Mountain pine beetle survey in the Peace Region of British Columbia and adjacent areas in Alberta

Kevin Pellow, Gurp Thandi, and Leo Unger

Mountain Pine Beetle Working Paper 2010-05

Natural Resources Canada
Canadian Forest Service
Pacific Forestry Centre
506 West Burnside Road
Victoria, British Columbia V8Z 1M5

MPB Program Project

Natural Resources Canada
Canadian Forest Service
Pacific Forestry Centre
506 West Burnside Road
Victoria, British Columbia V8Z 1M5
Canada

Printed in Canada

Library and Archives Canada Cataloguing in Publication

Pellow, Kevin
Mountain pine beetle survey in the Peace Region of British Columbia and adjacent areas in Alberta [electronic resource] / Kevin Pellow, Gurp Thandi and Leo Unger.

(Mountain pine beetle working paper ; 2010-05)
Electronic monograph in PDF format.
Issued also in printed form.
Includes abstract in French.
Includes bibliographical references.
ISBN 978-1-100-18318-3
Cat. no.: Fo143-3/2010-5E-PDF

1. Mountain pine beetle--Peace River Region (B.C. and Alta.) --Geographical distribution. 2. Pine--Diseases and pests--Peace River Region (B.C. and Alta.)--Geographical distribution. 3. Insect populations --Peace River Region (B.C. and Alta.). I. Unger, Leo II. Thandi, Gurp III. Pacific Forestry Centre IV. Mountain Pine Beetle Initiative (Canada) V. Title. VI. Series: Mountain Pine Beetle Initiative working paper (Online) ; 2010-05

SB945 M78 P45 2011 634.9'7516768 C2011-980041-1

Abstract

The current mountain pine beetle (MPB) outbreak exceeds any recorded infestation and is considered a threat to pine species in the boreal and eastern Canadian forest ecosystems. Previous studies have shown that moderate weather and successful fire suppression create prime conditions for MPB growth, which is affecting novel forest habitat. From 2008 to 2010, the Canadian Forest Service (CFS) conducted late spring surveys of MPB infestations in the Peace Region of British Columbia to determine changes in population and infestation levels based on attack and brood densities in infested trees. During 2009 and 2010, similar data was collected by the Alberta Sustainable Resource Development (SRD) on post-winter MPB survival in north-central Alberta. Overwintering population success was determined based on two rating systems of R-values: the Canadian Forest Service Forest Insect and Disease Survey (FIDS) system of the CFS, and the SRD system. R-value was calculated by summing all live mountain pine beetles of various life stages for every plot. The British Columbia and Alberta survey data (the R-values) were combined to determine the distribution of overwintering population success. During 2009 and 2010, the overwintering MPB population success in the Peace Region of British Columbia and adjacent Alberta was based on interpolated maps of SRD ratings of infestations. For comparison, a map for each rating system was created from the 2010 surveys of British Columbia and Alberta.

Keywords: mountain pine beetle, overwintering survey, R-value

Résumé

Le Canada connaît actuellement la pire infestation de dendroctone du pin ponderosa de son histoire. Le ravageur menace toutes les essences de pins des forêts boréales et des forêts de l'est du pays. Des études ont montré que des conditions météorologiques modérées et la suppression des incendies de forêt créent des conditions très favorables à la prolifération du dendroctone, lequel est en voie d'infester de nouveaux types de forêts. De 2008 à 2010, le Service canadien des forêts (SCF) a réalisé des relevés à la fin du printemps en Colombie-Britannique, dans le district de Peace River, afin de déterminer les changements d'intensité et d'étendue des infestations, d'après le nombre d'arbres attaqués et la densité de larves dans les arbres infestés. En 2009 et 2010, le ministère du Développement durable des ressources de l'Alberta a recueilli des données analogues afin d'estimer la survie hiémale du dendroctone dans le centre-nord de la province. La survie hiémale a été estimée à partir des données de deux systèmes de relevés : le Relevé des insectes et des maladies des arbres (RIMA) du SCF, et les relevés du ministère du Développement durable des ressources de l'Alberta. L'estimation de la survie hiémale a été obtenue par sommation du nombre de spécimens vivants de tous les stades de développement de l'insecte relevé dans chaque placette d'observation. Les données des relevés effectués en Colombie-Britannique et en Alberta ont été réunies pour permettre de déterminer la répartition de la population de dendroctone ayant survécu à l'hiver. Pour 2009 et 2010, la survie hiémale du dendroctone a été déterminée, pour la Colombie-Britannique et l'Alberta, à l'aide de cartes interpolées à partir des estimations du ministère du Développement durable des ressources de l'Alberta. Aux fins de comparaison, une carte a été établie pour la Colombie-Britannique et l'Alberta à partir des données de 2010 de chacun des systèmes de relevés.

Mots clés : dendroctone du pin ponderosa, relevés, survie hiémale

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Acknowledgements

This project was partially funded by the Mountain Pine Beetle Program of the Government of Canada. We would like to thank the following: Stephanie Haight (BCMoFR) for her ongoing support and invaluable assistance over the past 3 years; Brian Pate (West Fraser Mills, Chetwynd), Darrell Regimbald (Canfor, Fort Nelson), and Dr. Les Safranyik (CFS, Emeritus Scientist) for their help in survey location suggestions. Thanks also to Alberta (SRD) for providing R-value data for Alberta. Finally, we would like to acknowledge the following current and former CFS personnel at the Pacific Forestry Centre for their assistance with surveys: George Dalrymple, Rod Garbutt, Nick Humphreys, Gary Roke, Greg Smith, John Vallentgoed, and Vince Waring.

1. Introduction

During the current outbreak of the mountain pine beetle (MPB), infestations developed in the Peace Region of British Columbia and adjacent west-central Alberta, in areas beyond the beetle's historic range. Beetle populations from these infestations pose a potential threat of invasion and establishment in the pine forests of the boreal region located further north and east, and are of special concern (Safranyik and Wilson [editors] 2006).

From 2008 to 2010, the Canadian Forest Service (CFS) conducted late spring surveys of MPB infestations in the Peace Region to determine changes in population and infestation levels based on sampling of attack and brood densities near breast height in infested trees. During the initial year of the survey, sampling sites were established based on information provided by local forest industry and provincial government personnel, combined with ground-based reconnaissance. In subsequent years, a distribution of sampling sites from the preceding year was retained based on the history of brood production. Additional sites were selected in newly infested stands, especially along the northern parts of the known current infestations.

During 2009 and 2010 similar data was collected by the Alberta Sustainable Resource Development (SRD) on post-winter mountain pine beetle survival in north-central Alberta adjacent to the Peace Region of British Columbia. In each of these years, the British Columbia and Alberta survey data (the R-values) were combined to prepare a map showing the distribution of overwintering population success. Even though there were some differences between the provinces in sample protocols and interpretation of the R-values, data sets based on both methods gave qualitatively similar results regarding overwintering population success.

During 2009 and 2010, the general summary of overwintering MPB population success in the Peace Region of British Columbia and adjacent Alberta was based on interpolated maps of SRD ratings of infestations. For comparison, results from the 2010 survey of the Peace Region of British Columbia were also mapped using both rating systems.

2. Methods

Surveys of overwintering success by MPB populations in the Peace Region of British Columbia were carried out each year from 2008 to 2010 using the following methods. Latitude, longitude, and elevation for each plot were derived from the GARMIN 76CSx GPS device. The accuracy of the device varied from 3 to 10 m. Site aspect, and the number of symptomatic trees within the plot were also recorded. For each tree, sampling consisted of removing a 6 inch (15 cm) square bark patch at breast height from the north and south side of the tree. Within each bark patch, all live pine beetles were counted, as well as the total number of attack starts and the total number of galleries. Tree diameter at breast height was also recorded for each sampled tree.

For each year, surveys were carried out during June or early July. Although the number of plots varied for each year, an average of over 20 trees was typically examined for each plot. Plots were predominantly accessed by road, except for one or two days in which a helicopter was used for the areas north/northeast of Fort St. John, and in 2008 for the southernmost region.

R-values were calculated by summing all live mountain pine beetles of various life stages for each plot (larvae, pupae, and adult) and dividing that value by the sum of all attack starts (for the plot).

As outlined below, overwintering population success was determined based on two rating systems of R-values. The SRD rating system has more R-value classes compared to the Canadian Forest Service Forest Insect and Disease Survey (FIDS) system used in British Columbia. Therefore, the SRD rating allows for a finer scale mapping of overwintering population success.

The FIDS rating classes of MPB population success are:

- Decreasing: R-value ≤ 2.5
- Static: 2.5 < R-value ≤ 4.0
- Increasing: R-value > 4.0

The SRD rating classes for MPB population success are:

- Low: R-value ≤ 1.9
- Moderate: 1.9 < R-value ≤ 4.9
- High: 4.9 < R-value ≤ 9.9
- Extreme: R-value > 9.9

3. General Summary of Results

During the first year of the survey in 2008, sampling was focused on the southern distribution of infestations in the Peace Region (Table 1). Surveys in subsequent years covered a larger area of the infestation and provided a more complete picture of overwintering population success, especially in more northerly locations. For this reason, this report will concentrate on the most recent survey results with emphasis on the 2010 survey.

For the 2010 survey, 70 plots were established (Figure1). In contrast to the generally high R-values obtained in the 2009 survey (Table 2), cold temperatures in the fall of 2009 and again in the late spring of 2010 caused widespread mortality in the overwintering populations for that brood year (Table 3). Of 58 sites surveyed in 2009, approximately 45% of the plots yielded R-values over 4.0 (indicating increased overwintering population success according to the FIDS rating). Of 70 sites surveyed in 2010, only 16 plots (approx. 22%) indicated R-values over 4.0. These sites tended to be scattered, indicating microsite differences, although there was a general trend to increased R-values in areas running northeast of Tumbler Ridge towards Dawson Creek, as well as areas to the northwest of Fort St. John. A comparison between 2009 and 2010 indicated a marked decrease in beetle overwintering survival using the SRD rating classes (Figure 2).

3.1 Sampling Locations

Most of the areas surveyed in 2008 and 2009 were revisited in 2010, although the intention in 2010 was to focus on more northerly infested areas. These are located to the north and south of Tumbler Ridge; as well as the areas north, east, and west of Fort St. John (Figure 1).

4. Regional Summaries for 2010

4.1 Alberta Border

The 2010 plots were located to the east and 160 km north of Fort St. John along the border. They yielded an average R-value of less than 1.0, indicating very low survival. This was a decline in beetle success where comparisons with 2009 were possible

4.2 Tumbler Ridge South and East

Consistent with the 2008 and 2009 surveys, survival was low.

Table 1. Plot information for sites surveyed for the 2008 British Columbia MPB assessment.

Plot	R-value	FIDS rating	SRD rating	Trees sampled	Mean DBH (cm)	Elevation(m)	Latitude	Longitude	Date
1—1	0.13	Decreasing	Low	24	27.9 ±3.9	1270	54.36167	-120.09167	06/08/2008
1—2	0.18	Decreasing	Low	21	30.0 ±3.8	1150	54.35211	-120.11029	06/08/2008
1—3	0.12	Decreasing	Low	10	30.3 ±4.0	1168	54.35014	-120.15392	06/08/2008
2—1	0.05	Decreasing	Low	20	23.9 ±2.8	995	54.80833	-120.71917	06/04/2008
2—2	0.25	Decreasing	Low	20	35.3 ±5.0	1083	54.80306	-120.67556	06/04/2008
3—1	1.22	Decreasing	Low	20	32.5 ±4.1	1036	54.93667	-120.76778	06/04/2008
3—2	0.81	Decreasing	Low	20	36.8 ±5.5	1104	54.90028	-120.70306	06/04/2008
3—3	0.00	Decreasing	Low	20	28.0 ±4.2	1018	54.84917	-120.69611	06/04/2008
4—1	1.55	Decreasing	Low	24	35.3 ±5.8	1189	54.99500	-120.19389	06/05/2008
4—2	1.15	Decreasing	Low	25	39.6 ±5.2	1177	54.90556	-120.22278	06/05/2008
4—3	0.34	Decreasing	Low	20	27.9 ±3.7	1082	54.86722	-120.45500	06/05/2008
4—4	0.81	Decreasing	Low	24	33.9 ±4.3	1175	54.67250	-120.35139	06/05/2008
4—5	0.42	Decreasing	Low	22	28.7 ±4.5	1128	54.89525	-120.29383	06/05/2008
5—1	1.76	Decreasing	Low	23	30.2 ±3.1	1030	55.04778	-120.13528	06/04/2008
5—2	2.43	Decreasing	Moderate	21	37.3 ±4.5	1019	55.06611	-120.14028	06/05/2008
6—1	9.31	Increasing	High	22	38.2 ±8.7	903	55.52594	-120.26358	06/06/2008
6—2	0.22	Decreasing	Low	10	20.8 ±2.6	802	55.51244	-120.09769	06/06/2008
7—1	5.82	Increasing	High	18	48.4 ±6.6	940	55.56833	-120.31278	06/06/2008
7—2	0.10	Decreasing	Low	15	31.5 ±4.3	862	55.56028	-120.30778	06/06/2008
8—1	2.45	Decreasing	Moderate	14	33.7 ±7.8	994	55.67772	-120.36927	06/06/2008
9—1	4.58	Increasing	Moderate	23	39.2 ±8.4	784	55.51244	-120.09769	06/07/2008
9—2	1.31	Decreasing	Low	22	39.6 ±7.1	755	55.71667	-120.94497	06/07/2008
10—1	4.66	Increasing	Moderate	22	40.4 ±6.8	904	55.60378	-121.48931	06/09/2008
10—2	3.92	Static	Moderate	21	39.9 ±7.9	795	55.61100	-121.52858	06/09/2008
11—1	2.53	Static	Moderate	17	36.2 ±5.9	822	55.76350	-121.32089	06/07/2008
11—2	4.67	Increasing	Moderate	3	32.7 ±2.7	809	55.76628	-121.35906	06/07/2008
12—1	5.49	Increasing	High	23	36.4 ±6.1	877	55.81656	-121.35906	06/07/2008
12—2	3.37	Static	Moderate	16	38.2 ±7.0	781	55.79433	-121.30183	06/07/2008
13—1	0.66	Decreasing	Low	23	24.7 ±3.7	704	55.90747	-122.08817	06/09/2008
13—2	0.78	Decreasing	Low	23	22.8 ±1.9	750	55.90308	-122.08817	06/09/2008
13—3	2.99	Static	Moderate	23	33.7 ±4.7	746	55.91647	-122.06200	06/09/2008
14—1	0.05	Decreasing	Low	21	27.2 ±4.7	1190	54.60833	-120.09000	06/08/2008
14—2	0.30	Decreasing	Low	23	27.9 ±3.6	1117	54.57411	-120.16692	06/08/2008

4.3 Chetwynd/Hudson's Hope

The low survival in this area was in contrast to the previous results, which showed an increasing 2008 population that peaked in 2009.

4.4 Fort St. John–Fort Nelson

In 2010, areas were surveyed as far north as Buckinghorse River. Locations surveyed to the east of Highway 97 towards the Alberta border yielded low values. Higher survival amongst the beetle population was encountered south of Buckinghorse, beginning approximately 150 km north of Fort St. John and extending toward Fort St. John town center. Generally, these values decreased from 2009, although some sites still indicated high overwintering success.

4.5 Dawson Creek

Due to the large agricultural component surrounding the town, surveys were concentrated to the south and southwest. An overall decline in R-values was found in 2010 in comparison to the high R-values obtained in the 2009 survey, although a few sites south of the town continued to show high overwintering success.

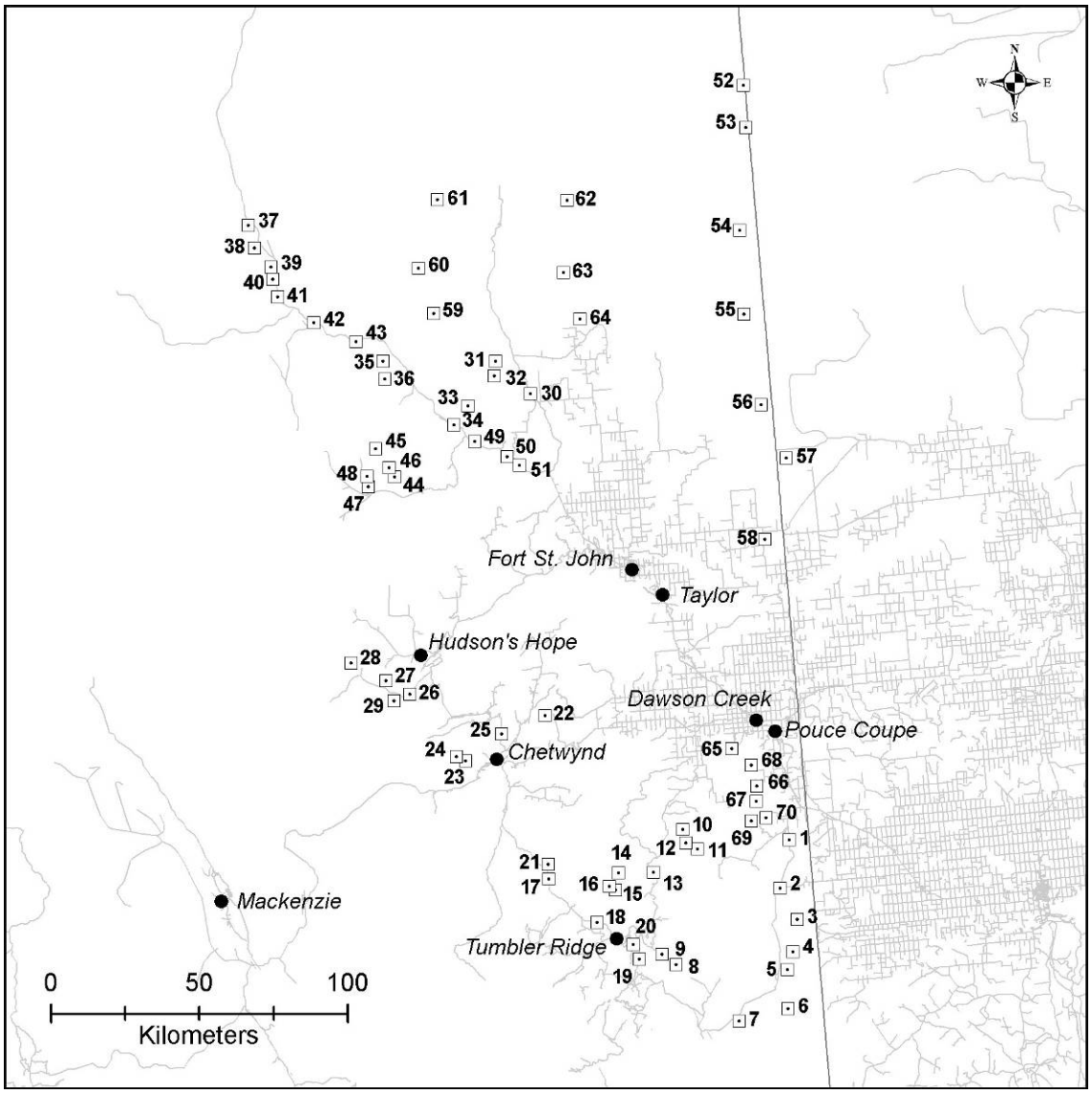

Figure 1. Sampled locations for the 2010 MPB British Columbia Peace Region survey.

Table 2. Plot information for sites surveyed for the 2009 British Columbia MPB assessment.

Plot	R-value	FIDS rating	SRD rating	Trees sampled	Mean DBH (cm)	Elevation(m)	Latitude	Longitude	# Fading trees in stand	Date sampled
1—1	0.10	Decreasing	Low	14	35.6 ± 3.3	1211	54.35385	-120.11877	< 30	04/07/2009
1—1	0.18	Decreasing	Low	12	25.2 ± 3.7	1339	54.34895	-120.15733	< 30	04/07/2009
2—1	0.01	Decreasing	Low	28	23.8 ± 3.9	1010	54.80925	-120.72460	> 30	01/07/2009
2—2	0.02	Decreasing	Low	24	31.8 ± 4.8	1026	54.80552	-120.70017	< 30	01/07/2009
3—1	0.17	Decreasing	Low	24	30.5 ± 4.2	994	54.93058	-120.74675	< 30	01/07/2009
3—2	0.19	Decreasing	Low	25	36.1 ± 5.2	1117	54.89963	-120.70303	> 30	01/07/2009
3—3	0.08	Decreasing	Low	25	28.6 ± 4.1	1007	54.84863	-120.69852	> 30	01/07/2009
4—1	0.45	Decreasing	Low	17	36.2 ± 6.3	1177	54.68263	-120.33497	< 30	04/07/2009
4—2A	1.52	Decreasing	Low	6	35.6 ± 5.2	1116	54.89213	-120.19933	< 30	02/07/2009
4—2B	2.00	Decreasing	Moderate	18	36.8 ± 6.6	1112	54.90482	-120.21690	< 30	02/07/2009
4—3	0.02	Decreasing	Low	28	23.6 ± 3.7	1070	54.86743	-120.48377	> 30	02/07/2009
4—4	1.92	Decreasing	Moderate	24	27.8 ± 3.1	1090	54.90917	-120.30597	> 30	02/07/2009
5—1	1.01	Decreasing	Low	19	26.3 ± 4.8	1040	55.05358	-120.13580	> 30	02/07/2009
5—2	5.03	Increasing	High	22	32.9 ± 7.4	1003	55.06657	-120.10217	> 30	02/07/2009
5—3	3.81	Static	Moderate	23	37.3 ± 5.9	978	54.99520	-120.19255	> 30	02/07/2009
6—1	6.77	Increasing	High	22	40.4 ± 7.2	888	55.53735	-120.22047	> 30	08/07/2009
6—2	8.11	Increasing	High	20	40.1 ± 5.8	836	55.48468	-120.14587	> 30	08/07/2009
7—1	13.12	Increasing	Extreme	20	44.6 ± 9.0	907	55.57063	-120.26053	> 30	08/07/2009
7—2	11.99	Increasing	Extreme	21	39.5 ± 7.7	950	55.57850	-120.35277	> 30	08/07/2009
8—1	8.41	Increasing	High	28	31.7 ± 5.2	915	55.67927	-120.36497	> 30	06/07/2009
9—1	1.17	Decreasing	Low	27	36.5 ± 5.0	746	55.71755	-120.94582	> 30	06/07/2009
9—2	1.76	Decreasing	Low	22	33.8 ± 7.0	766	55.71585	-120.89072	> 30	06/07/2009
10—1	4.72	Increasing	Moderate	32	39.1 ± 6.9	782	55.59142	-121.43647	> 30	05/07/2009
10—2	8.49	Increasing	High	27	35.9 ± 5.0	905	55.60367	-121.48917	> 30	05/07/2009
11—1	16.85	Increasing	Extreme	28	33.1 ± 4.5	813	55.78852	-121.30163	> 30	05/07/2009
11—2	10.54	Increasing	Extreme	31	35.7 ± 5.4	820	55.76900	-121.31960	> 30	05/07/2009
12—1	11.41	Increasing	Extreme	30	38.6 ± 6.1	882	55.81795	-121.36183	> 30	05/07/2009
13—1	10.00	Increasing	Extreme	25	37.3 ± 6.5	829	55.94968	-122.20132	> 30	04/07/2009
13—2	4.32	Increasing	Moderate	20	24.1 ± 3.6	704	55.88997	-122.16415	> 30	04/07/2009
13—3	6.97	Increasing	High	22	22.7 ± 3.3	736	55.89128	-122.15950	> 30	04/07/2009
13—4	6.62	Increasing	High	22	23.9 ± 2.7	753	55.90762	-122.07547	> 30	04/07/2009
14—1	0.02	Decreasing	Low	16	30.7 ± 4.0	1183	54.55362	-120.14647	< 30	04/07/2009
14—2	0.18	Decreasing	Low	18	35.6 ± 7.9	1266	54.42088	-120.30892	< 30	04/07/2009
17—1	7.13	Increasing	High	23	38.0 ± 6.0	762	56.50393	-120.30090	> 30	08/07/2009
17—2	0.18	Decreasing	Low	24	30.0 ± 6.4	705	56.39127	-120.20193	> 30	08/07/2009
18-19—1	9.90	Increasing	Extreme	27	33.5 ± 3.4	752	56.31033	-120.06115	> 30	08/07/2009
20—1	0.34	Decreasing	Low	23	27.9 ± 4.7	688	56.86147	-120.58323	> 30	08/07/2009
20—2	0.05	Decreasing	Low	25	27.8 ± 4.7	769	57.02543	-120.54833	> 30	08/07/2009
Bernadet—1	9.96	Increasing	Extreme	11	36.6 ± 6.6	860	56.63565	-121.86723	10—30	08/07/2009
BM—1	0.08	Decreasing	Low	27	23.0 ± 3.4	995	55.21763	-121.30497	> 30	03/07/2009
BM—2	3.40	Static	Moderate	28	31.0 ± 5.4	1059	55.19288	-121.21965	> 30	03/07/2009
BM—3	4.81	Increasing	Moderate	25	30.8 ± 7.0	1122	55.18375	-121.15190	> 30	03/07/2009
Buick—1	6.28	Increasing	High	17	25.7 ± 3.7	793	56.78858	-121.32538	> 30	07/07/2009
Buick—2	0.11	Decreasing	Low	13	27.9 ± 3.7	745	56.76838	-121.32775	< 30	07/07/2009
Halfway—1	0.00	Decreasing	Low	10	31.8 ± 4.2	750	56.60142	-122.12763	10—30	08/07/2009
Halfway—2	8.83	Increasing	High	16	32.6 ± 6.4	850	56.57140	-122.10568	> 30	08/07/2009
Halfway—3	13.90	Increasing	Extreme	16	35.5 ± 6.5	850	56.56222	-122.09698	> 30	08/07/2009
HH—1	1.50	Decreasing	Low	13	36.0 ± 7.5	503	56.16018	-121.59682	> 30	08/07/2009
Shepherd—1	9.10	Increasing	High	24	34.4 ± 5.9	836	56.52448	-121.23492	> 30	07/07/2009
Shepherd—2	1.54	Decreasing	Low	29	36.3 ± 6.0	814	56.55635	-121.22057	> 30	07/07/2009
Shepherd—3	7.96	Increasing	High	21	30.8 ± 5.5	861	56.47537	-121.20538	> 30	07/07/2009
Shepherd—4	11.25	Increasing	Extreme	19	31.6 ± 5.7	856	56.46037	-121.19418	> 30	07/07/2009
TR—1	3.41	Static	Moderate	27	34.4 ± 5.5	1005	55.06802	-120.95012	> 30	01/07/2009
TR—2	4.06	Increasing	Moderate	10	35.8 ± 1.9	880	55.10603	-120.95195	< 30	04/07/2009
WC—1	0.24	Decreasing	Low	23	26.2 ± 4.0	845	55.10753	-121.16320	> 30	03/07/2009
WC—2	2.27	Decreasing	Moderate	25	28.5 ± 5.8	1039	55.08412	-121.15422	> 30	03/07/2009
WC—3A	3.41	Static	Moderate	15	35.6 ± 9.7	964	55.14405	-121.11110	> 30	03/07/2009
WC—3B	3.69	Static	Moderate	16	34.2 ± 5.4	903	55.14758	-121.09307	> 30	03/07/2009

Table 3. Plot information for sites surveyed for the 2010 British Columbia MPB assessment.

Plot	R-value	FIDS rating	SRD rating	Trees sampled	Mean DBH (cm)	Elevation(m)	Latitude	Longitude	# Fading trees in stand	Date sampled
1	0.46	Decreasing	Low	22	44.7 ±7.9	885	55.39053	-120.10831	30—50	06-16-2010
2	0.66	Decreasing	Low	21	33.0 ±3.7	956	55.24670	-120.17654	> 50	06-16-2010
3	0.14	Decreasing	Low	22	32.4 ±5.4	983	55.14928	-120.09963	> 50	06-16-2010
4	0.20	Decreasing	Low	22	32.0 ±4.3	963	55.05380	-120.13694	> 50	06-16-2010
5	0.23	Decreasing	Low	22	41.2 ±8.8	944	55.00106	-120.17327	> 50	06-16-2010
6	0.51	Decreasing	Low	25	29.8 ±4.0	1117	54.88336	-120.18783	30—50	06-16-2010
7	1.92	Decreasing	Moderate	23	32.9 ±10.2	1127	54.85838	-120.44769	> 50	06-16-2010
8	0.07	Decreasing	Low	23	30.6 ±4.8	1153	55.04106	-120.75504	> 50	06-16-2010
9	3.87	Static	Moderate	23	38.2 ±5.8	1079	55.07677	-120.82689	> 50	06-17-2010
10	11.47	Increasing	Extreme	24	34.6 ±4.5	1063	55.44605	-120.66714	> 50	06-17-2010
11	5.81	Increasing	High	21	37.8 ±6.7	1063	55.38439	-120.59609	> 50	06-17-2010
12	9.90	Increasing	Extreme	24	37.1 ±6.4	1091	55.40530	-120.65560	> 50	06-17-2010
13	4.85	Increasing	Moderate	25	37.7 ±7.4	1089	55.32457	-120.83904	> 50	06-17-2010
14	4.72	Increasing	Moderate	23	27.4 ±2.8	1136	55.32923	-121.02345	> 50	06-18-2010
15	1.67	Decreasing	Low	22	25.1 ±4.1	1351	55.27849	-121.04803	> 50	06-18-2010
16	3.33	Static	Moderate	24	24.1 ±2.9	1170	55.29241	-121.07910	> 50	06-18-2010
17	0.03	Decreasing	Low	20	24.9 ±2.4	832	55.32524	-121.39706	10—30	06-18-2010
18	5.03	Increasing	High	24	32.0 ±5.0	1104	55.18567	-121.15556	> 50	06-18-2010
19	0.38	Decreasing	Low	22	25.5 ±3.2	978	55.06676	-120.94644	30—50	06-18-2010
20	0.06	Decreasing	Low	22	35.0 ±4.9	852	55.11168	-120.97308	> 50	06-18-2010
21	2.87	Static	Moderate	24	26.9 ±4.3	929	55.36959	-121.39620	> 50	06-19-2010
22	1.19	Decreasing	Low	5	38.8 ±8.8	884	55.81687	-121.36057	< 10	06-19-2010
23	0.20	Decreasing	Low	22	31.1 ±3.2	1023	55.69687	-121.80017	> 50	06-19-2010
24	0.67	Decreasing	Low	23	23.4 ±2.2	1089	55.71094	-121.84676	> 50	06-19-2010
25	0.61	Decreasing	Low	25	47.0 ±6.7	890	55.77114	-121.59957	30—50	06-19-2010
26	0.12	Decreasing	Low	24	23.9 ±2.8	744	55.90712	-122.07716	> 50	06-20-2010
27	2.62	Static	Moderate	24	34.3 ±6.0	837	55.95108	-122.20420	> 50	06-20-2010
28	0.78	Decreasing	Low	23	32.9 ±4.1	808	56.00978	-122.38534	30—50	06-20-2010
29	0.02	Decreasing	Low	24	19.1 ±2.6	725	55.88956	-122.16711	> 50	06-20-2010
30	0.06	Decreasing	Low	24	23.9 ±2.8	800	56.78803	-121.32481	> 50	06-20-2010
31	0.04	Decreasing	Low	24	28.2 ±4.4	841	56.89194	-121.50478	> 50	06-21-2010
32	0.00	Decreasing	Low	24	29.3 ±3.2	793	56.84874	-121.51637	> 50	06-21-2010
33	0.01	Decreasing	Low	24	31.7 ±4.4	861	56.76247	-121.67023	> 50	06-21-2010
34	6.04	Increasing	High	26	31.5 ±4.2	872	56.70808	-121.75619	> 50	06-21-2010
35	1.96	Decreasing	Moderate	24	41.7 ±6.6	957	56.91119	-122.12409	> 50	06-21-2010
36	5.06	Increasing	High	25	41.8 ±8.4	961	56.85801	-122.12011	> 50	06-21-2010
37	1.17	Decreasing	Low	24	30.0 ±3.1	1047	57.34035	-122.83504	> 50	06-22-2010
38	0.47	Decreasing	Low	24	27.3 ±3.2	993	57.27156	-122.80553	> 50	06-22-2010
39	1.75	Decreasing	Low	22	32.4 ±4.4	1060	57.21331	-122.72006	10—30	06-22-2010
40	6.64	Increasing	High	27	30.2 ±4.6	1140	57.17557	-122.71211	> 50	06-22-2010
41	8.20	Increasing	High	23	32.5 ±4.4	1105	57.12186	-122.69093	> 50	06-22-2010
42	5.15	Increasing	High	23	34.8 ±4.6	1127	57.03815	-122.49693	> 50	06-22-2010
43	9.31	Increasing	High	24	39.6 ±7.6	1047	56.97599	-122.26714	> 50	06-22-2010
44	5.53	Increasing	High	25	28.6 ±4.1	859	56.56156	-122.09656	> 50	06-23-2010
45	0.17	Decreasing	Low	24	31.8 ±4.1	740	56.65073	-122.19038	> 50	06-23-2010
46	0.36	Decreasing	Low	24	33.8 ±5.3	787	56.59005	-122.12315	> 50	06-23-2010
47	8.51	Increasing	High	25	38.7 ±5.1	798	56.53733	-122.24453	> 50	06-23-2010
48	0.08	Decreasing	Low	24	27.0 ±3.3	764	56.56881	-122.24680	> 50	06-23-2010
49	3.19	Static	Moderate	24	34.2 ±4.8	857	56.65429	-121.64742	> 50	06-23-2010
50	1.11	Decreasing	Low	24	30.2 ±4.7	832	56.60331	-121.47202	> 50	06-23-2010
51	2.18	Decreasing	Moderate	24	23.9 ±3.5	860	56.57482	-121.40862	> 50	06-23-2010
52	0.20	Decreasing	Low	17	29.1 ±4.6	833	57.66549	-120.01173	10—30	06-24-2010
53	0.12	Decreasing	Low	23	26.4 ±3.3	921	57.53857	-120.01697	> 50	06-24-2010
54	0.63	Decreasing	Low	23	26.2 ±4.6	836	57.23111	-120.10034	> 50	06-24-2010
55	0.16	Decreasing	Low	26	26.9 ±3.2	758	56.97826	-120.11565	> 50	06-24-2010
56	0.98	Decreasing	Low	20	34.2 ±5.0	791	56.70221	-120.06245	> 50	06-24-2010
57	0.93	Decreasing	Low	24	37.9 ±4.5	810	56.53600	-119.94822	> 50	06-24-2010
58	0.49	Decreasing	Low	24	24.0 ±2.7	744	56.29773	-120.10498	> 50	06-24-2010
59	2.53	Static	Moderate	23	39.3 ±5.8	916	57.04615	-121.83112	> 50	06-25-2010
60	1.63	Decreasing	Low	25	35.1 ±3.7	877	57.18525	-121.89825	> 50	06-25-2010
61	0.76	Decreasing	Low	25	37.6 ±6.1	895	57.38787	-121.77037	> 50	06-25-2010
62	0.67	Decreasing	Low	24	31.0 ±6.2	861	57.36105	-121.04917	> 50	06-25-2010
63	0.10	Decreasing	Low	24	27.2 ±3.2	731	57.14518	-121.09669	> 50	06-25-2010
64	0.14	Decreasing	Low	24	25.3 ±3.2	740	57.00106	-121.02190	> 50	06-25-2010
65	0.77	Decreasing	Low	14	29.5 ±6.0	904	55.67831	-120.37263	10—30	06-26-2010
66	5.74	Increasing	High	24	33.4 ±5.1	905	55.55925	-120.25529	> 50	06-26-2010
67	0.27	Decreasing	Low	24	31.2 ±5.6	823	55.51442	-120.26481	30—50	06-26-2010
68	0.03	Decreasing	Low	25	31.3 ±4.7	840	55.62299	-120.27516	> 50	06-26-2010
69	5.97	Increasing	High	25	34.4 ±3.7	933	55.45614	-120.29859	> 50	06-26-2010
70	0.04	Decreasing	Low	24	33.0 ±6.4	858	55.46239	-120.22102	> 50	06-26-2010

5. British Columbia and Alberta Map Data

Alberta SRD provided the data for Alberta's R-value sites so that the two provinces' data could be combined to create a seamless cross-border map (Figures 2a and 2b). Note that Alberta's method for R-value sampling varies from that used by the CFS; the SRD uses a 4-inch diameter circle, whereas the FIDS uses a 6-inch square. All maps were created using the Natural Neighbours technique to interpolate a raster. This technique uses a subset of samples surrounding the query point and interpolates values that are within the range of samples (ESRI ArcGIS Desktop Help). Two maps for British Columbia were created showing plot locations with associated R-values, one using the SRD ratings and the other using the FIDS ratings (Figures 3 and 4).

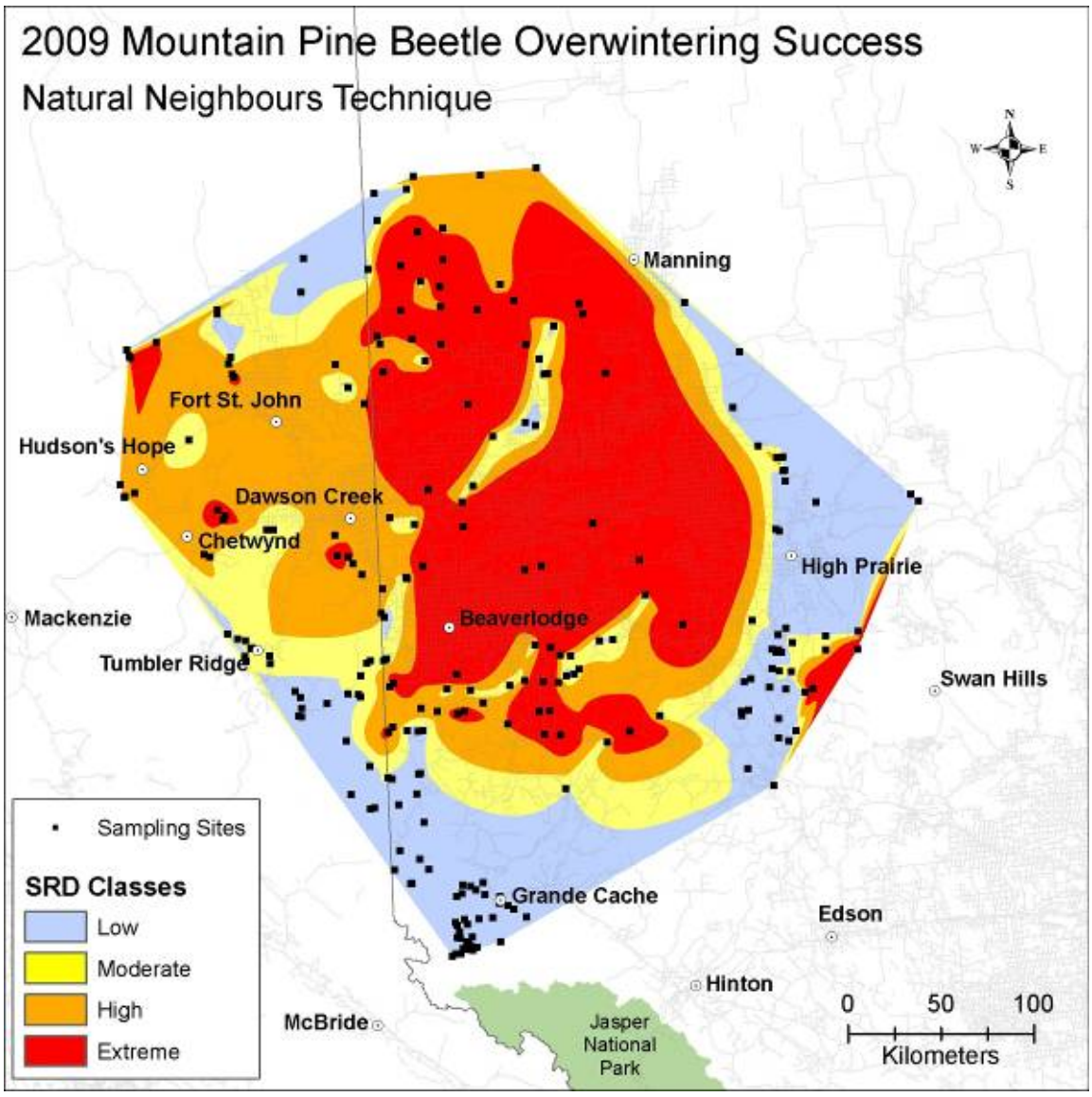

Figure 2a. Interpolation map for the 2009 British Columbia and Alberta surveys based on SRD ratings.

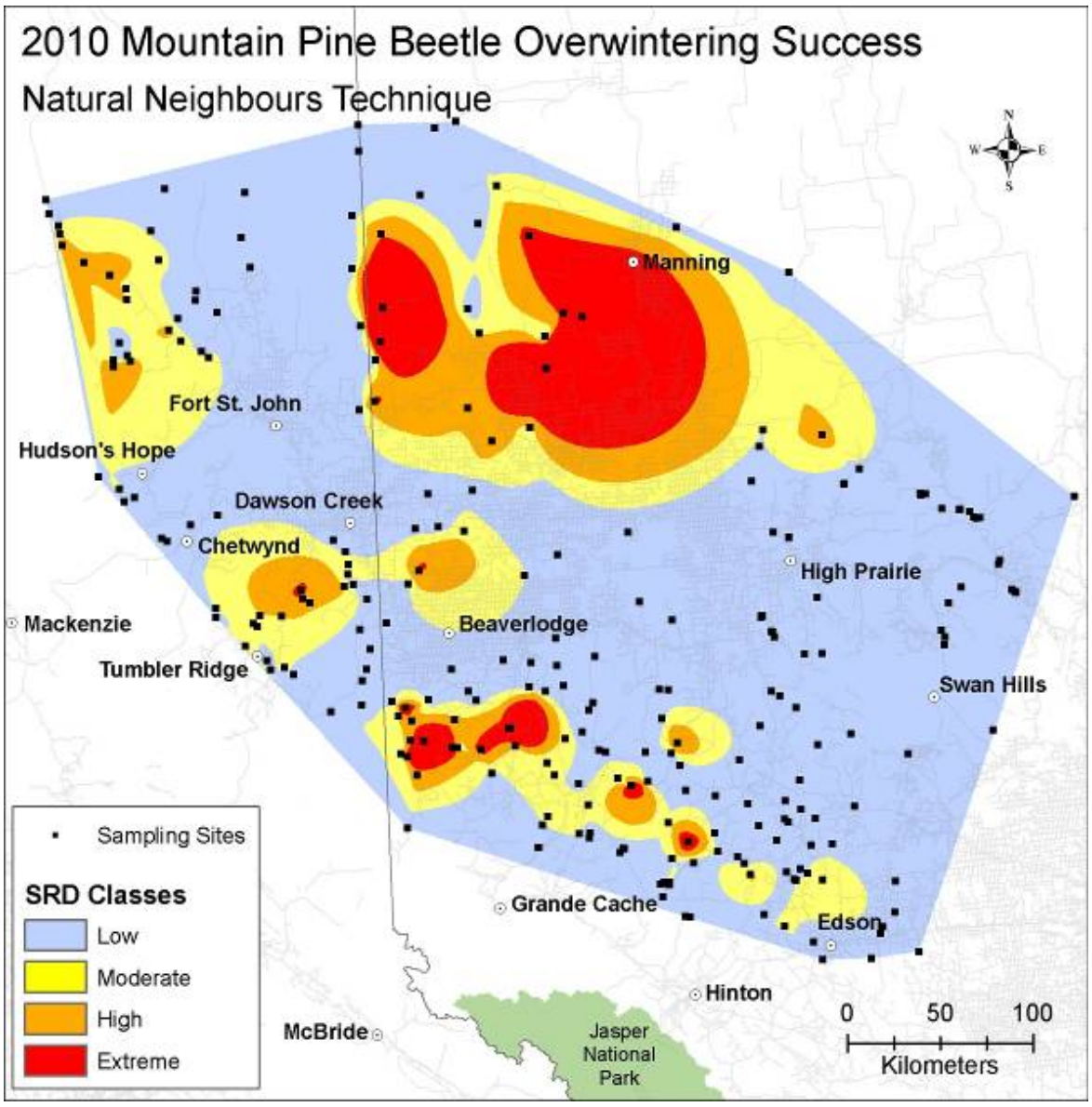

Figure 2b. Interpolation map for the 2010 British Columbia and Alberta surveys based on SRD ratings.

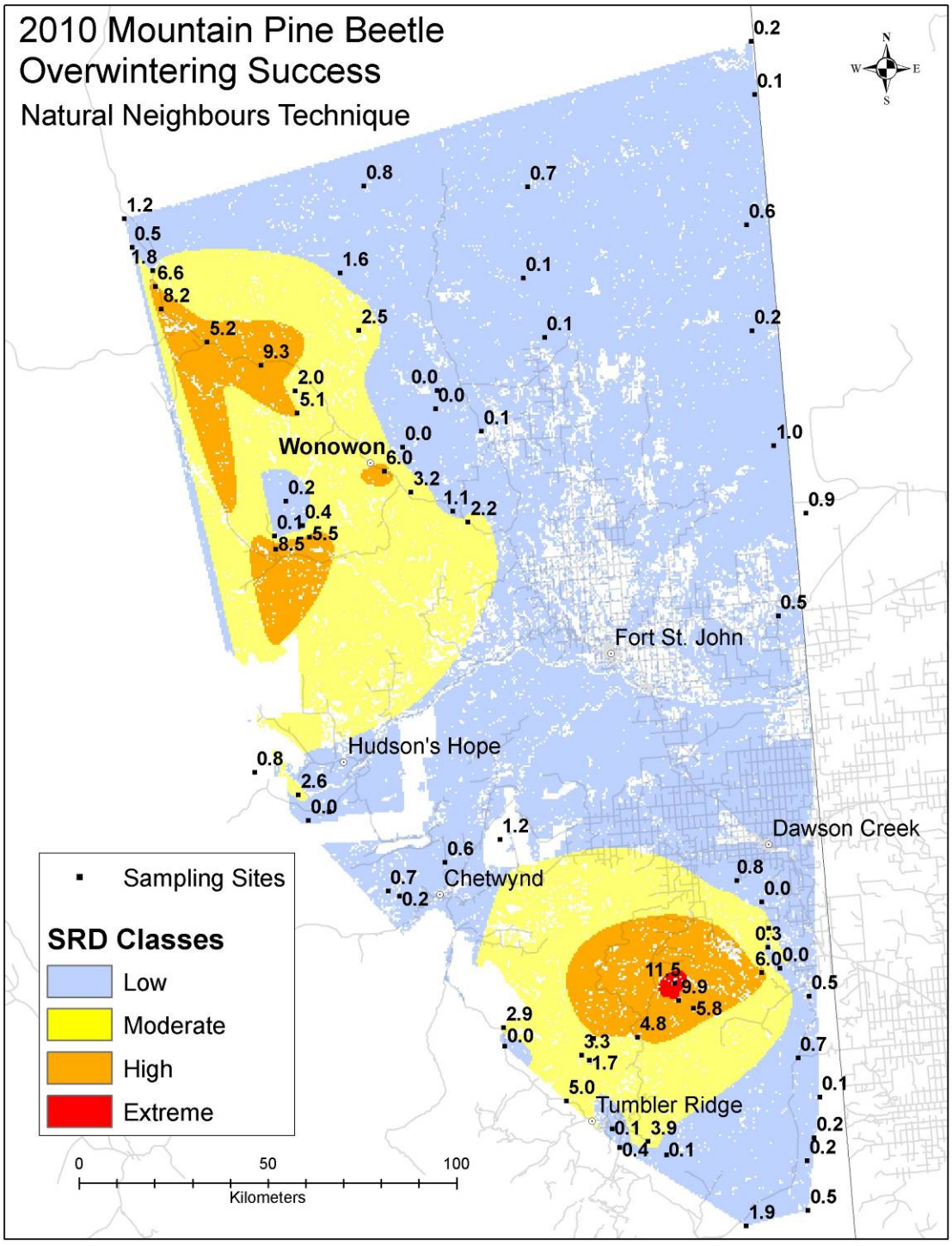

Figure 3. British Columbia R-value interpolation based on SRD rating classes for the 2010 survey.

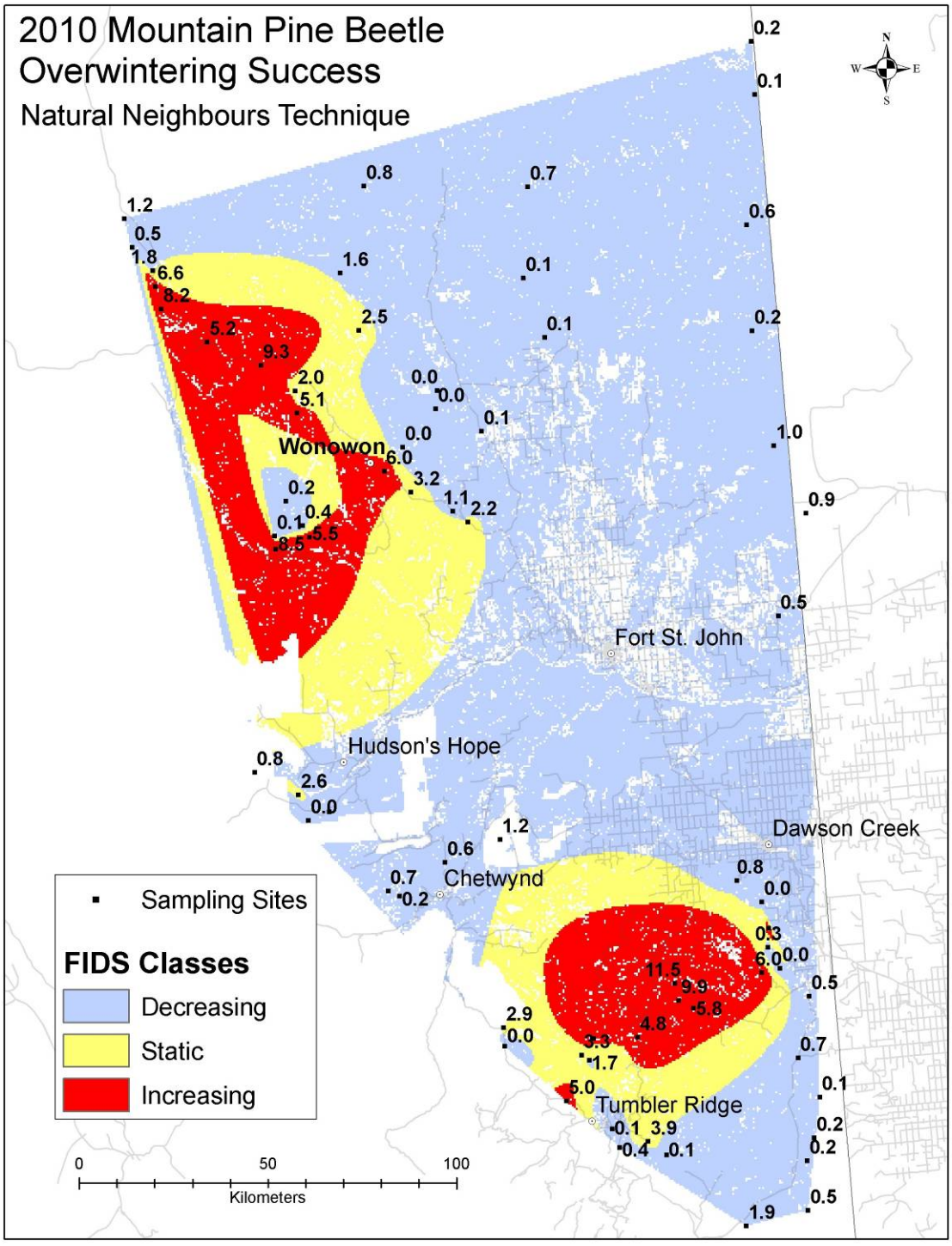

Figure 4. British Columbia R-value interpolation using FIDS rating classes for 2010 survey.

6. Conclusions

This report represents a snapshot of mountain pine beetle overwintering success for the past 3 years in the Peace region of British Columbia. Winter temperatures continue to be the most important factor in determining overwintering mortality. Within some of the survey areas, the amount of lodgepole pine suitable for MPB attack has diminished and, in some instances, disappeared. In many plots where low R-values were obtained, good survival of MPB below the snow line was observed. Therefore, in future surveys, brood survival below the snow line should also be considered in assessing the relative health of MPB populations. Although the 2010 survey indicated a general decline in MPB overwintering success, some regions in British Columbia and Alberta continue to indicate an increasing or extreme risk of beetle population survival. For this reason, concern should still exist for spread of the pine beetle into areas beyond its historic range (Nealis and Peter 2008).

7. Literature Cited

Nealis, V.; Peter, B. 2008. Risk assessment of the threat of mountain pine beetle to Canada's boreal and eastern pine forests. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, BC. Information Report BC-X-417.

Safranyik, L.; Wilson, B., editors. 2006. The mountain pine beetle: A synthesis of biology, management, and impacts on Lodgepole Pine. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, BC.