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# FOREST INSECT & DISEASE MANAGEMENT

USDA • FOREST SERVICE • NORTHERN REGION

State & Private Forestry • Missoula, MT 59801

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## R-1 FOREST INSECT AND DISEASE DAMAGE SURVEY SYSTEM

By

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### INTRODUCTION

The purpose of insect and disease damage surveys is to estimate losses caused by various pests so that the land manager can prescribe appropriate management action.

Systematic ground data collection systems provide to the land manager loss data that can be used for cost benefit analysis, management plans, environmental impact statements, and for projecting losses at a forest level. The survey data could be integrated into timber management plans to fill voids in stand models to predict losses. This handbook describes field data collection procedures and data recording necessary to operate the supporting computer program "INDIDS" (Insect and Disease Damage Survey).

### SURVEY TYPES

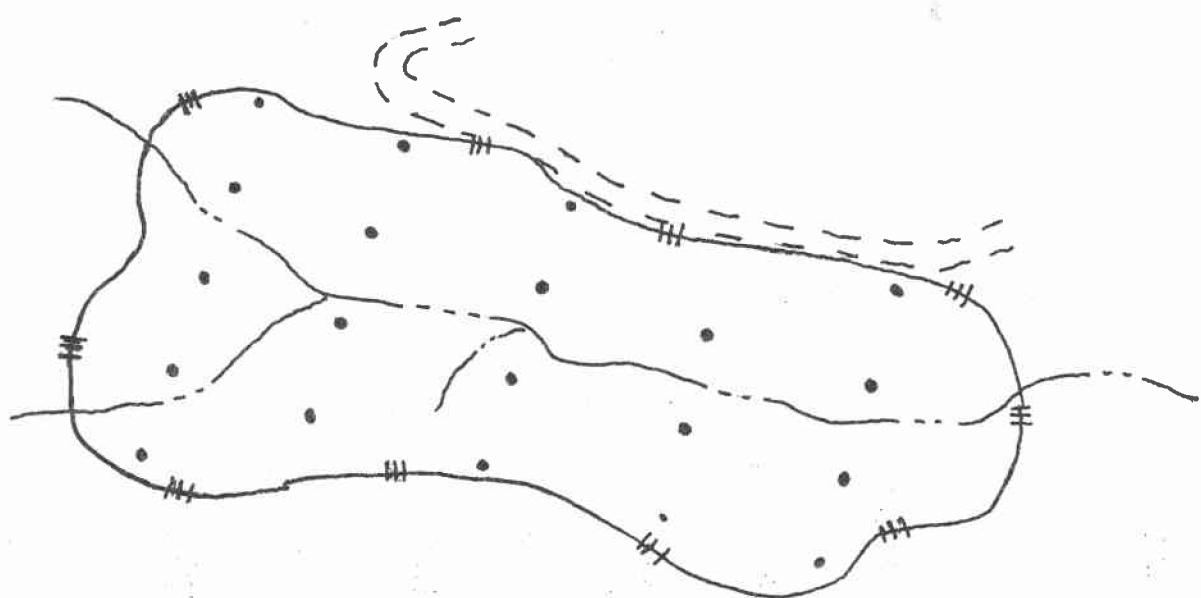
Usually, the land manager has only one specific pest in mind when conducting loss surveys. This system, however, provides for four specific pest types: (1) Bark beetles, (2) defoliators, (3) disease, (4) noninfectious disease. Data can be collected for all four types at the same time if desired, but analyzed separately using the computer program "INDIDS" for the different options. The program provides detailed mensurational data of stands by species, size class, and damage class of designated survey type and aggregates other problems in one column. Detailed statistics on other problems can be obtained by running the option desired. Each sample tree in the survey, however, is limited to three pest problems or severity.

For example, a tree could be attacked by bark beetles, have mistletoe, and be top killed by a defoliator. Another tree could be recorded as having moderate defoliation, be lightly top killed, and have root rot. This flexibility allows for several alternatives in data collection and four options to summarize detailed statistics.

Periodic annual increment is also an option. If growth loss estimates caused by a defoliator are desired and the stand recently became infested, then radial growth measurements covering the period during the infestation and prior to the infestation are measured, and adjusted mean growth between host and nonhost trees is tested by covariance analysis. If differences are significant, expected periodic annual increment is computed. Areas of chronic defoliation cannot be evaluated in this manner.

#### FIELD PROCEDURES

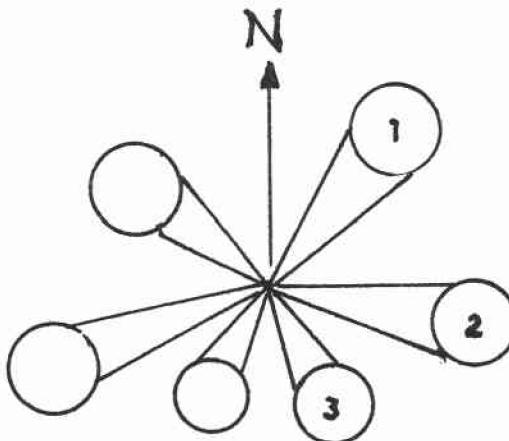
Areas examined must first be delineated into stands using standard photo interpretation (P.I.) guides explained in TM handbooks. Use existing stand delineations if the area is National Forest. Obtain either 2-inch or 2.6-inch/mile topographic maps of the area and resource photography to transfer stand boundaries to field maps. Sample points should occur on a 5- by 10-chain grid to sample a stand satisfactorily. Stands less than 40 acres should be sampled with greater intensity depending on desired sampling error. The following diagram shows how plots could be placed in a 100-acre stand.



When conducting bark beetle surveys uninfested tree information need only be taken on a sample of the total plots. However, at least 10 plots in each stand should be sampled for green stand statistics. For example, if a total of 20 plots are planned for the survey then record data on all trees within the plot on the even numbered plots, and on the odd numbered plots, record trees only if bark beetles have attacked or some other damaging agent is involved. Trees with a "0" code are computed using the green tree number of plots to expand the data to a per-acre basis.

Diameters of all trees in the plot are recorded to the nearest one-tenth of an inch. Tree heights are measured to the nearest 1 foot on a sample basis. The first three trees on each plot in clockwise direction (figure 1) are measured for height. Fewer trees can be sampled for height if precise cubic and board foot volume estimates are not necessary.

Figure 1--Height measurements of sample trees

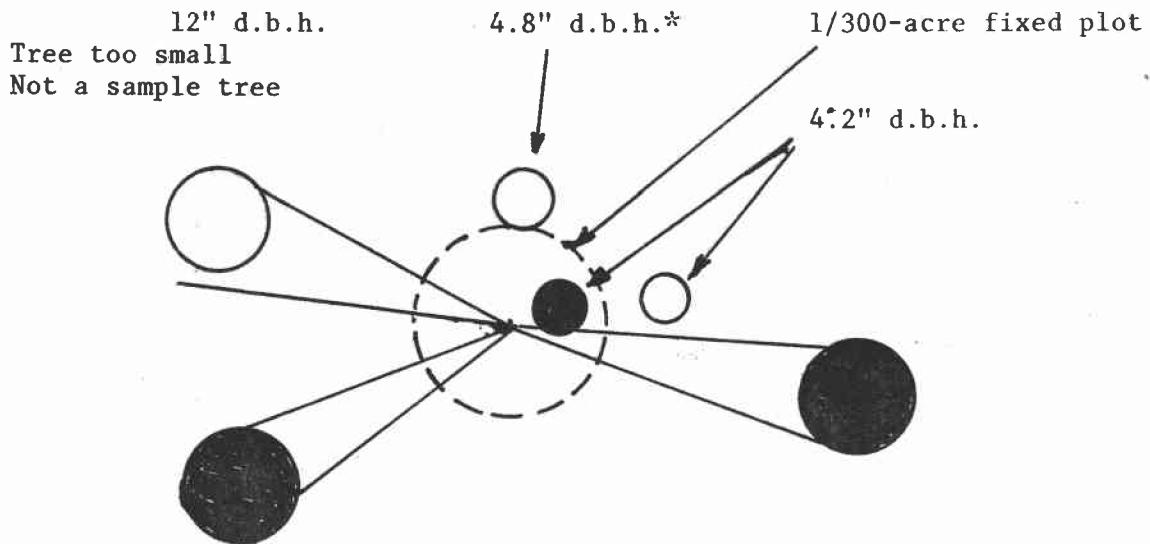


No heights are measured for trees less than 5 inches d.b.h. Regression estimates based on diameters and heights of sample trees are used to obtain heights for unmeasured trees. If periodic increment is desired, then habitat type must be obtained for each plot, and the last 10 years' radial growth measured on each tree that was sampled for height. Ten-year radial growth is measured to nearest 1/10 inch or 1/100 inch if possible. If growth loss is desired in the case of defoliators, then X-year and Y-year growth measurements explained later must be recorded. Douglas-fir, grand fir, subalpine

fir, and spruce will be considered host species. Ponderosa pine, white pine, limber or lodgepole pine will be considered nonhost species for covariance testing. Larch will not be considered because it is a host of budworm and larch casebearer which makes it difficult to determine years infested. If nonhost species are a minor part of the forest, then measure growth of all nonhost trees on the plot.

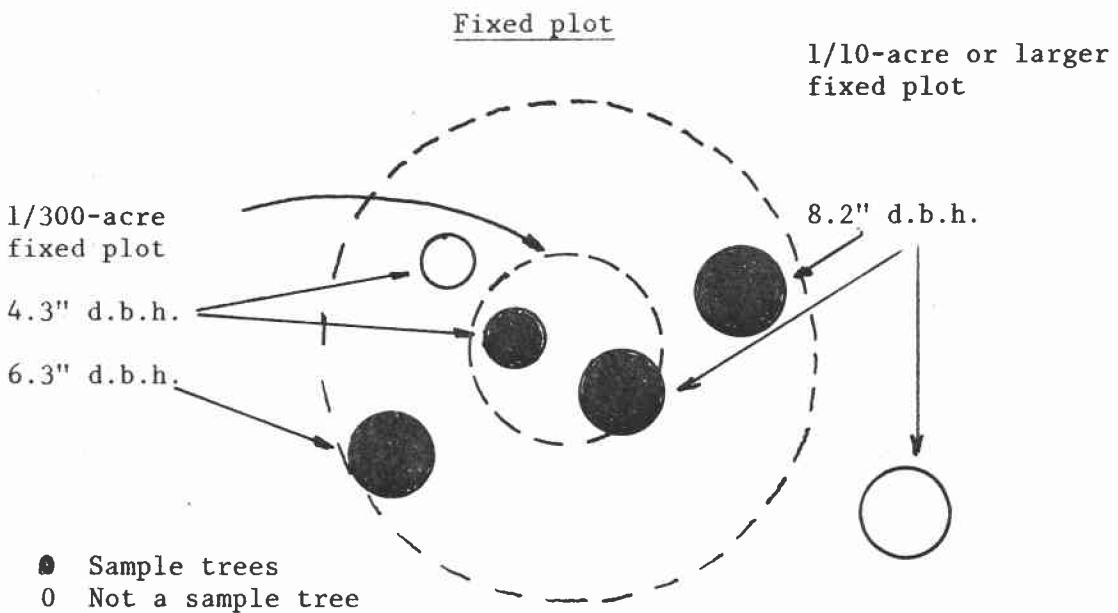
The supporting computer program "INDIDS" will handle both variable and fixed plot sampling. Trees less than 5 inches d.b.h. are only sampled when they occur within a 1/300-acre or 6.8-foot radius fixed plot. A maximum of four best management trees under 5 inches d.b.h. will be recorded on the 300th acre fixed plot. Excess trees are considered culls and will not be recorded. Trees greater than 5 inches d.b.h. are sampled from either variable plot method or fixed plot of 1/10 of an acre or larger plot. The following examples explain sample tree selection.

#### Variable plot



\*Tree in 20 BAF plot but less than 5" d.b.h.

- Sample tree
- Not a sample tree



#### RECORDING DATA FOR INDIDS

The following is an explanation of how to record sample tree data on the field data sheet (figure 2).

Identification code: Unique code which identifies header card with data cards--usually the Forest code followed by a number. For example (Ident code 1 0 3 where 10 is the Forest code for Flathead and 3 for that particular stand. This number is used to identify cards from the same stand only.

Forest: Alpha or numeric name of Forest, Park, Indian reservation, BLM, etc. Example F L A T H E A D

Stand or Area: Use compartment, subcompartment, and stand number, or drainage. Any combination of numeric or alpha characters that will identify the areas surveyed.

Examples 7 4 7 1 2 0 or R O C K C R E E K # 2

<u>Survey code</u>		<u>Survey type</u>
01	=	Bark beetle survey
02	=	Defoliator survey
03	=	Disease survey
04	=	Noninfectious disease survey

Observers: Names or initials of observers.

Type plot:

1 = Variable plot for trees >5" d.b.h. In addition, trees <5" are recorded on the 1/300-acre plot.

2 = Fixed plot for trees >5" d.b.h. In addition, trees <5" d.b.h. are recorded on the 1/300-acre plot.

Size plot: Enter BA factor or, 4 for  $\frac{1}{4}$ , 5 for  $\frac{1}{5}$  for fixed plots.  
Example of BAF 40 would be recorded as 4 0  
or 1/5-acre fixed plot would be recorded as 0 5

Green tree plots: Enter number sampled plots where green tree data was recorded. If green tree data was recorded on all plots then green tree plots would equal total plots.

Total plots: Enter total number of plots used in sampling the stand including green stand plots. Include all plots even if some had no trees.

Plot cards

Ident code: Use same as header card. Example: 1 0 3

Plot: Plot number in sequence. Do not duplicate plot numbers within a stand. Example 0 1 for first plot.

HAB: Habitat type for plot. Use Montana valid habitat type numbers. Example: 5 2 1 for grand fir/Clintonia uniflora phase (appendix I)

Species: Use valid species code. Left adjusted. Appendix II.  
Examples White pine W P,  
Larch L,

D.b.h.: Enter d.b.h. to nearest 1/10 inch, right adjusted. For example, a tree 12.3 inches in diameter is recorded as .1 2 .3.

Height: The height of trees sampled for height measurements is entered to the nearest foot, right adjusted.

Age: or tree number if identity is needed. Age measurements are optional (to be added later to Program).

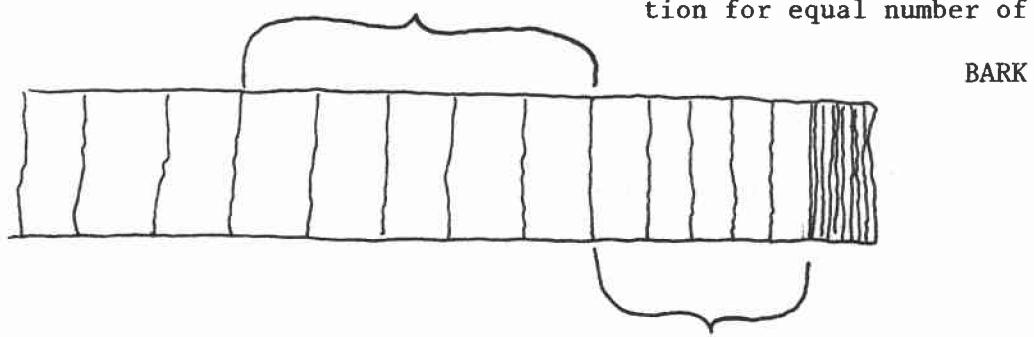
10-year growth: Last 10 years' radial growth in inches (two decimals assumed) right adjusted. Example of 1.05" 1 0 5.  
Example of .23" .2 3.

Y-year growth: Radial growth measurements for the period of infestation. Not less than 2 years and not to exceed the last 10 years (two decimals assumed, right adjusted)

X-year growth: Radial growth measurement of the period of normal growth (two decimals assumed, right adjusted) (figure 3).

Figure 3

(X-year growth)  
Radial growth prior to infesta-  
tion for equal number of years



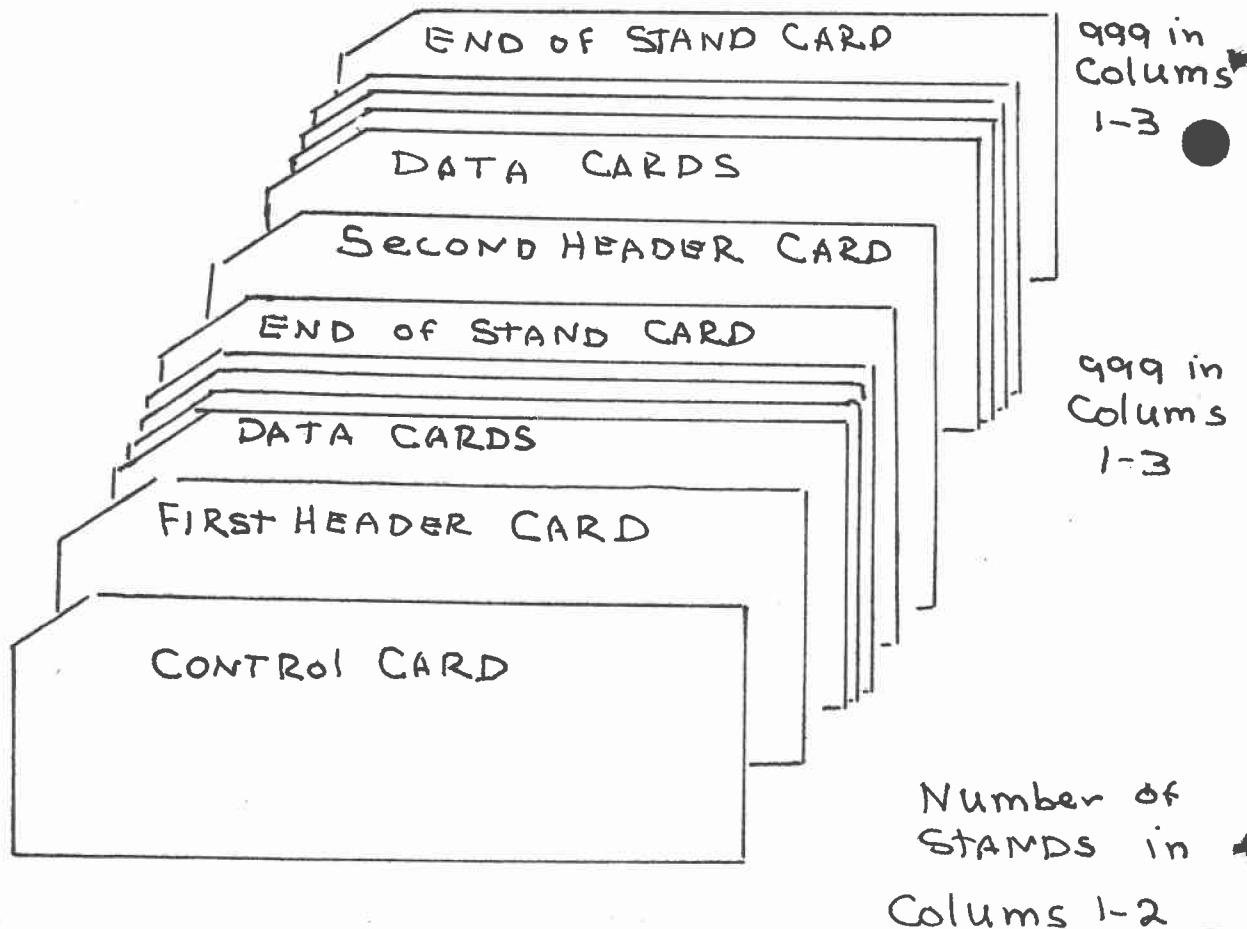
(Y-year growth)  
Last 2-10 years radial growth  
(period of infestation)

### INSECT OR DISEASE CODES

Examine each tree and assign a damage code to each tree. Be sure to use the 0 code if no damaging agents are found. Use only valid codes (appendix III). The 0 code must be placed in first column (tree is undamaged). Do not place 0 in first column (40-41) and another code in second column (43-44).

### INDIDS Deck Set Up for 2 Stands

A maximum of 99 stands can be run at one time. At present each stand has a limit of 365 sample trees if run on the CDC 3100 Computer at Missoula. Exhibit I shows examples of output from INDIDS.



## EXHIBIT I

BANK REFILE SURVEY  
---SPECIFCS 1P---

FLATHFAR            WHALE CREEK 2            868

0/21/78

DIAMETER CLASS	GREEN STAND	CURRENT ATTACK	LAST YRS	OLDER ATTACK	UNSUCC. ATTACK	SEC. ATTACK	OTHER			TOTAL
							I+D PROB.	DAM. AGENTS	OTHER MORT.	
M	TA	150.00	6	6	0	0	0	0	0	150.00
	BA	.11	6	6	0	0	0	0	0	.11
	CFA	0	0	0	0	0	0	0	0	0
	BFA	0	0	0	0	0	0	0	0	0
	APAI	0	0	0	0	0	0	0	0	0
	EPAI	0	0	0	0	0	0	0	0	0
3-4.9	TA	21.58	94.81	33.00	3.06	6.95	0	0	0	4.08
	BA	7.00	30.00	18.00	2.00	2.00	0	0	0	1.00
	CFA	197.23	1157.42	555.83	68.64	54.19	0	0	0	25.04
	BFA	156.90	2571.91	2462.69	332.80	0	0	0	0	5524.31
	APAI	0	0	0	0	0	0	0	0	0
	EPAI	0	0	0	0	0	0	0	0	0
5-11.9	TA	0	3.49	3.62	.95	0	0	0	0	.06
	BA	0	3.00	3.00	1.00	0	0	0	0	7.00
	CFA	0	102.04	98.23	35.66	0	0	0	0	295.93
	BFA	0	500.43	486.94	181.80	0	0	0	0	1178.07
	APAI	0	0	0	0	0	0	0	0	0
	EPAI	0	0	0	0	0	0	0	0	0
12.0+	TA	0	0	0	0	0	0	0	0	0
	BA	0	0	0	0	0	0	0	0	0
	CFA	0	0	0	0	0	0	0	0	0
	BFA	0	0	0	0	0	0	0	0	0
	APAI	0	0	0	0	0	0	0	0	0
	EPAI	0	0	0	0	0	0	0	0	0
16	TA	171.58	98.31	36.71	4.01	6.95	0	0	0	4.08
	BA	7.11	42.00	21.00	3.00	2.00	0	0	0	1.00
	CFA	197.23	1259.46	654.06	104.30	54.19	0	0	0	25.04
	BFA	156.90	3081.35	2949.53	514.60	0	0	0	0	2294.28
	APAI	0	0	0	0	0	0	0	0	0
	EPAI	0	0	0	0	0	0	0	0	0

APAI = Actual periodic annual increment

EPAI = Expected periodic annual increment  
(PAI) Cubic foot production per acre per year  
without damage

TA = Trees per acre  
BA = Basal area

CFA = Cubic ft. volume per acre  
BFA = Board ft. volume per acre

EXHIBIT I  
(con.)

0/ 0/ 0

**DEFOLIATOR SURVEY**  
---SPECIES TOTAL---

CLFWATER    WEST FORK SQUAW 104

DIAMETER CLASS	GREEN STANC	LIGHT MODERATE DEF.	HEAVY DEF.	MOD. TOP KILL	HEAVY TOP KILL	DEF. MORT.	OTHER I+D PROB.	OTHER DAM. AGENTS	TOTALS	
							TOP KILL	MORT.		
0-4.9	TA PA CFA BFA APA EPAI	393.75 1.23 0 0 0 0	0 0 0 0 0 0	18.75 1.09 0 0 0 0	18.75 2.76 0 0 0 0	56.25 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	487.50 7.06 0 0 0 0	
5-11.9	TA BA CFA BFA APA EPAI	46.13 15.00 222.09 476.77 13.00 13.00	10.85 2.50 26.01 2.42 2.42 2.42	8.37 2.50 34.19 1.19 1.19 1.19	19.56 5.67 66.33 6.37 6.37 6.37	0 0 0 0 0 0	13.21 7.50 133.04 442.97 6.44 6.44	0 0 0 0 0 0	0 0 0 0 0 0	4.77 49.51 145.31 1.35 2.13 2.13
12.5	TA RA CFA BFA APA EPAI	14.85 35.00 1233.96 6865.20 20.38 20.38	0 0 0 0 0 0	5.39 12.50 447.30 5549.25 5.82 5.31	3.95 7.50 271.26 1477.45 3.52 5.31	0 0 0 0 0 0	1.022 5.00 2110.38 1393.33 2.31 2.31	.44 5.00 258.85 32.04 36.38 36.38	25.85 2421.74 13532.33 32.04 36.38 36.38	
TOTALS	TA BA CFA BFA APA EPAI	454.72 51.23 1456.04 7341.97 33.38 33.38	10.85 2.50 34.18 0 2.42 2.42	38.31 6.89 66.33 2549.25 6.37 6.37	61.64 15.26 447.30 1920.42 6.82 6.82	17.17 15.00 404.30 0 7.41 7.41	0 0 0 0 0 0	5.21 7.50 308.36 1538.64 3.66 4.45	611.47 104.56 2897.40 14452.07 58.90 65.79	

## --Montana forest habitat types

APP code <sup>1</sup>	Abbreviation	Scientific names	Habitat types and phases	Common names
010	SCREE			
000			PINUS FLEXILIS CLIMAX SERIES	
010	PIFL/AGSP h.t.	<i>Pinus flexilis/Agropyron spicatum</i> h.t.	limber pine/bluebunch wheatgrass	
050	PIFL/FEID h.t.	<i>Pinus flexilis/Festuca idahoensis</i> h.t.	limber pine/Idaho fescue	
051	-FEID phase	- <i>Festuca idahoensis</i> phase	-Idaho fescue phase	
052	-FESC phase	- <i>Festuca scabrella</i> phase	-rough fescue phase	
070	PIFL/JUCO h.t.	<i>Pinus flexilis/Juniperus communis</i> h.t.	limber pine/common juniper	
100			PINUS PONDEROSA CLIMAX SERIES	
110	PIPO/AND h.t. <sup>2</sup>	<i>Pinus ponderosa/Andropogon</i> spp. h.t.	ponderosa pine/bluestem	
130	PIPO/AGSP h.t.	<i>Pinus ponderosa/Agropyron spicatum</i> h.t.	ponderosa pine/bluebunch wheatgrass	
140	PIPO/FEID h.t.	<i>Pinus ponderosa/Festuca idahoensis</i> h.t.	ponderosa pine/Idaho fescue	
141	-FEID phase	- <i>Festuca idahoensis</i> phase	-Idaho fescue phase	
142	-FESC phase	- <i>Festuca scabrella</i> phase	-rough fescue phase	
160	PIPO/PUTR h.t.	<i>Pinus ponderosa/Purshia tridentata</i> h.t.	ponderosa pine/bitterbrush	
161	-AGSP phase	- <i>Agropyron spicatum</i> phase	-bluebunch wheatgrass phase	
162	-FEID phase	- <i>Festuca idahoensis</i> phase	-Idaho fescue phase	
170	PIPO/SYAL h.t.	<i>Pinus ponderosa/Symphoricarpos albus</i> h.t.	ponderosa pine/snowberry	
171	-SYAL phase	- <i>Symphoricarpos albus</i> phase	-snowberry phase	
172	-BERE phase	- <i>Berberis repens</i> phase	-creeping oregon grape phase	
180	PIPO/PRVI h.t.	<i>Pinus ponderosa/Prunus virginiana</i> h.t.	ponderosa pine/chokecherry	
181	-PRVI phase	- <i>Prunus virginiana</i> phase	-chokecherry phase	
182	-SHCA phase	- <i>Shepherdia canadensis</i> phase	-buffaloberry phase	
200			PSEUDOTSUGA MENZIESII CLIMAX SERIES	
210	PSME/AGSP h.t.	<i>Pseudotsuga menziesii/Agropyron spicatum</i> h.t.	Douglas-fir/bluebunch wheatgrass	
220	PSME/FEID h.t.	<i>Pseudotsuga menziesii/Festuca idahoensis</i> h.t.	Douglas-fir/Idaho fescue	
230	PSME/FLSC h.t.	<i>Pseudotsuga menziesii/Festuca scabrella</i> h.t.	Douglas-fir/rough fescue	
250	PSME/VACA h.t.	<i>Pseudotsuga menziesii/Vaccinium caespitosum</i> h.t.	Douglas-fir/dwarf huckleberry	
260	PSME/PIMA h.t.	<i>Pseudotsuga menziesii/Physocarpus malvaceus</i> h.t.	Douglas-fir/ninebark	
261	-PIMA phase	- <i>Physocarpus malvaceus</i> phase	-ninebark phase	
262	-CARU phase	- <i>Calamagrostis rubescens</i> phase	-pinegrass phase	
280	PSME/VAGL h.t.	<i>Pseudotsuga menziesii/Vaccinium globulare</i> h.t.	Douglas-fir/blue huckleberry	
281	-VAGL phase	- <i>Vaccinium globulare</i> phase	-blue huckleberry phase	
282	-ARIV phase	- <i>Arctostaphylos uva-ursi</i> phase	-kinnikinnick phase	
283	-XETE phase	- <i>Xerophyllum tenax</i> phase	-beargrass phase	
290	PSME/LIBO h.t.	<i>Pseudotsuga menziesii/Linnaea borealis</i> h.t.	Douglas-fir/twinflower	
291	-SYAL phase	- <i>Symporicarpos albus</i> phase	-snowberry phase	
292	-CARU phase	- <i>Calamagrostis rubescens</i> phase	-pinegrass phase	
293	-VAGL phase	- <i>Vaccinium globulare</i> phase	-blue huckleberry phase	
310	PSME/SYAL h.t.	<i>Pseudotsuga menziesii/Symporicarpos albus</i> h.t.	Douglas-fir/snowberry	
311	-AGSP phase	- <i>Agropyron spicatum</i> phase	-bluebunch wheatgrass phase	
312	-CARU phase	- <i>Calamagrostis rubescens</i> phase	-pinegrass phase	
313	-SYAL phase	- <i>Symporicarpos albus</i> phase	-snowberry phase	
320	PSME/CARU h.t.	<i>Pseudotsuga menziesii/Calamagrostis rubescens</i> h.t.	Douglas-fir/pinegrass	
321	-AGSP phase	- <i>Agropyron spicatum</i> phase	-bluebunch wheatgrass phase	
322	-ARIV phase	- <i>Arctostaphylos uva-ursi</i> phase	-kinnikinnick phase	
323	-CARU phase	- <i>Calamagrostis rubescens</i> phase	-pinegrass phase	
324	-PIPO phase	- <i>Pinus ponderosa</i> phase	-ponderosa pine phase	
330	PSME/CAGE h.t.	<i>Pseudotsuga menziesii/Carex geyeri</i> h.t.	Douglas-fir/elk sedge	
340	PSME/SPBE h.t.	<i>Pseudotsuga menziesii/Spiraea betulifolia</i> h.t.	Douglas-fir/white spiraea	
350	PSME/ARIV h.t.	<i>Pseudotsuga menziesii/Arctostaphylos uva-ursi</i> h.t.	Douglas-fir/kinnikinnick	
360	PSME/JUCO h.t.	<i>Pseudotsuga menziesii/Juniperus communis</i> h.t.	Douglas-fir/common juniper	
370	PSME/ARCO h.t.	<i>Pseudotsuga menziesii/Arnica cordifolia</i> h.t.	Douglas-fir/heartleaf arnica	
380	PSME/SYOR h.t. <sup>2</sup>	<i>Pseudotsuga menziesii/Symporicarpos oreophilus</i> h.t.	Douglas-fir/mountain snowberry	
400			PICEA CLIMAX SERIES	
410	PICEA/EQAR h.t.	<i>Picea/Equisetum arvense</i> h.t.	spruce/common horsetail	
420	PICEA/CLUN h.t.	<i>Picea/Clintonia uniflora</i> h.t.	spruce/queencup beadily	
421	-VACA phase	- <i>Vaccinium caespitosum</i> phase	-dwarf huckleberry phase	
422	-CLUN phase	- <i>Clintonia uniflora</i> phase	-queencup beadily phase	
430	PICEA/PIMA h.t.	<i>Picea/Physocarpus malvaceus</i> h.t.	spruce/ninebark	
440	PICEA/GATR h.t.	<i>Picea/Galium triflorum</i> h.t.	spruce/sweet-scented bedstraw	
450	PICEA/VACA h.t.	<i>Picea/Vaccinium caespitosum</i> h.t.	spruce/dwarf huckleberry	
460	PICEA/SEST h.t.	<i>Picea/Senecio streptanthifolius</i> h.t.	spruce/cleft-leaf groundsel	
461	-PSME phase	- <i>Pseudotsuga menziesii</i> phase	-Douglas-fir phase	
462	-PICEA phase	- <i>Picea</i> phase	-spruce phase	
470	PICEA/LIBO h.t.	<i>Picea/Linnaea borealis</i> h.t.	spruce/twinflower	
480	PICEA/SMST h.t.	<i>Picea/Smilacina stellata</i> h.t.	spruce/starry Solomon's seal	
500			ABIES GRANDIS CLIMAX SERIES	
510	ABGR/XETE h.t.	<i>Abies grandis/Xerophyllum tenax</i> h.t.	grand fir/beargrass	
520	ABGR/CLUN h.t.	<i>Abies grandis/Clintonia uniflora</i> h.t.	grand fir/queencup beadily	
521	-CLUN phase	- <i>Clintonia uniflora</i> phase	-queencup beadily phase	
522	-ARNU phase	<i>Aralia nudicaulis</i> phase	-wild sarsaparilla phase	
523	-XETE phase	- <i>Xerophyllum tenax</i> phase	-beargrass phase	
590	ABGR/LIBO h.t.	<i>Abies grandis/Linnaea borealis</i> h.t.	grand fir/twinflower	
591	-LIBO phase	- <i>Linnaea borealis</i> phase	-twinflower phase	
592	-XLTE phase	- <i>Xerophyllum tenax</i> phase	-beargrass phase	

(con.)

ADP code <sup>1</sup>	:	Abbreviation	:	Scientific names	Habitat types and phases	Common names			
501				THUJA PLICATA CLIMAX SERIES					
530		THPL/CLUN h.t.		<i>Thuja plicata/Clintonia uniflora</i> h.t.	- <i>Clintonia uniflora</i> phase	western redcedar/queencup beadlily			
531		-CLUN phase				-queencup beadlily phase			
532		-ARNU phase		- <i>Aralia nudicaulis</i> phase		-wild sarsaparilla phase			
533		-MEFE phase		- <i>Menziesia ferruginea</i> phase		-menziesia phase			
550		THPL/OPHO h.t.		<i>Thuja plicata/Oplopanax horridum</i> h.t.		western redcedar/devil's club			
502				TSUGA HETEROPHYLLA CLIMAX SERIES					
570		TSHE/CLUN h.t.		<i>Tsuga heterophylla/Clintonia uniflora</i> h.t.	- <i>Clintonia uniflora</i> phase	western hemlock/queencup beadlily			
571		-CLUN phase				-queencup beadlily phase			
572		-ARNU phase		- <i>Aralia nudicaulis</i> phase		-wild sarsaparilla phase			
600				ABIES LASIOCarpa CLIMAX SERIES					
700				Lower subalpine h.t.s					
610		ABLA/OPHO h.t.		<i>Abies lasiocarpa/Oplopanax horridum</i> h.t.		subalpine fir/devil's club			
620		ABLA/CLUN h.t.		<i>Abies lasiocarpa/Clintonia uniflora</i> h.t.	- <i>Clintonia uniflora</i> phase	subalpine fir/queencup beadlily			
621		-CLUN phase				-queencup beadlily phase			
622		-ARNU phase		- <i>Aralia nudicaulis</i> phase		-wild sarsaparilla phase			
623		-VACA phase		- <i>Vaccinium caespitosum</i> phase		-dwarf huckleberry phase			
624		-XETE phase		- <i>Xerophyllum tenax</i> phase		-beargrass phase			
625		-MEFE phase		- <i>Menziesia ferruginea</i> phase		-menziesia phase			
630		ABLA/GATR h.t.		<i>Abies lasiocarpa/Galium triflorum</i> h.t.		subalpine fir/sweetscented bedstraw			
640		ABLA/VACA h.t.		<i>Abies lasiocarpa/Vaccinium caespitosum</i> h.t.		subalpine fir/dwarf huckleberry			
650		ABLA/CACA h.t.		<i>Abies lasiocarpa/Calamagrostis canadensis</i> h.t.	- <i>Calamagrostis canadensis</i> phase	subalpine fir/bluejoint			
651		-CACA phase				-bluejoint phase			
653		-GATR phase		- <i>Galium triflorum</i> phase		-sweetscented bedstraw phase			
		-VACA phase		- <i>Vaccinium caespitosum</i> phase		-dwarf huckleberry phase			
654		ABLA/LIBO h.t.		<i>Abies lasiocarpa/Linnaea borealis</i> h.t.		subalpine fir/twinflower			
660		-LIBO phase			-Linnaea borealis phase	-twinflower phase			
662		-XETE phase		- <i>Xerophyllum tenax</i> phase		-beargrass phase			
663		-VASC phase		- <i>Vaccinium scoparium</i> phase		-grouse whortleberry phase			
670		ABLA/MEFE h.t.		<i>Abies lasiocarpa/Menziesia ferruginea</i> h.t.		subalpine fir/menziesia			
680		TSME/MEFE h.t.		<i>Tsuga mertensiana/Menziesia ferruginea</i> h.t.		mountain hemlock/menziesia			
690		ABLA/XETE h.t.		<i>Abies lasiocarpa/Xerophyllum tenax</i> h.t.		subalpine fir/beargrass			
691		-VAGL phase			-Calamagrostis canadensis phase	-blue huckleberry phase			
692		-VASC phase		- <i>Vaccinium globulare</i> phase		-grouse whortleberry phase			
		-VASC phase		- <i>Vaccinium scoparium</i> phase					
710		TSME/XETE h.t.		<i>Tsuga mertensiana/Xerophyllum tenax</i> h.t.		mountain hemlock/beargrass			
720		ABLA/VAGL h.t.		<i>Abies lasiocarpa/Vaccinium globulare</i> h.t.		subalpine fir/blue huckleberry			
730		ABLA/VASC h.t.		<i>Abies lasiocarpa/Vaccinium scoparium</i> h.t.	- <i>Vaccinium scoparium</i> phase	subalpine fir/grouse whortleberry			
731		-CARU phase				-pinegrass phase			
732		-VASC phase		- <i>Calamagrostis rubescens</i> phase		-grouse whortleberry phase			
		-THOC phase		- <i>Vaccinium scoparium</i> phase		-western meadowrue phase			
733				- <i>Thalictrum occidentale</i> phase					
740		ABLA/ALSI h.t.		<i>Abies lasiocarpa/Alnus sinuata</i> h.t.		subalpine fir/Sitka alder			
750		ABLA/CARU h.t.		<i>Abies lasiocarpa/Calamagrostis rubescens</i> h.t.		subalpine fir/pinegrass			
770		ABLA/CLPS h.t.		<i>Abies lasiocarpa/Clematis pseudoalpina</i> h.t.		subalpine fir/virgin's bower			
780		ABLA/ARCO h.t.		<i>Abies lasiocarpa/Arnica cordifolia</i> h.t.		subalpine fir/heartleaf arnica			
790		ABLA/CAGE h.t. <sup>2</sup>		<i>Abies lasiocarpa/Carex geyeri</i> h.t.		subalpine fir/elk sedge			
791		-CAGE phase			-Carex geyeri phase	-elk sedge phase			
792		-PSME phase			- <i>Pseudotsuga menziesii</i> phase	-Douglas-fir phase			
800				Upper subalpine h.t.s					
810		ABLA/RIMO h.t. <sup>2</sup>		<i>Abies lasiocarpa/Ribes montigenum</i> h.t.		subalpine fir/mountain gooseberry			
820		ABLA-PIAL/VASC h.t.		<i>Abies lasiocarpa/Pinus albicaulis/Vaccinium scoparium</i> h.t.		subalpine fir-whitebark pine/grouse whortleberry			
830		ABLA/LUHI		<i>Abies lasiocarpa/Luzula hitchcockii</i> h.t.		subalpine fir/smooth wood-rush			
831		-VASC phase			- <i>Vaccinium scoparium</i> phase	-grouse whortleberry phase			
		-MEFE phase		- <i>Menziesia ferruginea</i> phase		-menziesia phase			
840		TSME/LUHI h.t. <sup>2</sup>		<i>Tsuga mertensiana/Luzula hitchcockii</i> h.t.		mountain hemlock/smooth wood-rush			
841		-VASC phase			- <i>Vaccinium scoparium</i> phase	-grouse whortleberry phase			
842		-MEFE phase		- <i>Menziesia ferruginea</i> phase		-menziesia phase			
890				Timberline h.t.s					
850		PIAL-ABLA h.t.s		<i>Pinus albicaulis-Abies lasiocarpa</i> h.t.s		whitebark pine-subalpine fir			
860		LALY-ABLA h.t.s		<i>Larix lyallii-Abies lasiocarpa</i> h.t.s		alpine larch-subalpine fir			
870		PIAL h.t.s		<i>Pinus albicaulis</i> h.t.s		whitebark pine			
900				PINUS CONTORTA CLIMAX SERIES					
910		PICO/PUTR h.t.		<i>Pinus contorta/Purshia tridentata</i> h.t.		lodgepole pine/bitterbrush			
920		PICO/VACA c.t.		<i>Pinus contorta/Vaccinium caespitosum</i> c.t.		lodgepole pine/dwarf huckleberry			
930		PICO/LIBO c.t.		<i>Pinus contorta/Linnaea borealis</i> c.t.		lodgepole pine/twinflower			
940		PICO/VASC c.t.		<i>Pinus contorta/Vaccinium scoparium</i> c.t.		lodgepole pine/grouse whortleberry			
950		PICO/CARU c.t.		<i>Pinus contorta/Calamagrostis rubescens</i> c.t.		lodgepole pine/pinegrass			

Total Number of Habitat Types = 64

Total Number of Habitat Types, Phase, and Pinus contorta Community Type Categories = 105

<sup>1</sup> Automatic data processing codes for National Forest System use.

<sup>2</sup> Minor type in Montana; described in other study areas.

## APPENDIX II

### Species Codes

GF = Grand fir  
AF = Subalpine fir  
J = Juniper  
L = Larch  
S = Spruce  
WLP = White bark or limber pine  
LP = Lodgepole pine  
WP = Western white pine  
PP = Ponderosa pine  
DF = Douglas-fir  
Y = Yew  
C = Western redcedar  
WH = Western hemlock  
MH = Mountain hemlock  
B = Birch  
ASH = Ash  
CW = Cottonwood  
ASP = Aspen  
OH = Other hardwoods  
AL = Alpine larch

### APPENDIX III

#### Damage Codes

##### Code

- 0 Healthy tree, no insect, disease, or damage problem
- 1 Unknown or natural mortality

#### Bark Beetles

- 2 Current beetle attack
- 3 Last year's attack
- 4 Older beetle attack
- 5 Unsuccessful attack
- 6 Secondary or other bark beetle attack

#### Defoliation

- 7 Light defoliation (less than 10%)
- 8 Moderate defoliation (10-70%)
- 9 Heavy defoliation (greater than 70%)
- 10 Light top kill (less than 10% top dead from repeated defoliation)
- 11 Moderate top kill (10-33% top dead)
- 12 Heavy top kill (greater than 33% dead top)
- 13 Defoliator mortality (mortality caused by defoliators only)

#### Disease

- 14 Mistletoe infected
- 15 Mortality from mistletoe
- 16 Root rot
- 17 Mortality from abiotic causes

#### Noninfectious Disease

- 18 Light damage
- 19 Moderate damage
- 20 Heavy damage
- 21 Mortality from abiotic causes
- 22 Other damaging agents (fire scar, lightning, old spike top, etc.)

FIGURE 2

Ident. code 103  
 (11-31) Forest FLATHEAD  
 (4-19) Slope 30 Aspect NE Elev 42  
 Stand or Area 747.4120  
 (20-35) Type plot 1  
 (69) Physo Site 6  
 Survey code EL  
 (36-37) Size plot 20  
 (70-71) Hab 740  
 Type BARK BEETLE  
 (38-51) Soil   
 Observers JONES & SMITH  
 (52-66) Green tree plots 10  
 (67-68) Total plots 20  
 (72-74) Date 9 4 77  
 (75-76) (77-78) (79-80)

## CONTINUATION SHEET

FIGURE 2, con.

FOREST FLATHEADSTAND 747 4 120

## FOREST INSECT AND DISEASE DAMAGE SURVEY

Ident. code	Plot (1-5)	HAB (3-6)	Species (12-17)	D.b.h. (16-18)	Height (20-22)	Age (24-26)	growth (28-30)	10-yr. growth (32-34)	Insect or disease codes (36-38)	(40-41)	(43-44)	(46-47)

103 05 740 Lp 89 68 RECORD DAMAGED 3 — —  
 ↓ ↓ Lp 103 71 TREES — — 4 — —  
 ↓ ↓ AF 92 62 — — — 9 — —  
 ↓ ↓ Lp 31 — 1/300 ACRE PLOT — — — — —  
 ↓ ↓ AF 21 — — — — — 9 — —  
103 06 750 Df 168 89 RECORD DATA 7 11 22  
 ↓ ↓ Lp 142 82 ON ALL TREES — — 0 — —  
 ↓ ↓ Lp 92 71 THIS PLOT — — 0 — —  
 ↓ ↓ Lp 168 — — — — 4 — —  
 ↓ ↓ AF 81 — — — — 0 — —  
 ↓ ↓ AF 21 — 1/300 ACRE PLOT — — 1 — —  
 ↓ ↓ AF 1 — — — — 0 — —  
 ↓ ↓ AF 1 — — — — 0 — —  
CONTINUE