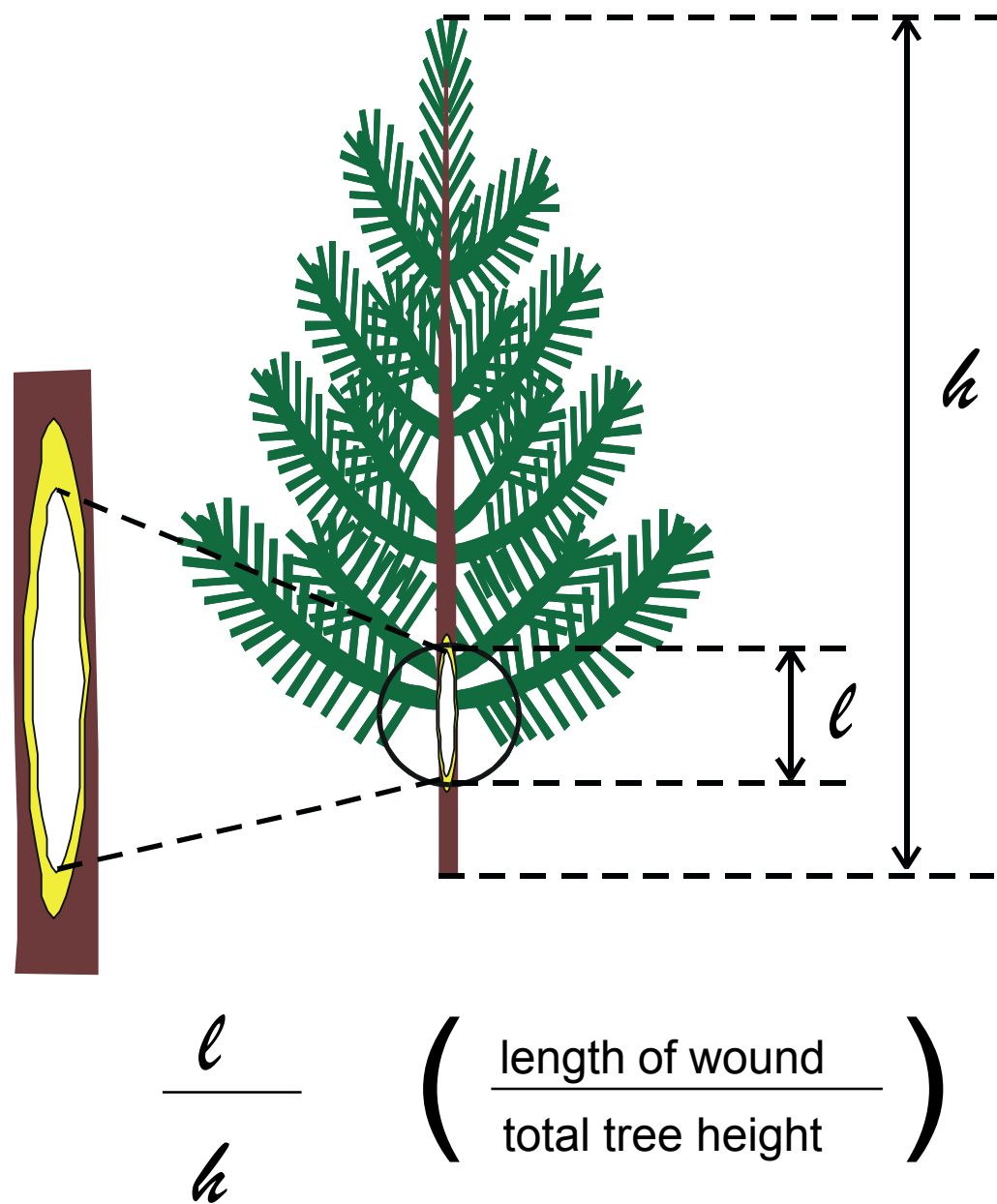


Figure 1. Calculation of wound along stem length.



There are two wound related criteria, one for circumference and the second for wounds along the length of the stem.

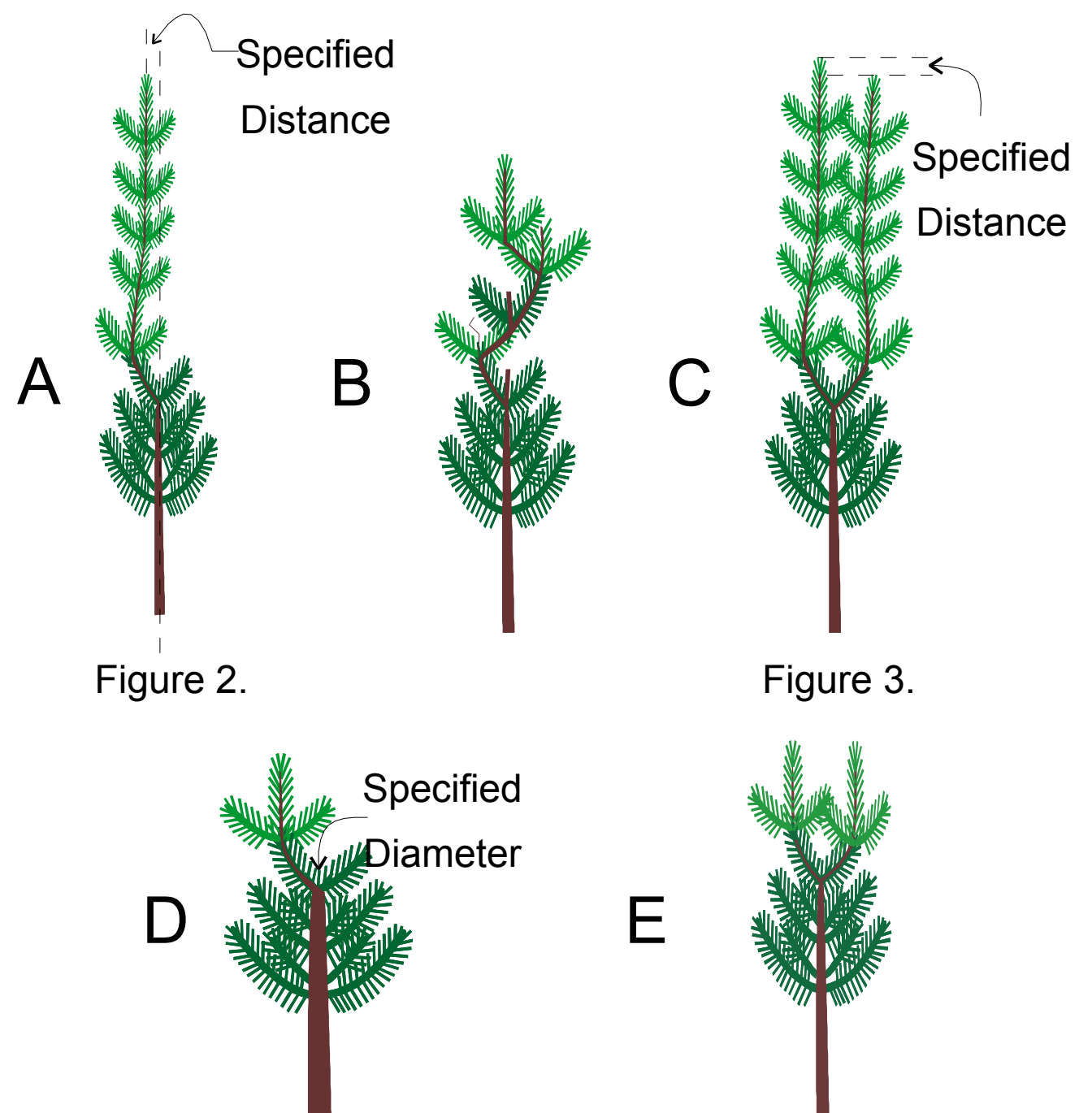
A wound that encircles the stem in excess of the specified amount is unacceptable.

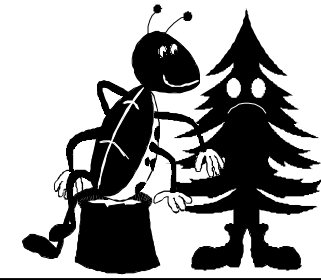
A wound that stretches along the length of the stem more than the specified amount is unacceptable.

The healed over part does not count.

The most important thing to remember is that we allow the tree a period of 5 years to correct itself. If less than 5 years has passed since the damage occurred, then the tree is acceptable.

Stem Deformation

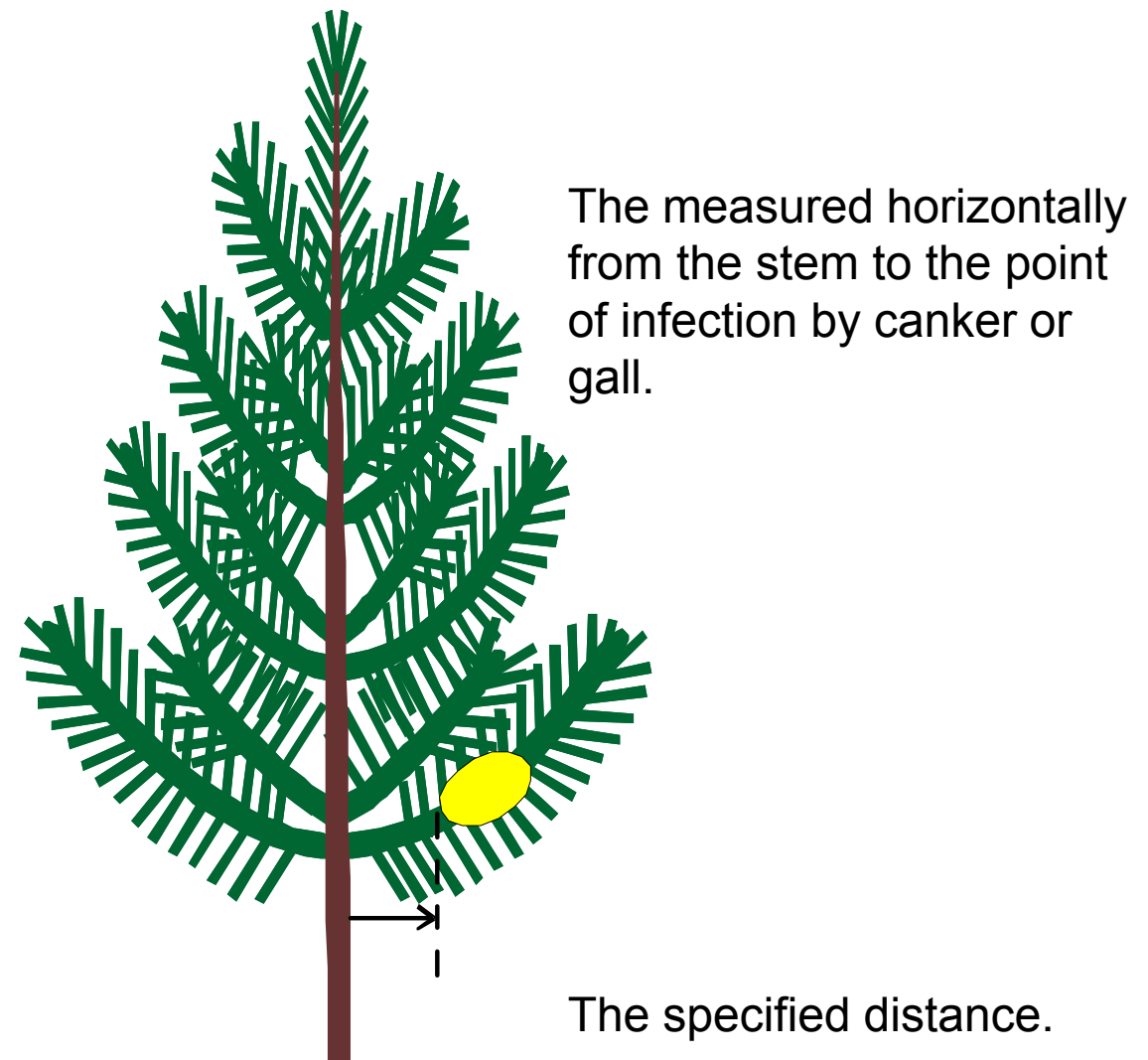




Measure from the stem to the
closest visible signs of infection
along the branch.

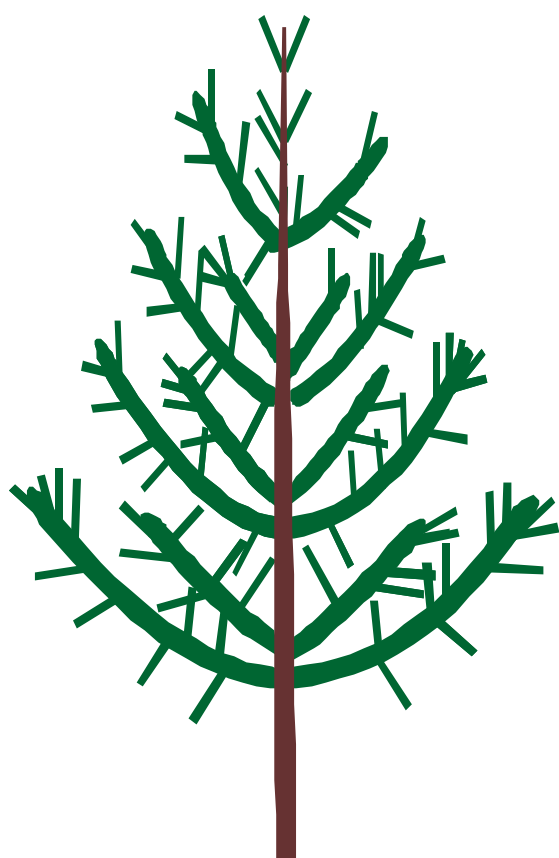
If the measurement from the tree
to the infection is less than the
distance specified in the Free
Growing Damage Criteria, the
tree is unacceptable.

Figure 4. Branch Infections



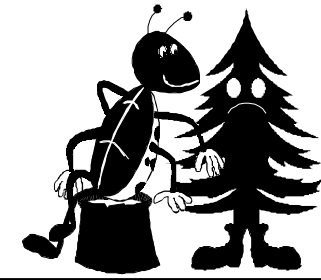
*The tree is unacceptable if with an infection
anywhere on the stem.

Defoliation

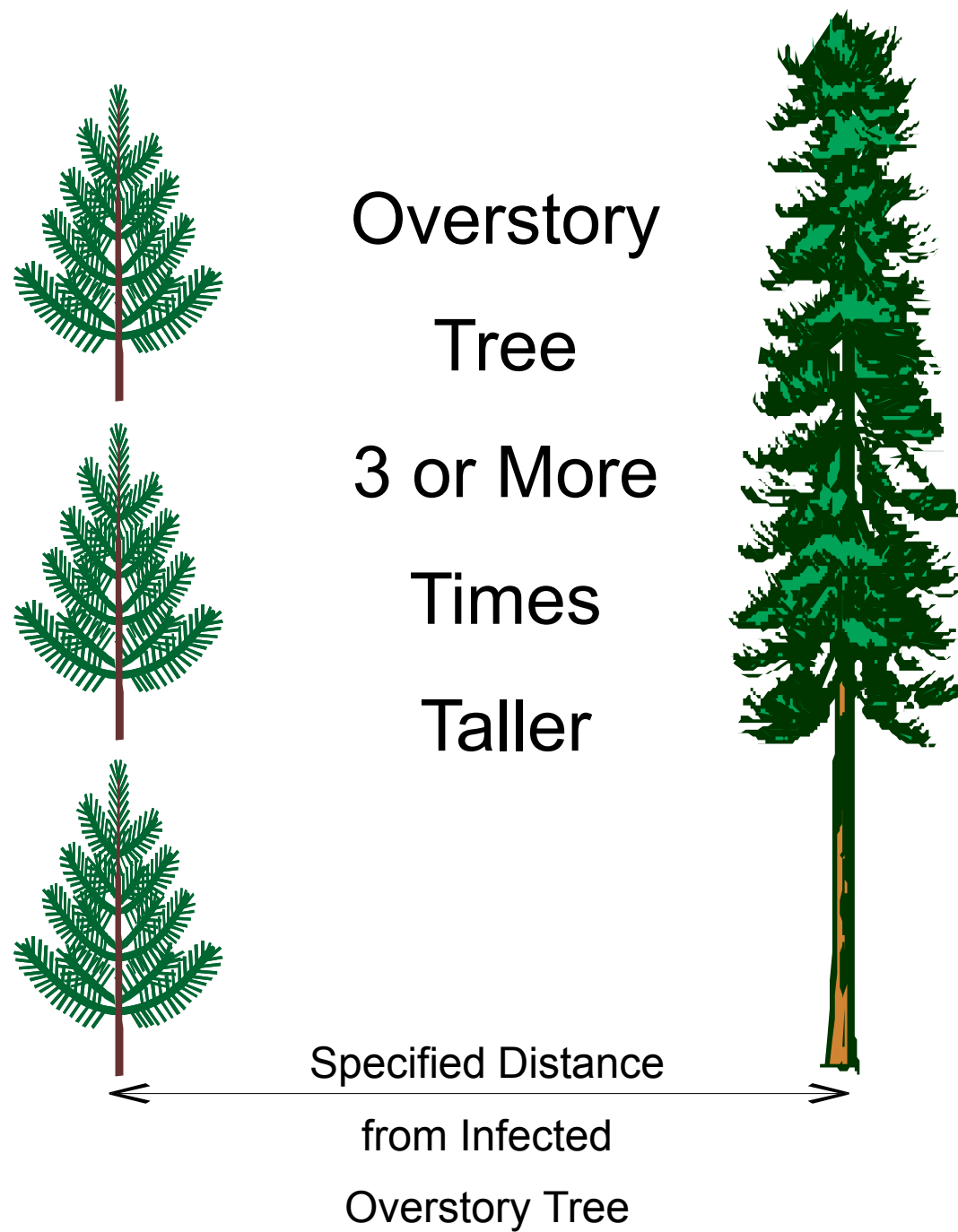


x % of the "normal" foliage is missing.

Visually estimate the
percentage of foliage that is
missing.



Dwarf Mistletoe Infection

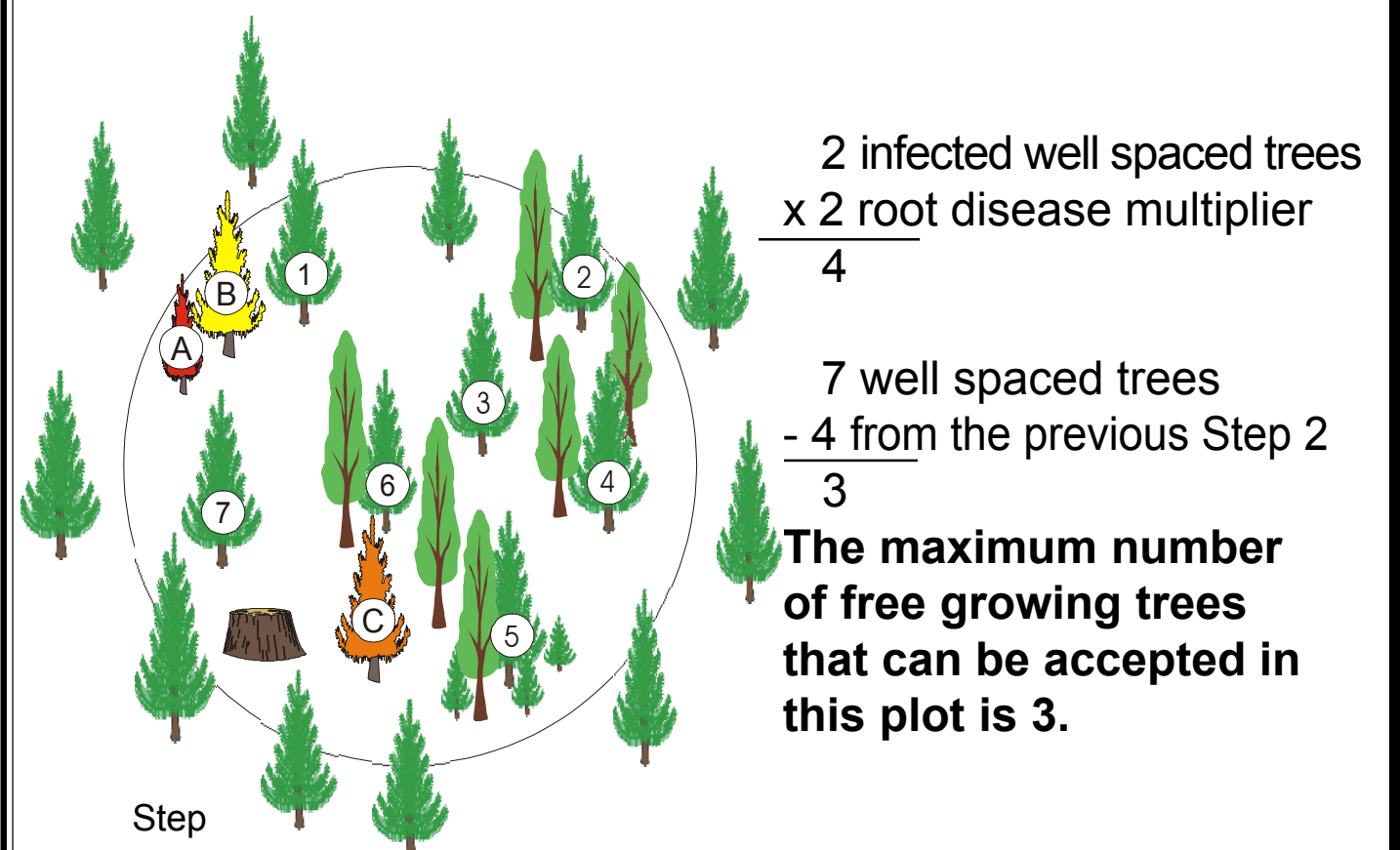


Remember to consider the
susceptibility of the tree species
to the particular mistletoe
species.

The purpose of this process is to
establish a cap on the number
of free growing trees that can
be selected.

The process for calculating the
maximum recognizes the
dynamics of root disease
spread.

Root Disease

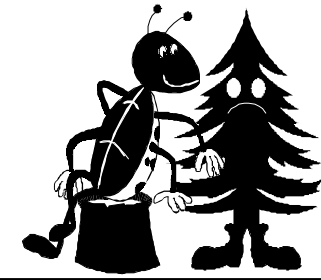


Step

- 1 Tree A, B and C are infected with root disease. However tree A and B are less than the minimum inter tree distance apart.
Count 2 well spaced infected trees.
- 2 The "root disease multiplier" in this plot is assumed to be 2, therefore 2 infected trees times the root disease multiplier of 2 = 4.
- 3 Trees 1 to 7 are greater than the minimum inter tree distance from each other.
Count 7 well spaced trees.
- 4 7 well spaced trees minus 4 from Step 2 = 3. Therefore, we can not accept any more than 3 free growing trees in this plot. These are likely to be tree 1, 7 and maybe 3.

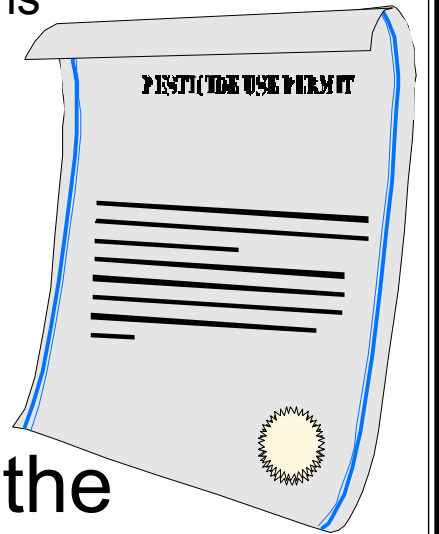


Forest Health for Silviculture Surveyors Participant's Workbook



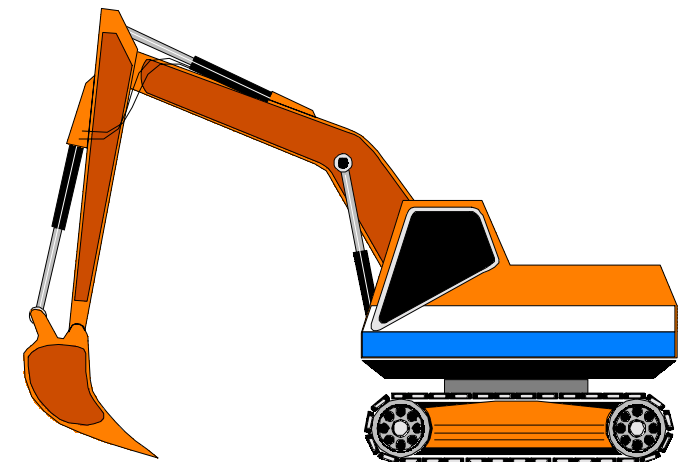
A Good Recommendation MUST...

- effectively address deficiencies
- be directed toward "Target", not minimums
- meet the requirements of the SP, where possible and practical
- consider the management objectives



It Would be Nice if the Recommendation...

- encouraged biodiversity
- limited "intrusiveness"
- was cost effective



For Good Recommendations you need...

Data -

- Accurately identified and collected
- Accurately compiled

Objectives -

- Local Land use Planning
- Silviculture Prescription
 - Stand Structure Objectives
 - Stocking Standards

Knowledge -

- Reference Material
- Guidebooks
 - Treatment Thresholds
- Treatment Options
- History of similar areas
- Communication with others



Forest Health for Silviculture Surveyors
Participant's Workbook



*This is in the Silviculture
Surveys Guidebook too.*

*These numbers refer to column
9 on the back of the summary
card.*

Silviculture Surveys Guidebook
Table 5-1. Forest health factor, code, incidence, and recommended treatment

Forest health Factor	Code	Incidence	Recommended treatment
Armillaria root disease	DRA	>1 to 5% of host species >5% of host species	Formal root disease survey Intensive control treatment
Phellinus root disease	DRL	>1 to 5% of host species >5% of host species	Formal root disease survey Intensive control treatment
Tomentosus root disease	DRT	any presence >15% of host species	Formal root disease survey Intensive control treatment
Rhizina root disease	DRR	Any incidence and replanting is required Any incidence and replanting not required	Delay planting 2 growing seasons after the broadcast burn Resurvey in year 2-3
Coastal hemlock dwarf mistletoe	DMH	Any	Eradicate infected trees <3 m in height Eradicate infected trees that are <10 m from and/or overtopping new regeneration Eradicate infected trees >3 m in height on low or poor sites
Interior lodgepole pine, Douglas-fir and larch dwarf mistletoes	DMP DMF DML	Any	Eradicate infected trees >3 m in height where the infection is in the top half of the tree Eradicate infected trees that are <15 m from and/or overtopping new regeneration
Comandra blister rust, Stalactiform blister rust, and Western gall rust	DSC DSS DSG	<10% all three stem rusts combined 10-20% all three stem rusts combined >20% all three stem rusts combined	Eradicate infected stems and prescribe a posttreatment target density equal to the target stocking standard Eradicate infected stems and prescribe a posttreatment target using the formula below Delay spacing 3 to 5 years, resurvey and evaluate using these rules
White pine blister rust	DSB	Any	Eradicate infected stems and those with branch infections closer than 60 cm to the stem, and prune all other infections

* Incidence referred to in the above table is calculated as described in column 9 on the back of the FS 659 card.



Case Study #1

Description:

SBS dw1 04
clearcut silviculture system
harvested 20 years ago
natural lodgepole pine regeneration was very effective

Survey Results:

Inventory Label: PI10 14-4.7-20-64-10340/0(99)(7)
Silviculture Label: PI100-14-5.8-20-1070(99)(7)
DSG is measured at 17%

Case Study #2

Description:

ICH mk1 01
clearcut silviculture system
harvested 3 years ago
broadcast burned in the fall of the year harvested
planted with a mix of Douglas fir and spruce 2 years ago

Survey Results:

Inventory Label: NSR-Fd6Sx4-6-0.3-25-1-445/0(99)(7)
Silviculture Label: NSR- Fd6Sx4-6-0.3-25-410(99)(7)
Mortality from DRR measures 25%
35% unknown case of mortality planted seedlings
Weather through the first year following planting was exceptionally good for Seedling development.
Vegetation competition is moderate but increasing.



Case Study #3

Description:

IDF dk3 01
Single tree selection harvesting 15 years ago

Survey Results:

Inventory Label: L1-Fdi6Pli4-98-23.0-19-15-260/4(99)(7)
L2-Fdi10-85-14.0-19-6-175/3(99)(7)
L3-Fdi10-35-5.8-19-35-8450/2(99)(7)
L4-Pli10-7-0.4-21-30-6930/1(99)(7)
Silviculture Label: L1-Fdi60Pli40-98-23-19-260(99)(7)
L2-Fdi100-89-16.0-19-45(99)(7)
L3-Fdi100-42-6.7-19-160(99)(7)
L4-Pli100-7-0.4-21-340(99)(7)

The survey indicates the area is sufficiently regenerated.
All of the well spaced trees in layers 1, 2 and 3 meet the free growing criteria. None of the layer 4 trees are free growing.
Vegetation is minimal, restricted to low herbs and grass.
Layer 1 has 18% and layer 4 has 2% DMP
Layer 4 has 7% DSG

Case Study #4

Description:

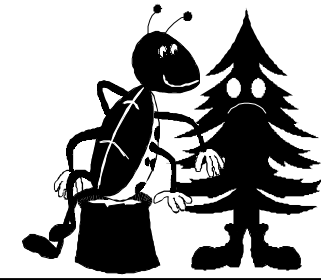
CWH xm 04
Clearcut 10 years ago
Broadcast burned the year following the harvest
Planted with Douglas fir 9 years ago with 2 year old stock
A survey 2 years and 4 years after planting indicated an excellent looking new crop.
The late free growing date is 11 years
Fdc is the only preferred or acceptable species listed in the silviculture prescription.
Cw, Lw and Pw are listed as tertiary species in the Establishment to Free Growing Guidebook. Hw is not listed.

Survey Results:

Inventory Label: NSR-Hw7Fdc3-5-0.6-26-16-5850/0(99)(7)
Silviculture Label: NSR-Fdc100-11-4.5-28-257(99)(7)
DRL found to have caused 23% mortality, and an additional 12% have been found infected.



Forest Health for Silviculture Surveyors Participant's Workbook



So where are we going?

How are we getting there?

When will we be back?

What are we doing when we get there?

- practice pest identification
- practice the use of the reference material
- practice recording and summarizing data
- collect specimens
- discuss recommendations

So where are we going?

How are we getting there?

What should we bring?

- Lunch
- Appropriate clothing for the weather
- Sturdy knife
- Calculator
- Reference books
- Reference card (FS 747)
- Plot cards (FS 658 and FS 659)
- Free Growing Damage Criteria
- Shovel/Pulaski/Ax
- Small folding saw
- Measuring tape
- 3.99m plot cord
- Field note book & pencil

We will be in small groups so we can share.

