

**Cariboo Forest Region
Douglas-fir Bark Beetle Winter Mortality
and Rating Value Survey 2014**



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1 Executive Summary

Bark samples were collected from infestation sites in Douglas-fir stands from the Cariboo-Chilcotin and Quesnel Forest Districts to evaluate overwinter mortality and establish R-values. Thirty sites were sampled with 14 in the Chilcotin, 13 in Central Cariboo and 3 in Quesnel. Results from the Chilcotin and Central Cariboo portions of the Cariboo-Chilcotin District were summarized separately for comparison to data from previous years.

A flight was conducted prior to the survey onset to select good candidate areas for sampling. Detailed GPS data from flights in the fall of 2013 were used to locate sites with larger numbers of chlorotic trees with reasonable access.

R-values provide a means to predict bark beetle population behaviour. The R-value is the ratio of surviving brood to initial attack. For Douglas-fir beetle, R-values over 1.3 indicate increasing populations. R-values were lower in 2014 when summarized by district and for the region. The regional mean R-value for all sites was 4.0, down from 6.35, in 2013. The largest change was in the Chilcotin where average R-values dropped from 6.8 in 2013 to 3 in 2014. Population increase is predicted over the survey area even though the value has fallen from the previous year.

Adult mortality over the survey area was higher in 2014 at a value of 27.8 % from 13.2% in 2013. Larval mortality was also higher at 99% up from 93.5% in 2013. The surviving brood was 98.5% adult indicating there will likely not be a significant second flight of Douglas-fir beetle in June.

Sample sites were abundant in areas adjacent to recent wildfires in the Cariboo-Chilcotin District. Fire damage and western spruce budworm defoliation have contributed to increased host susceptibility these areas. In contrast the 100 Mile House and Quesnel Forest Districts have shown a drop in the number and size of new infestation sites and only 3 suitable sample sites were used from Quesnel and none in 100 Mile House. Recent fire damage along the Blackwater River was the exception to this trend with no new infestation sites suitable for sampling found on the south side of the river.

2 Survey Methodology

Samples sites were selected based on aerial observations of crown symptoms indicating current bark beetle attack. Larger sites were selected to ensure a minimum of ten sample trees could be found. Access was also considered and only sites with reasonably good access were chosen.

Samples slightly larger than 15x15 cm square were cut from the north and south aspects of infested host trees at or slightly above breast height. Paired samples were tied together with flagging tape and packed in breathable sacks for transport. Samples were stored in an unheated building prior to analysis.

Many mass attacked trees were passed over since they did not have attack low enough on the bole. All sample trees were confirmed to have current attack at sample height by chopping prior to cutting.

Sample analysis was completed within ten days of collection. Incubation was accomplished slowly over several days to avoid shocking the brood. This took slightly longer than normal since temperatures were very low in the initial collection period.

Any questionable brood were placed in petri dishes and incubated at room temperature for 1-2 days to extend the observation period. Live and dead brood were counted along with gallery starts on the sample area to give a value for initial attack levels, R-value calculations and mortality percentages. Predators and parasites were also noted including secondary insects such as woodborers. Instar stages and percentage of the sample area consumed by larval and adult galleries were also recorded. Woodpecker predation was minimal and was noted on only a few samples.

Percent mortality was calculated from live and dead brood counts for each site visited using sums from all samples at each site. R-values were also calculated this way using the sum of all live brood from each site divided by the initial attack on all samples obtained from the site. District values were obtained similarly by pooling all sample values from all sites in the district rather than using an average of site values.

3 Results

3.1 Chilcotin Portion of the Cariboo-Chilcotin District

In the Chilcotin portion of the Cariboo-Chilcotin District, samples were collected along the Chilanko and Chilcotin River drainages from Pyper Lake to Hanceville. Most sites tended to be fairly dry and fell in the IDF dk4 or xm ecosystem zones. The abundance of sites around the numerous large wildfires of past years was evidence that many of the populations that started in fire damaged timber had now spread to the adjacent green trees. Many of these sites were very large, exceeding 100 trees in some cases.

Western spruce budworm has also contributed to host stress in many areas along the Chilcotin River and south towards Big Creek. Defoliation increases susceptibility to bark beetle attack and decreases host defenses.

Adult brood mortality in the Chilcotin increased to 31% from 15% in 2013. Since almost all surviving brood were adults this increase in adult mortality is reflected in the decline in R-value for 2014 to 3.0 from 6.78 in 2013. This value still represents a trend to increasing populations since the increase threshold is 1.3 for Douglas-fir beetle.

The presence of high number of predators in many samples from the Chilcotin may be responsible for some of the variability seen between sites. Many sites are close to areas with long infestation histories from Douglas-fir beetle where predators and parasites may have increased. The most common natural enemy found in all samples was the predatory

larva of the long legged fly *Medeterra aldrichii*. These predators are very aggressive and continue to feed on larvae and adults well up to the time of emergence. Parasitism from the wasp parasite *Coeloides brunneri* was also commonly noted but was not as common or abundant as *M. aldrichii*.

Figure 1 shows the distribution of sample sites in the Chilcotin. The Chilko and Taseko Rivers also have active populations of Douglas-fir beetle, but these areas were not sampled due to more difficult access.

Figure 1 Chilcotin Sample Sites

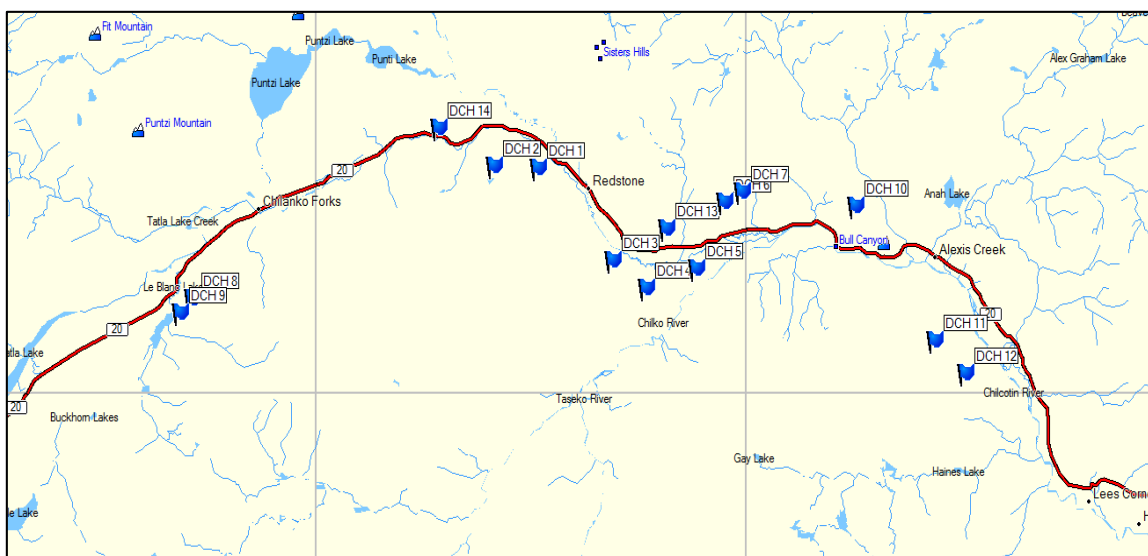
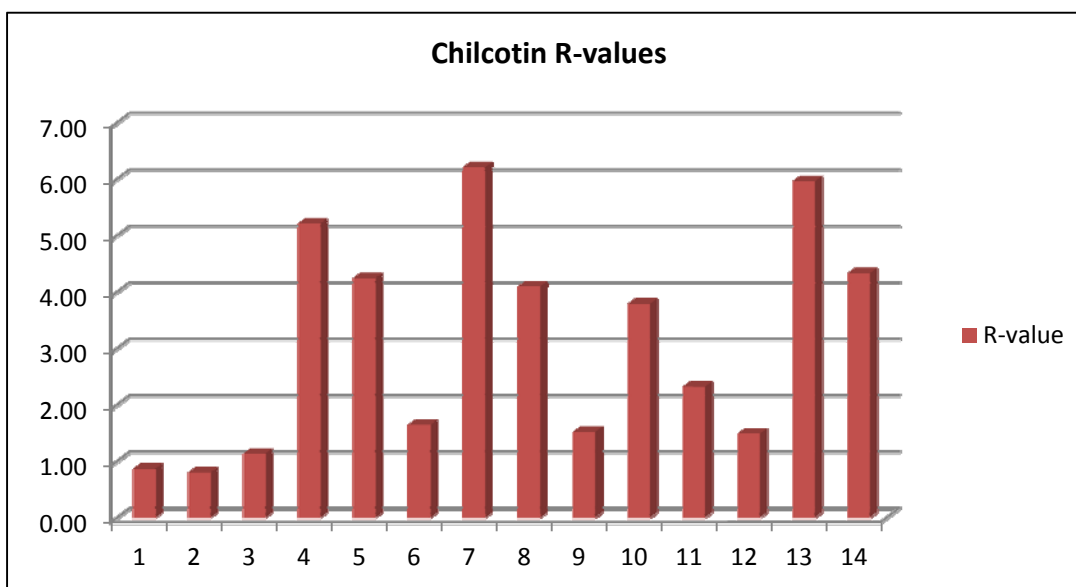


Figure 2 shows the R-values obtained at the 14 sites sampled in the Chilcotin.

Figure 2 Chilcotin R-values



In Table 1 more detailed site information shows the variability between sites in adult mortality. Only adult mortality is shown since larval mortality is generally extremely high (>95%). This year the numbers of surviving larvae were so low that they contributed minimally to R-value calculations. Surviving larvae are included in the live brood counts in the table below.

Table 1 Chilcotin sample site results

Site	Number of Samples	Adult Mortality %	Total live Progeny	Total Gallery Starts	Rating Value
DCH-1 Redstone FSR	20	72.70	39	45	0.87
DCH-2 Redstone FSR	20	57.50	40	50	0.80
DCH-3; 4300 Rd.	20	37.00	61	54	1.13
DCH-4; 4300 Rd.	20	0.00	245	47	5.21
DCH-5; 4300 Rd.	20	40.00	191	45	4.24
DCH-6; 4100 Rd.	20	64.50	79	48	1.65
DCH-7; 4100 Rd.	20	40.50	236	38	6.21
DCH-8; Pyper Lake	20	0.00	205	50	4.10
DCH-9; Pyper Lake	20	45.10	85	56	1.52
DCH-10; Alexis L. Rd	20	0.00	182	48	3.79
DCH-11; S. of C1 fields	20	0.00	130	56	2.32
DCH-12; S. of C1 fields	20	40.10	73	49	1.49
DCH-13; W of Alexis Cr	20	24.60	316	53	5.96
DCH-14; Redstone	20	34.80	169	39	4.33

3.2 Central Cariboo Portion of the Cariboo Chilcotin Forest District

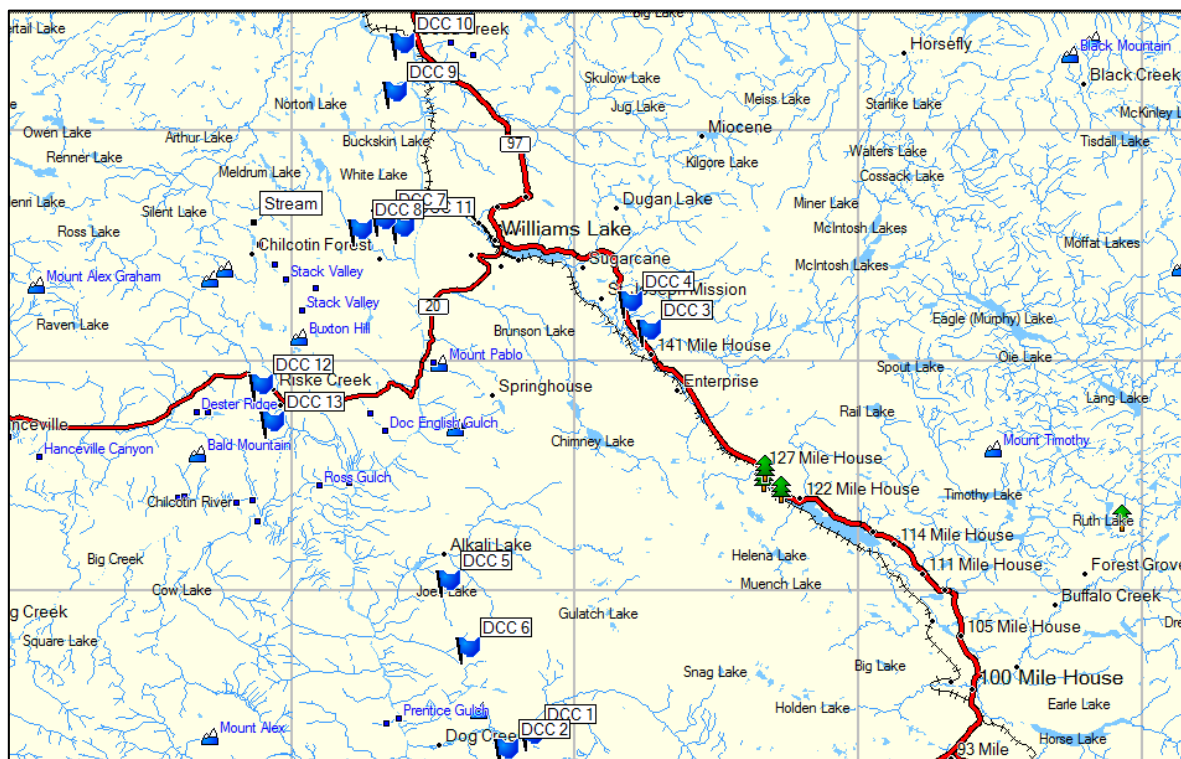
Sample sites in the Central Cariboo ranged from the east side of Bald Mountain in the west to Knife Creek in the east. The southern range of sites sampled was on Tinmusket Road south of Dog Creek. The most northerly site was south of Marguerite on the West Fraser Road.

The pre-survey flight to establish good candidate sample sites was very helpful in the Central Cariboo since many sites here had trees with minimal attack at a height that could be reached using a chainsaw. Many more trees need to be assessed when the attack does not extend down lower on the bole.

Most of the current activity for Douglas-fir beetle in the Central Cariboo is located in close proximity to recent wildfires of the last several years. The situation is similar to that found in the Chilcotin where fire damaged trees have provided good habitat for populations to increase before moving out into the healthy green timber adjacent to the burns.

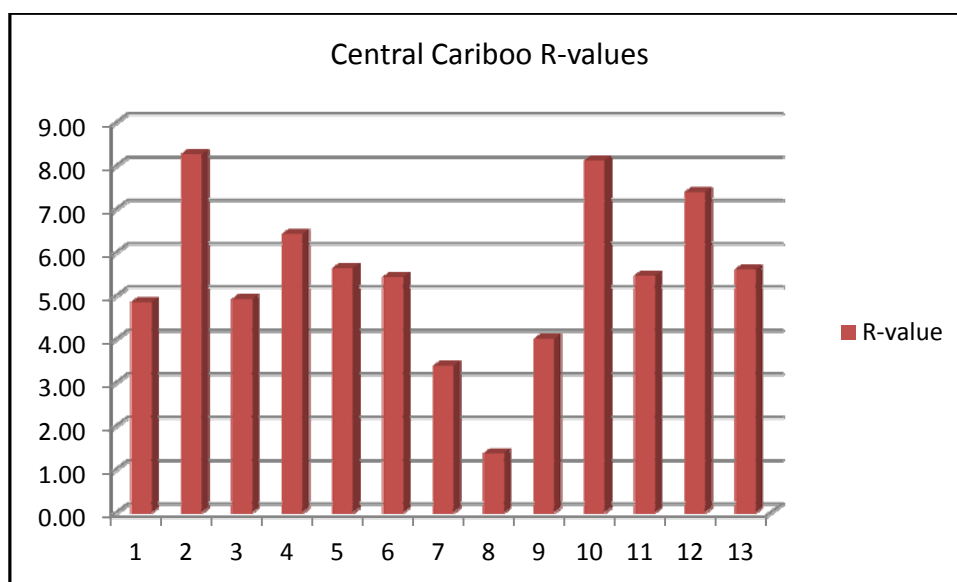
The distribution of sample sites is shown in Figure 3.

Figure 3 Central Cariboo Sample Sites



R-values in Central Cariboo ranged from 1.36 to 8.27 with a mean value of 5.1. This value is down slightly from the 2013 value of 5.7. The R-values obtained from 13 sites sampled in the Central Cariboo are shown in figure 4.

Figure 4 Central Cariboo R-values



All sites sampled in Central Cariboo had R-values above the increase threshold of 1.3 with site number 8 from Meldrum Creek at the lower end with a value of 1.36 and the highest value of 8.27 from site 2 on Tinmusket Road south of Dog Creek. Adult brood mortality increased in 2014 to 25.4% for all sites sampled, from 11.8% in 2013.

Table 2 lists a summary of the results for all sites sampled in the Central Cariboo in 2014.

Table 2 Central Cariboo sample site results

Site	Number of Samples	Adult Mortality %	Total live Progeny	Total Gallery Starts	Rating Value
DCC-1; Dog Creek	20	18.97	160	33	4.85
DCC-2; Dog Creek	20	25.97	248	30	8.27
DCC-3; Knife Cr.	20	24.11	172	35	4.91
DCC-4; Knife Cr.	20	23.17	199	31	6.42
DCC-5; Joe's L. Rd.	20	14.36	169	30	5.63
DCC-6; Joe's L. Rd.	20	19.25	152	28	5.43
DCC-7; Meldrum Cr.	20	25.77	125	37	3.38
DCC-8; Meldrum Cr.	20	20.95	83	61	1.36
DCC-9; 100 Road	20	44.25	160	40	4.00
DCC-10;W Fraser Rd	20	20.08	211	26	8.12
DCC-11;W Fraser Rd	20	31.34	142	26	5.46
DCC-12; Riske Cr.	20	30.53	266	36	7.39
DCC-13; 2000 Road	20	19.73	241	43	5.60

Brood success was somewhat higher in the Central Cariboo compared to the Chilcotin, with less predation noted and a lower attack density per square meter of 78 versus 107.8 for the Chilcotin. This difference may be related to better host availability in Central Cariboo where a higher percentage of better quality host trees is available. Many of the Chilcotin sites had depleted old growth components from years of chronic bark beetle mortality, harvesting and extensive wildfires. Brood density was also somewhat lower in the Central Cariboo samples. Lower density broods have less intraspecific competition, a factor that contributes to brood success.

The eastern areas of the Central Cariboo had very little Douglas-fir beetle activity noted in overview surveys and detailed GPS surveys. Only two of the 13 sites sampled were collected east of the Fraser River.

3.3 Quesnel Forest District

Only three sample sites were collected in the Quesnel Forest District. All three sites were in the Nazko area with two coming from the Honolulu Road south of Nazko and the third from just east of Nazko near Snaking River.

The two sites south of Nazko were just above the Nazko River on very dry south facing slopes. Both of these sites had relatively high R-values of 7.9 and 4.4. The third site was much wetter with an east aspect. Samples here yielded a much lower value of 2.8

The collapse of populations along the Blackwater River was noted in 2013 when suitable sample sites were not found after ground checking several sites from aerial surveys. The proximity to a large wildfire suggested that there might be concern for this area but the 2014 flight for the current survey confirmed there were no new patches on the Cariboo side of the river. This area has a limited component of Douglas-fir along the river with wetter site conditions. These factors may have caused the collapse in populations after the fire damaged timber was consumed.

The mean R-value for the three sites sampled in Quesnel was 5.1. This value is the same as the value for the Central Cariboo and indicates a fairly strong trend to population increase.

4 Summary

Table 3 summarizes the sampling frequency with results for R-values and mortality for 2014. The results presented in table 3 show a decrease in R-value over the previous year's values. The most significant change was in the Chilcotin where mortality has doubled over the past year and the R-value dropped to 3 from 6.8.

Central Cariboo R-values are fairly consistent over the two year period with only a slight decrease in R-value in 2014. Adult mortality in Central Cariboo did increase to 25.4% from 11.8% in 2013. This increase in mortality is not reflected in a drop in R-value because the density of initial attack was still relatively low in the Central Cariboo.

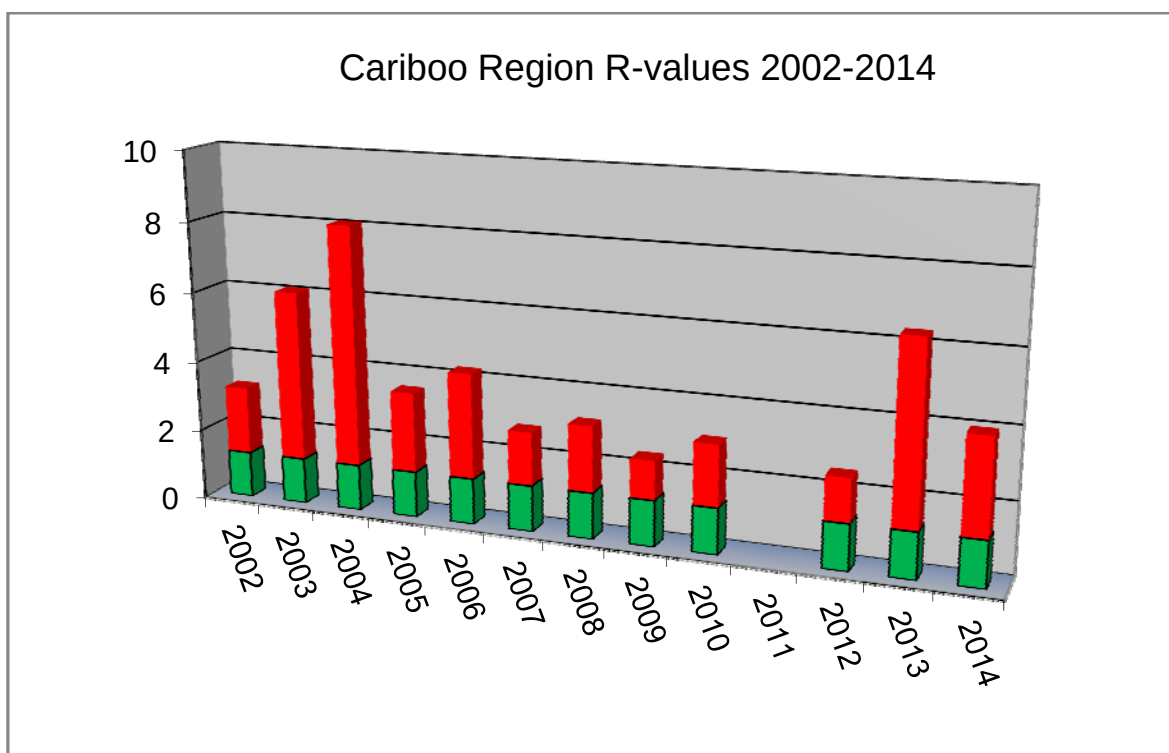
Table 3 Survey Summary by District or Area

District or Area	Number of Sites	Number of Samples	R-value		Adult Mortality (%)
			2013	2014	
Chilcotin	14	280	6.78	3.03	30.8
Central Cariboo	13	260	5.7	5.11	25.4
Quesnel	3	60	NA	5.12	26.5
Sum or Mean	30	600		4.0	27.8

Historically R-values have cycled up and down but remained above the increase threshold even in low years. Figure 5 shows regional R-values for the past thirteen years where data was available. The green portion of the column indicates the 1.3 increase threshold. The red portion is the amount over the increase threshold.

Historical values in figure 5 reflect varying sample sizes over the years, but show the consistent trend to population increase. The fall in 2014 to 4.0 from 6.35 in 2013 was mainly a result of lower values from the Chilcotin.

Figure 5 Historical R-values for the Cariboo Region



The decrease in R-value in the Chilcotin is likely due to several factors. Host availability and an increase in natural enemies are the most likely factors since weather events have not played a significant role in population control for the past several years. Higher brood density also causes higher mortality and this was observed at many sites in the Chilcotin.

Winter temperatures in 2014 were relatively mild with the coldest sustained period falling in the first week of February. The lowest temperature reached at the Williams Lake recording station of Environment Canada was -32.7 on February 7. This cold period lasted roughly ten days and was likely not long enough or cold enough to have any significant effects on brood success. Late winter cold effects must be extreme for long periods of time to cause brood depletions in larvae or adults that have developed cold-hardiness.

Sample sites for this survey were targeted based on size and accessibility. Sites with higher percentages of current attack to old attack were chosen and are not necessarily indicative of the population as a whole. Data from these sites may provide slightly higher values for population predictions than older sites with longer infestation histories. Larger sites with a higher percentage of current attack are chosen to allow the sample size of ten trees to be reached and to give some flexibility if suitable trees are not found.

The timing of sampling also affects the results since predators continue to work on broods until they emerge. As a result values represented in this survey will indicate higher brood

success than those obtained just prior to emergence. These factors will influence the prediction for population behaviour and should be considered.

In comparing previous year results it is clear that populations in the areas sampled have consistently shown a trend of increase. For most of the areas surveyed this means that where host trees are still available there will likely be an increase in the level of infestation from flights in the spring of 2014. The majority of these areas are adjacent to large wildfires from the past several years or areas that have been affected by chronic budworm defoliation.

5 Appendix

The appendices are district summaries from excel spreadsheets. They are also available in excel format along with detailed site data sheets for each site from Jodi Axelson, regional entomologist for the Cariboo at Jodi.Axelson@gov.bc.ca.

Forest District Summary Sheet for Winter Mortality and R-Value Survey 2014													
		Beetle Species	<i>D. pseudotsugae</i>						Forest District :	Chilcotin			
		Date Collected :	March 11-30						Date Examined :	March 18- April 9			

Forest District Summary Sheet for Winter Mortality and R-Value Survey 2014													
		Beetle Species	<i>D. pseudotsugae</i>						Forest District :	Central Cariboo			
		Date Collected :	March 5-31						Date Examined :	March 14- April 8			

5.3

Forest District Summary Sheet for Winter Mortality and R-Value Survey 2014													
		Beetle Species	<i>D. pseudotsugae</i>						Forest District :	Quesnel			
		Date Collected :	March 4,5						Date Examined :	March 9-13			

5.4

Cariboo Forest Region											
Regional Summary : Winter Mortality and R-Value Survey 2014											
Douglas-fir Beetle (IBD)											
Progeny											
Forest District	Number of Samples	Larval Count		Adult Count		Mortality(%)		Av. Live Progeny/ Sample	Total Gallery Starts	Av. Starts/ Sample	Rating (R) Value
		Live	Dead	Live	Dead	Larval	Adult				
Chilcotin	280	25	3448	2026	901	99.3	30.8	7.3	678	2.4	3.03
Central Cariboo	260	50	3197	2278	775	98.5	25.4	9.0	456	1.8	5.11
Quesnel	60	4	819	703	254	99.5	26.5	11.8	138	2.3	5.12
Totals	600	79	7464	5007	1930				1272		
Larval Mean Mortality (%)		2014	99.0					Mean Attack Density/Sample			2.12
Adult Mean Mortality (%)		2014	27.8					Mean Attack Density/ Sq. Meter			94.22
Combined Mean Mortality (%)		2014	64.9					Mean Number of Live Brood/Sample			8.48
Regional R- value		2014	4.00								