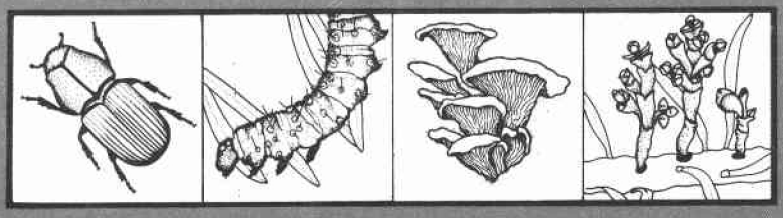
Forest Pest Management



REPORT 86-7

3450
May 1986

RATING SUSCEPTIBLITY OF STANDS TO WESTERN SPRUCE BUDWORM: USERS GUIDE AND DOCUMENTATION TO SBW-HAZARD

Wayne E. Bousfield[1], N. William Wulf[2], and Clinton E. Carlson[3]

INTRODUCTION

SBW-HAZARD is a computer model of the concepts set forth by Wulf and Carlson (In Press) and Carlson et al. (In Press), and is available at the Fort Collins computer center. The model will run from an inventory tree list in the same computer format as the R1-EDIT[4] and will calculate a numerical hazard index for western spruce budworm[5] from 0 to 100. There are nine multiplicative values in the model of which eight are calculated from the stand inventory. One variable must be supplied by the user if different from the default value. The model as now coded is valid only for the Northern Region; however, with minor revisions an Idaho R-4 version could become available. The concept could be expanded and used for other Regions.

The nine variables in the model are:

1. Percent crown cover (PCC)
2. Percent host crown cover (PHCC)
3. Percent climax host crown cover (PCHCC)
4. Relative stand density (RSD)
5. Coefficient of variation of host tree height (CV)
6. Mean host tree age (MHA)
7. Site quality for spruce budworm (SITE)
8. Regional climate (CLIM)
9. Surrounding host type (Value not obtained from R-1 EDIT)

---

[1] Entomologist, Cooperative Forestry and Pest Mgt. Missoula, Mont.
[2] Silivculturist, Clearwater N.F. Orofino, Idaho.
[3] Research Forester, Intermtn. Res. Sta., Forestry Sciences Lab., Missoula, Mont.
[4] Region 1 Timber Management program
[5] Choristoneura occidentalis

United States Department of Agriculture | Forest Service | Northern Region | P.O. Box 7669 Missoula, Montana 59807

MODEL STRUCTURE

The initial steps in the program will fill in missing height and age by regression analysis for all trees since these variables are collected on a sampling basis. Tranformations of 1/d.b.h and ln (hgt.) are made on the sampled trees to predict for trees with unmeasured heights (Bruce and Schumacker 1950). No transformations are done to predict missing age. The following mensurational statistics are necessary for the model: (1) trees per acre, (total, host, and stressed host[6]), (2) stand basal area, and host basal area, (3) stand and host age weighted by basal area, (4) coefficient of variation for host tree height, (5) crown area (total, host, and climax host), and (6) maximum basal area. The following equations will calculate these statistics.

1. Trees per acre (TPA)

   For trees less than the break point diameter[7] (Usually 5.0 inches)

   TPA = SIZE[8]* NUMBER OF TREES / NUMBER OF PLOTS

   For trees greater than the break point diameter sampled on the variable plot.

   TPA = BAF[9]/ (DBH^2 * .005454) / NUMBER OF PLOTS

2. Basal area (BA)

   For trees less than the break point diameter

   BA = DBH^2 * .005454 * TPA

   For trees greater than the break point diameter sampled on the variable plot

   BA = BAF * NUMBER OF TREES / NUMBER OF PLOTS

3. Age weighted by basal area (WAGE)

   This variable is calculated for both total stand age and host age.

   WAGE = AGE * BA / TBA

   Where BA = Basal area the sample tree represents
   TBA = Total stand basal area

---

[6] Those trees with specific stress codes on R-1 Edit (Appendix 1)

[7] Trees smaller than the break point diameter are sampled on a specified fixed plot. Trees larger than the break point diameter are sampled on a variable plot.

[8] Reciprocal of fixed plot size (1/300 = 300)

[9] Basal area factor for variable plot size.

4. Coefficient of variation (CV) of host tree height.

Multistoried stands are considered more susceptible than single-storied stands. Host tree heights less than 2 feet are not included in the computations. The coefficient of variation is calculated as follows:

$$SWHGT = SWHGT + (HGT * TPA)$$

$$SQWHGT = SQWHGT + (HGT * TPA)^2$$

$$CV = SQRT((SQWHGT - (SWHGT^2 / N)) / (N-1)) / (SWHGT / N) * 100$$

WHERE: SWHGT = Sum of weighted tree heights
SQWHGT = Sum of squared weighted tree heights
N = Number of host trees in the tree list

5. Crown Area[10]

Spruce budworm hazard is a function of stand density in this model. Stand density is measured in terms of crown canopy coverage and is calculated from crown width equations. (Moeur 1981) Total crown area, host crown area and climax crown area are calculated for each stand. The stand habitat code is used to determine what species is climax (Appendix 2). Host trees are Douglas-fir, grand fir, subalpine fir and spruce. Although western larch is a host of the western spruce budworm, its presence does not influence the hazard.

The following equations will compute the crown area that each sample tree represents. Total crown area, host crown area, and climax host crown area are accumulated separately.

For trees less than 3.5 inches in diameter:

$$CA = (EXP(b_1 * \ln(HGT) + b_2 * \ln(CL) + B_3 * \ln(BA)) / 2)^2 * 3.14 * TPA$$

For trees greater than 3.5 inches in diameter:

$$CA = (EXP(b_4 + b_5 * \ln(DBH) + b_6 * \ln(HGT) + b_7 * \ln(CL)) /2)^2 * 3.14 * TPA$$

WHERE: DBH = Diameter at 4.5 ft.
HGT = Tree height
CL = Crown length (computed from crown ratio)
TPA = Trees per acre represented by the sample tree
BA = Stand basal area
b_i = Species specific coefficients (Moeur 1981)

---

[10] Sum of projected crown area in ft^2 per acre.

6. Maximum basal area

The maximum basal area (MAXBA) is the average maximum competition a particular stand will support without excessive competition. The relative stand density is obtained by comparing the actual basal area to the maximum basal area (MAXBA).

Using R-1 timber management guide lines[11] the maximum basal area can be computed using the following equation. Coefficients for the equation are forest zone and habitat dependent (Appendix 3 and 4).

$$MAXBA = MB(1) + MB(2) * 1/X + MB(3) / X^2 + MB(4) / X^3 + MB(5) / X^4 + MB(6) / X^5 + MB(7) * ALOG(X) + MB(8) * (ALOG(X)^2) + MB(9) * (ALOG(X)^3)$$

Where X = Stand age weighted by basal area (WAGE)

MB_i = Coefficient that is habitat group and forest zone dependent. Appendix 4.

CALCULATION OF INDEX VALUES

Wulf and Carlson (In Press) displayed the values for the various indexes by classes. To facilitate computer coding the values were fitted to equations. Most often the Gompertz[12] curve fit will describe the relationship. The indexes for the nine variables can now be computed. The value for the various indexes are computed as follows:

1. TOTAL PERCENT CROWN COVER (TPCC)

$$TPCC = 1.6667 * 0.3085^{.6171**(PCC/20 + .5)}$$

Where PCC = (Total crown area / 43560 * 100)

This relationship is shown in Figure 1

2. PERCENT HOST CROWN COVER

$$IPHCC = .01988 + .0245 * (HCC / TCC * 100)$$

Where TCC = Total crown cover
HCC = Host crown cover

This relationship is shown in Figure 2

3. PERCENT CLIMAX HOST CROWN COVER

$$IPCHCC = 2.4058 * 0.1341^{0.6741 ** (PCHCC / 10 + .5)}$$

Where PCHCC is the percent of climax host crown cover

This relationship is shown as Figure 3

---

[11] R-1 Preliminary stocking curves. Timber Mgt., Missoula, Mont.

[12] The Gompertz equation: $Y = C\ a^{(b ** x)}$

4. RELATIVE STAND DENSITY

There are two equations for the index for relative stand density (IRSD) depending on the percentage of trees per acre classified as stressed (Figure 4). If the percentage is less than 30, then:

$$IRSD = 1.5253 * 0.02129^{0.4889} ** (BA / MAXBA * 100 / 20 + 1$$

or if greater than 30 percent then:

$$IRSD = 1.6167 * 0.0237^{0.4682} ** (BA / MAXBA * 100 / 20 + 1)$$

Where BA = Stand basal area
MAXBA = Maximum basal area as calculated using R-1 guidelines.

5. COEFFICIENT OF VARIATION OF HOST TREE HEIGHT (ICV)

The relationship of the coefficient of variation of host tree heights is computed using the following equation and shown as Figure 5:

$$ICV = 1.736 * .339^{(618 ** (CV * 100 / 10 + .5)}$$

6. HOST AGE (IMHA)

Host age is another variable considered in the hazard rating. The index (IMHA) is displayed as Figure 6 and computed as:

$$IMHA = 1.3325 * .0454^{.4084} ** (HOST AGE / 30 + .5)$$

7. SITE QUALITY FOR SPRUCE BUDWORM

The site quality (SITE) that will support spruce budworm populations is classified on the premise that cold wet conditions are unfavorable and warm dry conditions are favorable. Classification is based on stand habitat type. Appendix 5

Site description	Index value
Cold subalpine fir timberline	.0
Cool, wet subalpine fir, cool wet spruce	.6
Warm, wet grand fir, cedar, hemlock; warm subalpine fir	1.1
Cold Douglas-fir; cold grand fir; cold, dry spruce, cold, dry subalpine fir	1.2
Mesic grand fir, warm mesic spruce; warm, moist subalpine fir	1.3
Mesic Douglas-fir; dry grand fir; warm mesic spruce; warm, dry subalpine fir	1.4
Warm, dry Douglas-fir	1.5

8. REGIONAL CLIMATE:

Calculations for regional climate index (CLIM) are based on the forest code.

Forest	Index
Beaverhead	1.2
Bitterroot	1.2
Clearwater	1.0
Custer	1.2
Deerlodge	1.2
Flathead	0.5
Gallatin	1.2
Helena	1.2
Idaho Panhandle	.2
Kootenai	.2
Lewis and Clark	1.2
Lolo	1.0
Nezperce	1.1

9. SURROUNDING HOST TYPE

The index for the surounding host type is defaulted to 1.0 because this information is not available from the R-1 data. Please refer to the publication by Wulf and Carlson for more information.

CALCULATION OF HAZARD VALUES

The hazard rating value is calculated as follows:

HAZ = IPCC * IPHCC * IPCHCC * IRSD * ICV * IMHA * SITE * CLIM * 1

PROGRAM EXECUTION

SBW-HAZARD is currently operating at the Fort Collins Computer Center and is available to all users. Formatting and coding for SBW-HAZARD assumes that the data is on an R-1 EDIT data tape. To execute SBW-HAZARD use the following job control language:

```
@XQT INDIDS * INDIDS.RUN-STANDS
```

This program will ask you questions and one will be if you want to hazard rate for spruce budworm. Answer all other questions and it will build your run stream for you.

OUTPUT INTERPRETATION

An example of output is shown as Appendix 6. The numerical hazard rating, the index values, and the stand characteristics are displayed in the output. Values less than 15 are considered low hazard, and values greater than 30 will be high. This is based on limited testing of a few stands.

REFERENCES

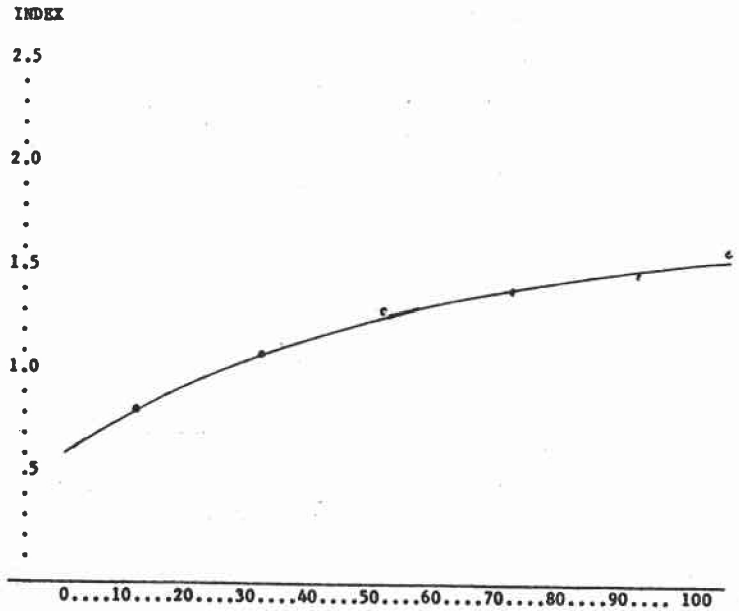
Bruce, D. and F. X. Schumacher. 1950. Forest Mensuration. McGraw Hill Book Co., New York.

Carlson, C. E.; R. Heller; K. Stoszek;, N. W. Wulf. In Press. Rating stand hazard to western spruce budworm. In Brooks, M. H.; J. J. Colbert; R. G. Mitchell; and R. W. Stark. Tech. Coords. Managing trees and stands susceptible to western spruce budworm. Tech. Bull. 1655. Wash., D.C., USDA Forest Service, Canada-United States Spruce Budworms Program.

Moeur, M. 1981. Crown width and foliage weight of northern Rocky Mountain conifers. USDA Forest Service, Intermtn. Forest and Range Exp. Sta., Res. Pap. INT-283. 14 pp.

Wulf, N. and C. E. Carlson. In Press. General indexing Model. CANUSA books.

Fig 1. Percent Crown Cover

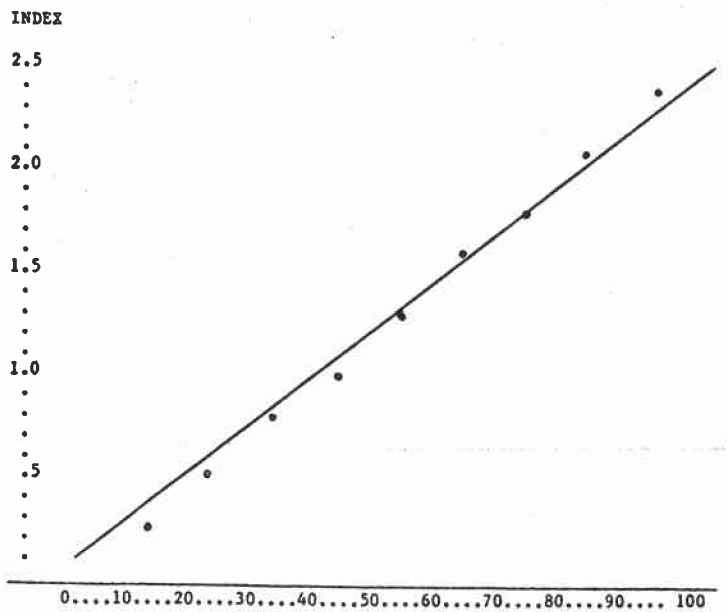


Where Index = C * A^{B} ** X

A = 0.3085
B = .6170
C = 1.6667
X = PERCENT / 20 + .5

1 Data points are from Wulf and Carlson

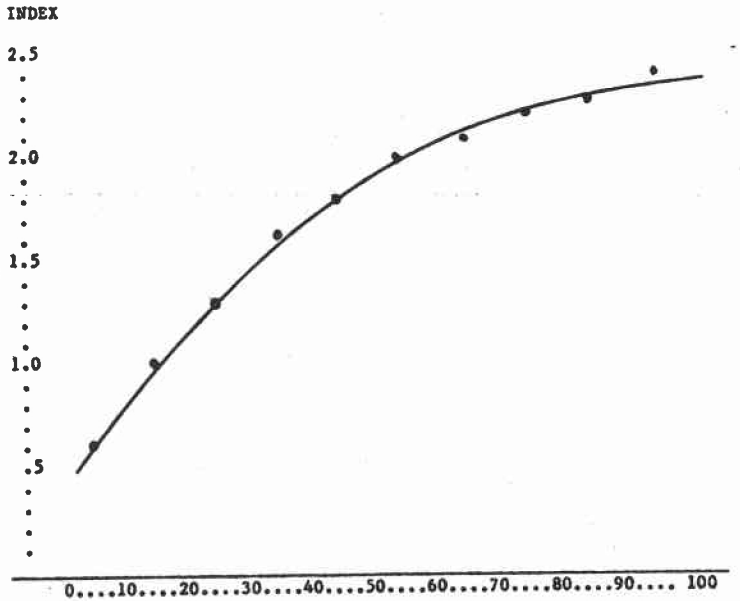
Fig 2. Percent Host Crown Cover



Where Index = A + B * X

A = .0198
B = .0245
X = TOTAL CROWN COVER / HOST CROWN COVER

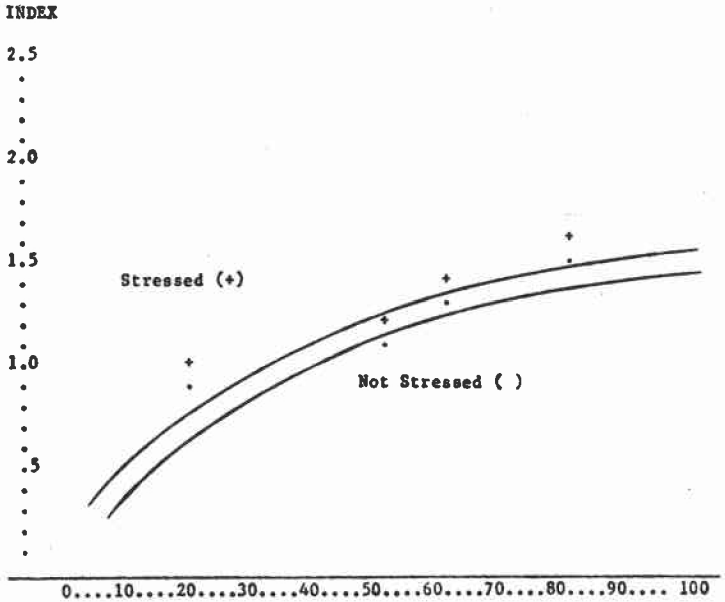
Fig 3. Percent Climax host Crown Cover



Where Index = $C * A^{B} ** X$

A = 0.1341
B = .6741
C = 2.4058
X = PERCENT / 10 + 0.5

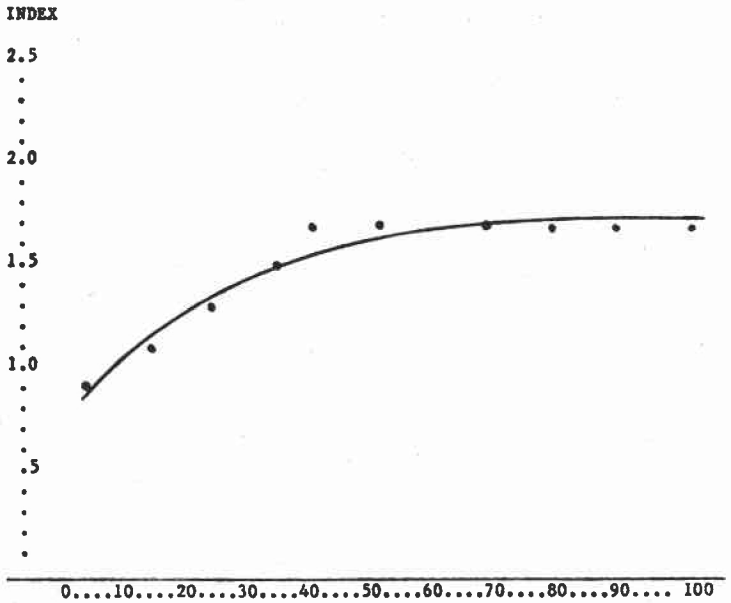
Fig 4. Relative Stand Density



$RSD = C * A^{B} ** PERCENT$

Not stressed	Stressed
A = .02129	A = .0237
B = .4889	B = .4686
C = 1.5253	C = 1.6167

Fig 5 Index for Coefficient of Variation of Host Tree Heights

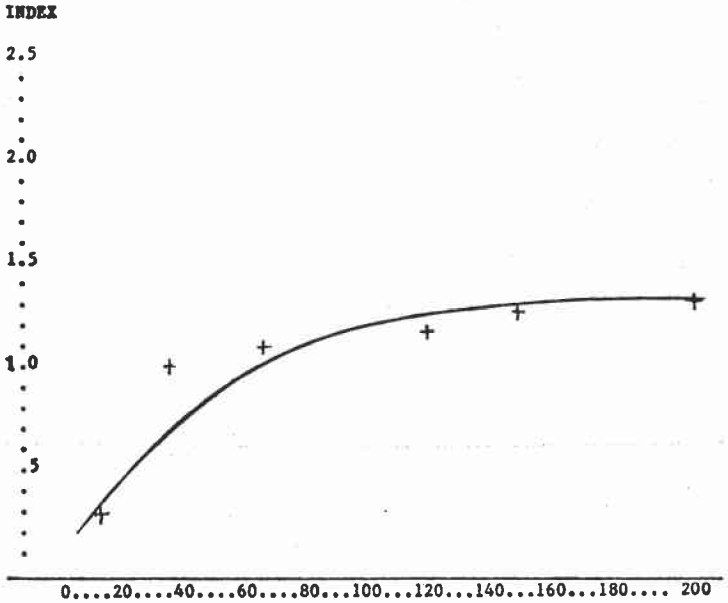


INDEX FOR COEFFIEIENT OF VARIATION OF HOST TREE HEIGHTS

Where Index = C * A^{B} ** X

A = 0.339
B = .618
C = 1.736
X = CV * 100 / 10 + .5

Fig 6. Index for Mean Host Age



MEAN HOST AGE

Where Index = C * A^{B} ** X

A = .0454
B = .4084
C = 1.3325
X = HOST AGE / 30 + .5

Appendix 1. Trees with the following R-1 edit damage codes are considered stressed.

01 03 04 07 08 13 14 20 22 30 32 33 35 40 42
50 51 52 54 60 61 62 63 64 65 70 71 72 73 75
76 77 78 79 80 81 82 84 85 86 87 88 91 93 94

Appendix 2. Habitat codes to determine what species will be climax host.

Grand fir climax codes

505 506 507 508 510 511 512 515 516 517 518
519 520 521 522 523 524 525 526 527 529 580
585 590 591 592 593

Subalpine fir climax codes

605 610 620 621 622 623 624 625 630 635 636
637 638 640 645 650 651 652 653 654 655 660
661 662 663 670 671 672 674 690 691 692 693
694 705 707 710 711 712 713 720 721 722 723
730 731 732 733 734 740 745 750 751 752 760
761 762 770 780 781 782 790 791 792 793 810
820 831 832 833

Spruce climax codes

410 415 420 421 422 430 440 450 460 461 462
470 480 490 493 497

Douglas-fir climax codes

010 040 050 051 052 060 070 080 090 091 092
093 094 095 100 110 120 130 140 141 142 150
155 160 161 162 170 171 172 180 182 190 200
210 220 221 222 230 250 260 261 262 263 264
265 280 281 282 283 290 291 292 293 310 311
312 313 314 315 320 321 322 323 324 325 326
330 331 332 333 334 340 341 342 343 344 350
360 370 371 372 375 380 385 390 391 392 395
396 397 398 399

Appendix 3. Habitat codes used to determine what group for maximum basal area computations.

Eastern Montana forest zone habitat codes

Habitat group 3	000 010 040 050 051 052 060 070 080 090 091 092 093 094 095 100 110 120 130 140 141 042 150 155 160 161 162 170 171 172 180 181 182 190 200 210 220 230 311 321 380
Habitat group 4	320 321 322 323 324 325 330 340 350 360 370
Habitat group 5	260 261 262 263 310 311 312 313 430
Habitat group 6	250 290 291 292 293 470 480 660 661 662 663 930
Habitat group 7	280 281 282 283 690 691 692 693 694 720
Habitat group 8	730 731 732 940
Habitat group 9	410 420 421 422 440 450 605 610 620 621 622 623 624 625 630 635 636 637 640 650 651 652 653 654 655 733 734 920
Habitat group 10	670 671 672 673 674 675 676 677 680 681 682 685 686 687 740
Habitat group 11	460 461 462 710 711 712 713 750 770 780 790 791 792 810 820 830 831 832 840 841 842 850 860 870 910 920 925 950

Western Montana Habitat groups

Habitat group 1	010 040 050 051 052 060 070 080 090 091 092 093 094 095 100 110 120 130 140 141 142 150 155 160 165 360 361 362 745 850 860 870 960
Habitat group 2	170 171 180 181 190 195 210 220 221 222 230 250 260 261 262 310 311 312 313 320 321 322 323 324 325 330 340 350
Habitat group 3	280 281 282 283 323 330 331 332 334 360 370 371 372 375 380 390 391 392 393 505 506 507 508 510 511 512 515 516 517 518 550 585 750
Habitat group 4	430 450 460 461 462 490 493 580 638 640 641 663 690 691 692 693 694 720 730 731 732 733

Western Montana habitat groups

Habitat group 5a	290 291 292 293 590 591 592 593
Habitat group 5b	410 420 421 422 440 470 480 516 517 518 519 520 521 522 523 524 525 526 527 529 530 531 532 533 540 541 542 545 546 547 550 555 560 561 562 565 570 571 572 573 574 575 576 577 578 579
Habitat group 6a	605 610 620 621 622 623 624 625 630 635 636 637 660 661 662
Habitat group 6b	650 651 652 653 654 655 670 671 672 673 674 675 676 677 680 681 682 683 685 686 687 710 711 712 713 740 832 840 841 842 910 920 930 940 950

North Idaho forest zone habitat types

Habitat group 1	530 531 532 533 534 535 540 541 542 545 546 547 548 550 555 560
Habitat group 2	565 570 571 572 573 574 575 576 577 578 579 591 592
Habitat group 3	505 506 507 508 510 511 512 515 516 517 518 519 520 521 522 523 524 525 526 529
Habitat group 4	410 420 421 422 430 440 450 460 461 462 470 610 620 621 622 623 624 625 630 635 636 367 640 650 651 652 653 654 655 660 661 662 663 670 671 672 673 674 675 676 677 680 681 682 685 686 687 690 691 692 693 694
Habitat group 5	(Same as group 4)
Habitat group 6	010 050 060 080 090 091 092 093 094 095 100 110 120 130 140 141 142 150 155 160 161 162 170 171 172 180 181 182 190 210 220 230 250 260 261 262 263 280 281 282 283 290 291 292 293 310 311 312 313 320 321 322 323 324 325 330 340 350 360 370 380
Habitat group 7	680 681 682 685 686 687 710 711 712 713 720 730 731 732 733 740 750 770 780 790 791 792 810 820 830 831 832 840 841 842 850 860 870 900 910 920 925 930 950

Appendix 4. Coefficients for maximum basal area curves.

Coefficients for Eastern Montana forest zone

Habitat group	3	0.21253E3	-0.82170E4	0.68752E6
		-0.32581E8	.55405E9	-0.2909E10
		0.0	0.0	0.0
	4	0.24589E4	0.0	0.0
		0.0	0.0	0.0
		-0.2289E4	0.6708E3	-0.60414E2
	5	0.5701E2	0.4378E5	-0.35997E7
		0.10572E9	-0.13189E10	0.5774E10
		0.0	0.0	0.0
	6	0.14446E4	0.0	0.0
		0.0	0.0	0.0
		-0.1415E4	0.4357E3	-0.40125E2
	7	-0.15540E3	0.11053E6	-0.95262E7
		0.3155E9	-0.43984E10	0.2087E11
		0.0	0.0	0.0
	8	-059688E2	0.7541E5	-0.62491E7
		0.19907E9	-0.27008E10	0.12602E11
		0.0	0.0	0.0
	9	-0.69895E2	0.64214E5	-0.49709E7
		0.14681E9	-0.18639E10	0.82945E10
		0.0	0.0	0.0
	10	-0.6832E2	0.72957E5	-0.60002E7
		0.19135E9	-0.26084E10	0.12227E11
		0.0	0.0	0.0
	11	-0.31089E3	0.13143E6	-0.10528E8
		0.33549E9	-0.45659E10	0.21355E11
		0.0	0.0	0.0
	12	No coefficients		
	13	0.29389E4	0.0	0.0
		0.0	0.0	0.0
		-0.26967E4	0.78038E3	-0.70216E2

Coefficients for western Montana forest zone

Habitat Group 1

	0.11094E4	0.0	0.0
	0.0	0.0	0.0
	-0.107820E4	0.33767E3	-0.306876E2
2			
	0.561209E2	0.420411E5	-0.327916E7
	0.958416E8	-0.121213E10	0.539229E10
	0.0	0.0	0.0
3			
	0.63979E2	0.31262E5	-0.17413E7
	0.30464E8	-0.16211E9	0.0
	0.0	0.0	0.0
4			
	-0.1206E2	0.5056E5	-0.29126E7
	0.58763E8	-0.46441E9	0.1177E10
	0.0	0.0	0.0
5			
	0.15035E4	0.0	0.0
	0.0	0.0	0.0
	-0.1418E4	0.44615E3	-0.4181E2
5B	0.16111E3	0.32225E5	-0.2554E7
	0.73404E8	-0.91657E9	0.40443E10
	0.0	0.0	0.0
6A	0.49805E1	0.44672E5	-0.235001E7
	0.39945E8	-0.20897E9	0.0
	0.0	0.0	0.0
6B	0.11766E3	0.24628E5	-0.13593E7
	0.22904E8	-0.11862E9	0.0
	0.0	0.0	0.0

Appendix 4, cont.

Coefficients for Northern Idaho forest zone

Habitat group				
	1	0.44641E3	-0.90233E4	0.49359E5
		-0.40782E5	0.0	0.0
		0.0	0.0	0.0
	2	0.39022E3	-0.92901E4	0.51429E5
		0.59527E5	-0.102056E6	0.0
		0.0	0.0	0.0
	3	0.15740E4	0.0	0.0
		0.0	0.0	0.0
		-0.15990E4	0.51789E3	-0.50381E2
	4	0.28108E3	-0.43726E4	-0.23445E5
		0.45888E6	-0.43134E6	0.0
		0.0	0.0	0.0
	5	0.19968E4	0.0	0.0
		0.0	0.0	0.0
		-0.19988E4	0.642E3	-0.634457E2
	6	0.20067E3	-0.746E3	0.22574E6
		-0.179E8	0.35175E9	-0.19629E10
		0.0	0.0	0.0
	7	0.24493E4	0.0	0.0
		0.0	0.0	0.0
		-0.23081E4	0.68924E3	-0.63694E2
	8	No coefficients for this group		

Appendix 5. Habitat type[1] to determine site quality for hazard rating

1. Cold subalpine-fir, timberline types

Whitebark Pine, Subalpine Larch Series

850 PIAL-ABLA
860 LALY-ABLA
870-897 PIAL TYPES

Mountain Hemlock Series

680-682 TSME/MEFE
710-712 TSME/XETE
840-842 TSME/LVHI

Subalpine Fir Series

734 ABLA/VASC/PIAL
810-812 ABLA/RIMO
820 ABLA-PIAL/VASC
830-833 ABLA/LUHI

Spruce Series

497 PICEA/RIMO

2. Cool, moist spruce, cool, moist subalpine fir types

Mountain Hemlock Series

675-677 TSME/STAM
685-687 TSME/CLUN

Subalpine Fir Series
605 ABLA/CABI
635-637 ABLA/STAM
650-655 ABLA/CACA
670-674 ABLA/MEFE
740 ABLA/ALSI

Spruce Series

410 PICEA/EQAR
415 PICEA/CALE
490 PICEA/CADI

3. Warm, wet grand fir, western redcedar, western hemlock, warm, wet subalpine fir types

Subalpine Fir Series

610 ABLA/OPHA

Western Redcedar Series

530-535 THPL/CLUN
540-542 THPL/ATFI
545-548 THPL/ASCA
550 THPL/OPHO
555 THPL/GYDR
560 THPL/ADPE

Western Hemlock Series

565 TSME/GYDR
570-574 TSME/CLUN
575-578 TSME/ASCA
579 TSME/MEFE

Grand Fir Series

529 ABGR/SETR

4. Cold grand fir, cool dry spruce, cool dry subalpine fir types

Subalpine Fir Series

640 ABLA/VACA
690-694 ABLA/XETE
701 ABLA/ARLA
707 ABLA/PERA
720-723 ABLA/VAGL
730-733 ABLA/VASC
745 ABLA/JUCO
780-782 ABLA/ARCO
790-793 ABLA/CAGE
795 ABLA/CARO

Spruce Series

450 PICEA/VACA
460-462 PICEA/SEST
475 PICEA/JUCO
485 PICEA/VASC
493 PICEA/HYRE
495 PICEA/ARCO

Grand Fir Series

580 ABGR/VACA

5. Moist grand fir, warm moist spruce, warm moist subalpine fir types

Subalpine Fir Series

601 ABLA/ACRU
603 ABLA/PHMA
609 ABLA/THOC
620-625 ABLA/CLUN
630 ABLA/GATR
645-647 ABLA/ACGL
660-663 ABLA/LIBO

Spruce Series

420-422 PICEA/CLUN
430 PICEA/PHMA (SAF is minor climax)
440 PICEA/GATR
470 PICEA/LIBO

Grand Fir Series

516-519 ABGR/ASCA
520-526 ABGR/CLUN (SAF is a minor climax)
525-527 ABGR/ACGL
590-593 ABGR/LIBO

6. Mesic Douglas-fir, dry grand fir, warm, dry spruce, warm, dry subalpine fir types

Subalpine Fir Series

607 ABLA/SYAL
638 ABLA/COOC
702-704 ABLA/BERE
705 ABLA/SPBE
750-752 ABLA/CARU
760-762 ABLA/OSCH
770 ABLA/CLPS

Spruce Series

480 PICEA/SMST

Grand Fir Series

505 ABGR/SPBE
506-508 ABGR/PHMA
510-512 ABGR/XETE
511 ABGR/COOC
515 ABGR/VAGL
585 ABGR/CARU

Appendix 5, cont.

Douglas-fir Series

260, 261, 265, 266 PSME/PHMA
280-283 PSME/VAGL
290-293 PSME/LIBO
390-393 PSME/AGGL

7. Dry Douglas-fir types

010 Scree (Douglas-fir, spruce and subalpine fir can be climax)

Douglas-fir Series

210 PSME/AGSP
220-222 PSME/FEID
230 PSME/FESC
250 PSME/VACA
262 PSME/PHMA-CARU
263 PSME/PHMA-SMST
264 PSME/PHMA-PIPO
310-315 PSME/SYAL
320-326 PSME/CARU
330-334 PSME/CAGE
340-344 PSME/SPBE
350 PSME/ARUV
360 PSME/JUCO
370-372 PSME/ARCO
375 PSME/OSCH
380 PSME/SYOR
385 PSME/CELE
395-399 PSME/BERE

Limber Pine Series (Douglas-Fir is Co-climax)

040 PIFL/AGSP (R-1 Code 091)
050-052 PIFL/FEID (R-1 Code 092-094)
060 PIFL/CELE
070 PIFL/JUCO (R-1 Code 095)
080 PIFL/HEKI

---

[1] Steel, Robert et al. 1983. Forest Habitat Types of Eastern Idaho - Western Wyoming General Technical Report INT - 144.

Steel, Robert et al. 1981. Forest Habitat Types of Central Idaho. General Technical Report INT - 114.

Pfister, Robert D. et al. 1977. Forest Habitat Types of Montana. General Technical Report INT -34.

Cooper, Stephen; Kenneth Neiman and Robert Steele. Forest Habitat Types of Northern Idaho. Review Draft, INT. F&RES.

Appendix 6. Display of output.

HAZARD RATING FOR SPRUCE BUDWORM

Forest 11 Dist. 1 Comp. 10 Sub. 1 Stand 8 No. plots 9

The hazard value for this stand is 18.00

Total trees per acre	1,033.29	Habitat	261
Total basal area	62.49	Coeff-Var	64.38
Total crown area	34,067.06	Site	1.40
Host crown area	33,598.04	Climax cr area	33,598.0
Total stand age	48.65	Host age	49.24
Maximum basal area	139.95		

The values for the 9 indexes

Percent host crown cover =	2.39	Percent climax host crown cover =	2.37
Percent crown cover =	1.41	Index for coeff. of variation =	1.67
Relative stand density =	1.04	Mean host tree age =	.77
Site =	1.40	Regional climate =	1.20
Surrounding host type =	1.00		