



Province of
British Columbia
Ministry of
Forests

Prince George, Mackenzie,
and Dawson Creek
Timber Supply Areas
Standard Operating Procedure

Number: 10-1

SUBJECT:

Ground detection and assessment
procedures for spruce beetle,
Dendroctonus rufipennis (Kirby).

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Purpose:

To establish uniform procedures for ground detection and assessment of damage by spruce beetle, *Dendroctonus rufipennis*, in the Prince George, Mackenzie, and Dawson Creek Timber Supply Areas. These procedures will enable surveyors to determine: 1) the location (area, boundary, and pattern) of spruce beetle attack, 2) the percent and intensity of beetle attack in the past 3 years, and 3) the stand structure and potential for management options. Probes or walkthroughs as described herein are the only accepted ground survey procedures for determining spruce beetle attack densities. **These procedures are not to be conducted in conjunction with timber cruises nor should timber cruising precede at least a walkthrough.** Timber cruisers may not be sufficiently experienced in spruce beetle ground detection, and beetle attack data from cruising is not detailed enough for proper beetle management planning.

Definitions:

Walkthrough- a non-systematic preliminary ground reconnaissance conducted by an **experienced** spruce beetle ground surveyor in order to determine **rough estimates** of the extent and intensity of beetle attack prior to the recommendation of any possible probing or other management decision. The configuration and extent of walkthroughs are site-specific decisions made by the surveyor. The licensee may specify a minimum number of pixels (see Fig. 1) be included from a representative area within the walkthrough boundary.

Probe - a systematic and detailed secondary ground reconnaissance conducted by at least a two-person crew. Probing will indicate the extent, intensity, vigour, and year(s) of beetle attack. It will also provide additional information on stand species composition, diameter, and general susceptibility. Probe lines are spaced no further than 100 m apart (see pg. 4). Probing is only recommended in a small minority of stands requiring more detailed and systematic survey information or in sensitive areas having high wildlife values, First Nations land claims, high visual quality objectives, or other constraints.

Salvage Harvesting: harvesting operations primarily designed to recover timber damaged or degraded by fire, **an old insect attack**, wind, or disease before the wood becomes unmerchantable. Control of forest health factors such as bark beetles is incidental and is not the primary objective of salvage logging.

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Sanitation Harvesting: logging operations specifically designed to maximize the extraction of **currently infested** or infected stands in order to reduce the damage caused by forest pests and to prevent their spread. Currently infested spruce are those which have been attacked by spruce beetle in 2006 on a 1- or 2-year cycle or those attacked in 2005 on a 2-year cycle.

Initial Detection (Sketchmapping)

All susceptible spruce stands are normally aerially sketchmapped before any walkthroughs are undertaken. Since foliage of attacked spruce can take up to 30 months to fade and become noticeable from the air, sketchmapping merely maps previously killed trees and is a starting point from which walkthroughs are planned. Susceptible spruce stands usually have an average d.b.h. of 41 cm or more with 65% or more of spruce in a well-drained creek bottoms or low benches. Sketchmapping will provide preliminary information contained in Table 1.

Table 1. Preliminary Information from Sketchmapping

<u>Sketchmapping Classification</u>	<u>Percent "Discoloured" Trees*</u>	<u>Suggested Priorities for Walkthroughs**</u>
Light	0 - 5	2nd or 3rd
Moderate	6 - 15	1st
Heavy	16+	2nd or 3rd

* based on total stems

** at each District's discretion

Walkthroughs will determine **rough estimates** of:

- 1) the **size** (ha), **boundary**, and **pattern** (spatial distribution) of the infestation;
- 2) the **incidence and severity** of the infestation as measured by:
 - the percentage of spruce attacked in the last 3 years, i.e., 2006, 2005, and 2004 (or previous); and
 - the attack densities and success of the attacking beetles and the vigour of the new broods as measured by a few random phloem samples;
- 3) the **risk of beetle spread** within (and to outside) the stand based on stand susceptibility and beetle pressure;
- 4) **access, operability**, and **integrated resource management issues**;
- 5) a **sanitation and salvage harvesting priority rating** (Table 5, pg. 11); and
- 6) the **necessity to obtain further information or take other action** as detailed below.

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Based on walkthroughs, the surveyor will classify the area/stand and recommend one of the 3 broad options in column 3 of Table 2

Table 2. Spruce Beetle Management Options After Walkthroughs

<u>Walkthrough Classification</u>	<u>Sanitation Harvest Rating*</u>	<u>Beetle Management Recommendations**</u>
Light	0 - 599	Leave (monitor, trap trees, baits, etc..)
Moderate	600 - 999	Probe (to obtain further information)
Heavy	1000+	Recommend Operational Cruising (prior to expeditious sanitation logging)***

* See formula in Table 5 which mainly weights 2005- and 2004-attacks (2003- or older attacks are a minor consideration).

** all recommendations must consider access and integrated resource management issues. The precise thresholds for management action may vary by District or even by operating areas within a District (see *Bark Beetle Management Guidebook* for further information).

*** assuming road access exists or could be in the near future.

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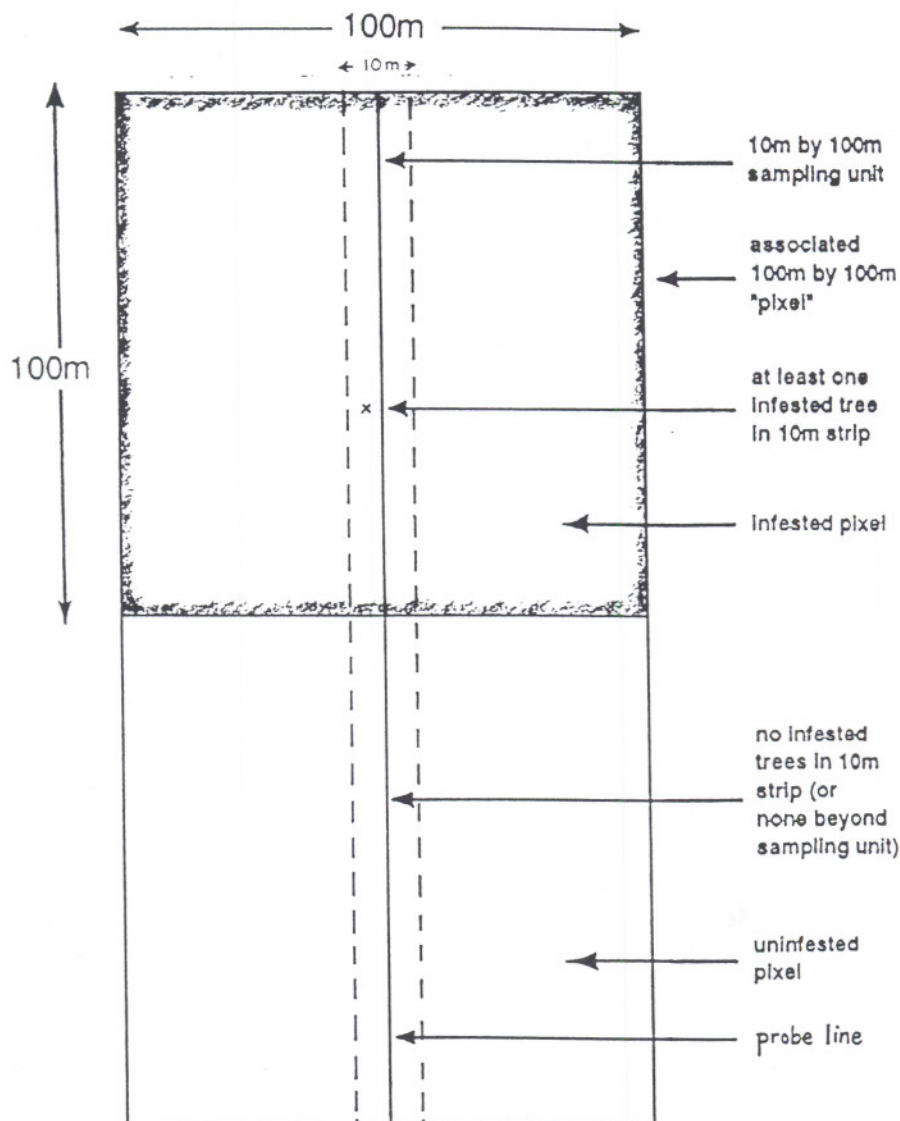
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Figure 1. Layout of Spruce Beetle Probe Lines (Sampling Units and Pixels)



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Figure 2. Spruce Beetle Probe Card (FS 1111) with filled in example.



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SPRUCE BEETLE
PROBE CARD

LOCATION <i>Hook Lake</i>		<i>South helispot</i>		PAGE <i>1</i> OF <i>3</i>					
BEARING <i>245° SL-1</i>		DISTANCE <i>0-100 m</i>		STRIP WIDTH <i>10 m</i>					
DIAMETER CLASS	SURFACE AREA FACTOR	NUMBER OF HEALTHY HOSTS	BARK BEETLE CODE BY YEAR OF ATTACK						OTHER TREE SPECIES
			1	2	3	4	5	6	
17.5 - 25.0	3.3	.							<i>B PI</i>
25.1 - 30.0	5.3	..							<i>7</i>
30.1 - 35.0	7.1	..	.						<i>..</i>
35.1 - 40.0	9.4	..	.	.	..	.			<i>☒</i>
40.1 - 45.0	11.6	☐	..	.	☐	.	.		<i>☒</i> <i>..</i>
45.1 - 50.0	13.8	☒	☉	.	..	.	.		<i>☒</i> <i>..</i>
50.1 - 55.0	16.2	☐	.	.	.	..	..		<i>..</i>
55.1 - 60.0	18.7	..	.						<i>.</i>
60.1 +	25.3	.							
TOTALS		<i>40</i>	<i>8</i>	<i>3</i>	<i>8</i>	<i>2</i>	<i>5</i>	<i>44</i>	<i>8</i>
BARK SAMPLES 15cm x 15cm	NO. ENTRANCE HOLES	NO. PARENT ADULTS	NO. LARVAE	NO. PUPAE	NO. CALLOW ADULTS	FRESH (GREEN) BLOWDOWN			
						Attacked	Unattacked		
<i>1a</i>	..	..	☒☐			.			
<i>1b</i>	.	..	☒	.					
COMMENTS - 90% on a 2-year cycle - a few pitchouts on smaller diam. stems ☐ also code 2									
CREW NAMES <i>John Smith + Bill Jones</i>						DATE Y M D <i>06 11 20</i>			

FS 1111 RPG 2000/01 7530881048 (100/tdl)

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Probing will determine **detailed estimates** of:

- 1) the **size** (ha), **boundary**, and **pattern** (spatial distribution) of the infestation;
- 2) the **incidence and severity** of the infestation as measured by:
 - the percentage of spruce attacked in the last 3 years, i.e., 2006, 2005, and 2004 (or previous); and
 - the attack densities and success of the attacking beetles and the vigour of the new broods as measured by a series of phloem samples;
- 3) the **risk of beetle spread** within (and to outside) the stand based on stand susceptibility and beetle pressure;
- 4) **access, operability, and integrated resource management issues**; and
- 5) a **sanitation and salvage harvesting priority rating** (see Table 5, pg. 11); and
- 6) the necessity for possible **beetle management action** within the stand

If probing is recommended after walkthroughs (from Table 2), then delineated stands will be grid-probed via systematic parallel probe lines consisting of 10 m-wide strips (5 m on each side of centre line) and spaced 100 m apart (Fig. 1). All trees greater than 17.5 cm dbh within the 10 m-wide strip will be recorded within one of the existing diameter classes on the *Spruce Beetle Probe Card* (FS 1111) (Fig. 2 - example) or *Beetle Probe Card* (FS 1111A). As information will be summarized by 100 m long strips, all probe lines should be run to the nearest 100 m.

All spruce beetle-attacked trees will be recorded as codes 1-6 as per the *Regional Bark Beetle Codes* summarized in Table 3 and recorded on the *F.S. 1111* in numerical form (Fig. 2). Probers must remove at least a small portion of phloem from every infested tree within their 10 m strip to ensure coding accuracy. All attacked trees will also be mapped on the *Compass and Traverse Sheet* (F.S. 375) or similar (Fig. 3 - example) which will accompany the completed *FS 1111*.

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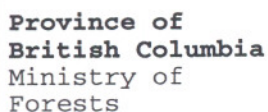
Table 3. Bark Beetle Codes for Spruce Beetle*

<u>Code no.</u>	<u>Year of attack</u>	<u>Year** and type of attack</u>
1	Most recent	<u>2006</u> - Full
2	Most recent	<u>2006</u> - Strip
3	Second recent	<u>2005</u> - Full
4	Second recent	<u>2005</u> - Strip
5	Third recent	<u>2004</u> - Full
6	Third recent	<u>2004</u> - Strip

* a complete summary of the signs and symptoms
of attack for each code is available from the Regional
Forest Entomologist or through the *Probing Accreditation Course*.

** fill in the appropriate years of attack in the blank
lines as illustrated. They will always be in pairs
for the past 3 years of attack.

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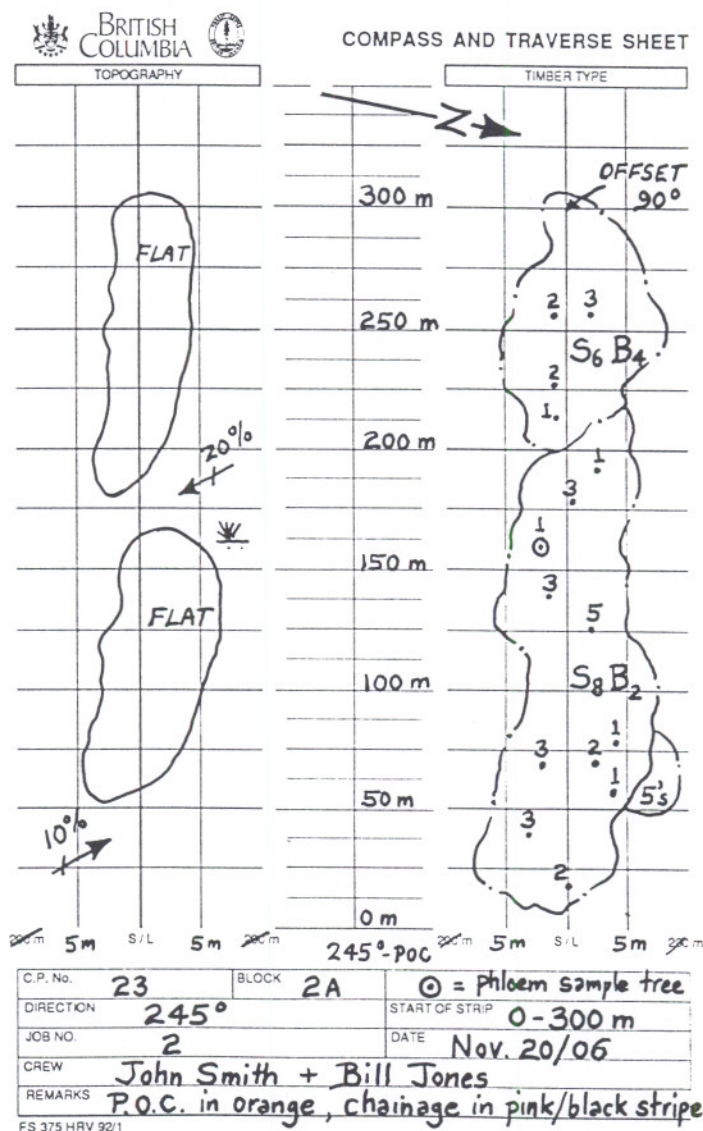
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To determine relative beetle attack densities and brood densities between areas during probing, a total of 20 *most-recently* attacked spruce (i.e., 2006-attacks based on the current date) must be sampled per area/stand. Ideally, one tree should be sampled approximately every 200 m along the probe line. At each sample tree, two 15 cm x 15 cm (225 cm²) bark samples are removed at dbh; one from the north side and one from the south and the appropriate information tallied as depicted in the lower portion of the *FS 1111* (Fig. 2). Such sample trees must also be clearly delineated (e.g., by a circle) on the F.S. 375 (Fig. 3). While some of these samples will undoubtedly be "clumped" (e.g., 5 trees within 300 m), the overall objective is to obtain a relative comparison of beetle attack densities and brood densities between areas/stands probed. If specified, a few such samples can be taken during walkthroughs. Bark sample data also provides a key bark beetle coding check for probing supervisors and Forest Service and Licensee field monitors. Table 4 can be used to rate the mean beetle attack densities and larval densities between areas probed in order to further rank sanitation logging priorities.

Table 4. Spruce Beetle Attack Density and Larval Density Rating

Mean no. entrance holes per 225 cm ² <u>phloem sample*</u>	Mean attack <u>density</u>	Mean no. living larvae per 225 cm ² <u>phloem sample*</u>	Mean larval <u>density</u>
< 1	low	< 4.9	low
1.0 - 1.9	moderate	5.0 - 14.9	moderate
2.0 - 3.9	high	15.0 - 24.9	high
> 3.9	severe	> 24.9	severe

* Assumes samples taken from July 15 - March 31 from a population in the
first year of a 2-year cycle

Probe Line Delineation

The initiation and termination of all probe lines should be clearly marked with highly visible flagging tape which indicates:

- 1) the geographic location, unit number, and probe/strip line number, e.g., *Windfall Cr., Probe A, SL #5*;
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- 2) the "point-of-commencement" (*P.O.C*) or "point of termination" (*P.O.T.*) and bearing, e.g., *P.O.C. - 270°*;
and
- 3) the crew number/name and date, e.g., *Crew #2, Nov. 15/03*

Along the length of the probe line, flagging tape should be hung at appropriate intervals (approximately every 30-50 m) indicating the bearing so that anyone standing anywhere on the line at a later date can follow it without using a compass. Every 100 m interval along the line should be marked with different or longer flagging tape, e.g., *0 + 100 m*. Wherever the crew changes direction, offset bearings and distances must also be clearly indicated by flagging tape, e.g., *0 + 500 m, offset 90° + 100 m*.

Probe Data Calculations and Summarization

Beetle code data collected on the *F.S. 1111* must be multiplied by the corresponding "mean surface area (of bark) per m²" (*S.A. factor*) (*Fig. 2, column 2*) (for strip attacks, i.e., codes 2, 4 & 6, use 0.5) and the products transposed to the *Spruce Beetle Infestation Summary Sheet* (Table 5 - example). Summarized data will then provide:

- 1) the proportion of the block infested (based on the number of infested 100 m x 100 m pixels);
- 2) the percent attack in the past 3 years.

If road access exits into the probed area/stand or a road could be constructed soon, the District should calculate the *Sanitation and Salvage Harvest Priority* value (Table 5 - bottom formula). If *salvage* wood can not be utilized for particular products such as veneer, the third component in the formula can be omitted. Complete details on the rationale for the formula are provided in the *Bark Beetle Management Guidebook*.

On the completion of probing, data from *F.S. 1111's* and *F.S. 375's* should be summarized by area, stand, or other unit into an appropriate spreadsheet or table to indicate the following minimum information;

- 1) Contract number (if relevant);
- 2) Geographic reference, e.g., "*Parsnip R. south*";
- 3) Opening number (if available), mapsheet, unit, and block numbers, e.g., *93-0-11-e, Unit 2e, Block 1*;
- 4) Names of probers and their certification numbers;
- 5) Date of the probe;

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Table 5. Spruce Beetle Infestation Summary Sheet

DBH Class	Healthy Spruce	2006		2005		2004		Other Species
		1	2	3	4	5	6	
17.5 - 25.0	3.3							3.3
25.1 - 30.0	10.6							31.8
30.1 - 35.0	21.3	7.1						35.5
35.1 - 40.0	47.0	9.4	4.7	18.8	4.7			103.4
40.1 - 45.0	81.2	23.2	5.8	34.8	5.8	11.6		139.2
45.1 - 50.0	151.8	27.6	6.9	27.6		13.8		193.2
50.1 - 55.0	113.4	16.2		16.2		48.6		32.4
55.1 - 60.0	56.1	18.7						18.7
60.1 +	25.3							
Totals	510	102.2	17.4	97.4	10.5	74		557.5

STEPS

- Proportion of Block Infested = $\frac{\text{No. Of Infested Pixels}}{\text{Total No. of Pixels in Survey}} = \underline{\hspace{2cm}}$
- Percent Attack Within Infested Portion (assumes 85%+ beetles on a 2-year life cycle)
 - The results from all infested pixels should be used.
 - The number of trees on the SB Probe Card should be multiplied by the SAF* with products calculated separately for each row and column individually in the above table.
 - % 2006 Attack = $\frac{102.2 + 17.4}{811.5} \times 100 = 14.7\%$
 - % 2005 Attack = $\frac{97.4 + 10.5}{811.5} \times 100 = 13.3\%$
 - % 2004 or Older = $\frac{74 + 0}{811.5} \times 100 = 9.1\%$
 - % Spruce in Stand = $\frac{811.5}{1369} \times 100 = 59.3\%$
 - Sanitation Harvest Priority (calculate if required by the District or Licensee)
 - $(\frac{\% \text{ 2005}}{1.5} + \frac{\% \text{ 2005}}{1.5} + \frac{\% \text{ 2004 or older}}{4}) \times \% \text{ spruce} = \underline{\hspace{2cm}}$
 - $(\frac{14.7}{1.5} + \frac{13.3}{1.5} + \frac{9.1}{4}) \times 59.3 = 1532.9$

* Surface area factor (mean surface area per diameter class)

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- 6) Total m probed;
- 7) Total ha probed;
- 8) Total no. of healthy spruce tallied;
- 9) Total no. of attacked spruce by beetle codes 1 - 6;
- 10) Total no. of all spruce tallied;
- 11) Percent attack for each beetle code 1 - 6;
- 12) Percent attack in each of the last 3 years, i.e., for 2006, 2005, and 2004 (from Table 5);
- 13) Proportion of the block infested (from Table 5);
- 14) Mean attack density and mean larval density (from Table 4);
- 15) Percent spruce in the stand; and
- 16) Percent other conifers by species.

Mapping

An appropriate 1:10,000 scale summary forest cover map for each probed area/stand must also be included which contains:

- 1) a 10,000 map scale and north arrow;
- 2) an opening number or unit and mapsheet number which matches the spreadsheet data;
- 3) clearly plotted probe lines with UTM coordinates tied into a physical feature indicating *P.O.C.'s*, *P.O.T.'s*, strip line numbers, bearings, and distances;
- 4) a colour stratification of infested areas into 3 categories of combined 2006 + 2005 attacks:
 - light - 0 - 5%
 - moderate - 6 - 9%
 - heavy - 10% +
- 5) a 4-character label must be added to the attacked map polygon indicating the percent attack in the past three years and the percent spruce (healthy plus attacked) in the stand, i.e., 5,8,6,70 which equates to a 5% attack in 2006, 8% in 2005, 6% in 2004 (or previous), and 70% spruce; and
- 6) as a contract option, all adjacent trap tree patches and recent blowdown can also be included on the map as per Ministry of Forests cartographic standards.

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Additional Probe Information

Further information can also be specified depending on District/Licensee requirements and the experience of the probing crew and their consulting company, and can include:

- 1) topography and operability for winter or summer logging;
- 2) integrated resource management concerns such as riparian zones, wildlife habitat, landscape values, etc..
- 3) vigour of the beetle population considering its:
 - possible origin and attack history in the stand;
 - potential for spread considering the next major flight and the percent 1- and 2-year cycle beetles; and
 - impacts of woodpecker activity, host resistance, and other population limiting factors.
- 4) site specific recommendations for spruce beetle management such as:
 - sanitation logging (clearcut, group selection, diameter limit, and single tree "snip and skid");
 - conventional trap trees;
 - semiochemical grid-baiting of standing trees;
 - utilization and remedial actions required for hazard reduction (e.g., low stumps and blowdown extraction); and
 - further detection requirements (sketchmapping, walkthroughs, and probes)

W.J. (Bill) Warner, R.P.F.
Regional Executive Director
Northern Interior Forest Region

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