



Photo courtesy of Barbara Zimonick (2016)

2016 Douglas-fir Beetle Overwinter Analysis, Cariboo Region

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Ministry of Forests, Lands and Natural Resource Operations

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1 EXECUTIVE SUMMARY

Douglas-fir (*Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco) bark samples collected from infested sites in the Cariboo-Chilcotin, Quesnel and 100 Mile House Forest Districts in the Cariboo Region of British Columbia. From each collection site 10 trees had two samples collected on north and south aspects of the trees, which were dissected to determine the overwinter mortality of Douglas-fir beetle (*Dendroctonus pseudotsugae* Hopkins) at all life stages and to calculate the R-value.

In keeping with report results from previous years' surveys samples were split by old Forest District boundaries: Central Cariboo and Chilcotin, respectively, and were assessed and reported on separately.

At the site, district and regional level calculated R-values were significantly higher than all other survey years (2002 to 2015). R-values are determined by summing all live larvae, pupae, and adults and dividing this by the total number of gallery starts for each sample. In 2016, the average gallery starts were 0.45 gallery starts/sample versus 1.96 gallery starts/sample in 2015. To deal with this discrepancy the forest entomologist for the Cariboo Region computed the average gallery starts at the site level from 2002 to 2015. This average value (multiplied by number of samples at each site) was used as the denominator in all 2016 R-value calculations.

In 2016, R-values decreased in the Central Cariboo and Quesnel Forest Districts and increased slightly in the Chilcotin Forest District compared to 2015 values. Calculated R-value decreased in the 100 Mile House Forest District from 2013, the last sampling period. Regional R-value decreased slightly but continues to remain above the threshold value for increasing Douglas-fir beetle population (R-value > 1.35).

2 METHODOLOGY

In total, two hundred Douglas-fir bark samples from 20 sites (10 trees/site, 2 samples (one north-facing and one south-facing)/tree) were assessed using the following methodology:

- a) Bark samples were received in two shipments on March 11th and March 18th. The bark samples had been cut to 15 cm x 15 cm, bundled in pairs, and boxed according to site location.
- b) The boxes were stored in an area cooled to approximately 4°C prior to being introduced to room temperature.
- c) Two boxes (i.e., bark samples from two sites) per day, beginning March 13, were shifted from the cool storage area to the lab area that was heated to 18°C to 20°C. The boxes were kept at room temperature for a minimum of two days to allow the insect's time to acclimate to the increased temperature so their movement would make it easier to identify live versus dead beetle adults and larvae.
- d) Dissection of the bark samples began on March 16. Using a wood chisel, the bark (inner and outer) was carefully separated from the sapwood to expose the gallery systems.
- e) The following information was recorded on Excel spreadsheets (each site recorded in a separate table) for each bark sample:
 - Number of larvae (Figure 5), pupae (Figure 6) and adults alive;
 - Number of larvae, pupae and adults dead;
 - Identification of the Instar Stages (1 to 4) of the larvae, alive and dead;

- Number gallery starts were determined based on the following steps:
 1. The “top” of the bark sample was determined based on the location of boring dust in the bark crevices. If there was no boring dust in the bark crevices, but resin was present, then the direction of the resin flow helped to determine the top of the sample. If neither boring dust nor resin was present, then we made our best estimate of the top of the bark sample.
 2. We looked for the presence of the characteristic j-shaped or angled gallery start, often with an enlarged nuptial chamber packed with boring dust/frass, followed by the formation of the egg gallery that is roughly perpendicular, either straight or slightly sinuous (Furniss and Carolin, 1977; Humphreys, 1995). Removing the boring dust/frass, we would probe any possible gallery starts for evidence of the entry hole.
 3. Bark samples in which 95% - 98% of the inner bark had been mined due to the combination of Douglas-fir beetle and woodborer activity, and that contained barely recognizable gallery tunnels, were probed to find potential entry holes;
 - The presence of “egg galleries only” but no larval mining;
 - Evidence of “pitch-out”: egg galleries fully or partially filled with pitch; larval development is negligible; attacking beetle often found dead in the pitch-filled gallery;
 - Percentage of the bark sample consumed;
 - Identification of other predator or parasitic insects (see Figures 7 to 13 in Appendix);
 - Percentage of predation by woodpeckers;
 - Additional comments pertaining to the bark sample (e.g., presence of fungal mycelium).
- f) The bark samples were thoroughly dissected to ensure no remaining insects were present, then burned.
- g) All insects were killed.

3 OVERWINTER SURVIVAL AND R-VALUE DETERMINATION

R-value calculations were determined by dividing the average number of live progeny by the average number of gallery starts by (a) site, (b) forest district and, (c) forest region.

Sums were determined for each sample site for the following:

- a) Larvae and pupae alive (L),
- b) Larvae and pupae dead (D),
- c) Adults alive (L),
- d) Adults dead (D), and
- e) Gallery starts.

Based on these sums, the following calculations were computed for each sample site:

- a) Site R-value,
- b) Average winter mortality – adult (%),
- c) Average winter mortality – larval (%),
- d) Average winter mortality – adult and larval combined (%), and
- e) Average woodpecker predation area (%).

A summary sheet was compiled for each Forest District (Central Cariboo, Chilcotin, Quesnel and 100 Mile House) from the minimum of five Douglas-fir tree samples at each site in each District. Using the sums for each sample site we calculated the following:

- a) District R-value,
- b) Average winter mortality (adults, larval, and both combined),
- c) Mean woodpecker area (%),
- d) Mean attack density/sample, and
- e) Mean attack density/square metre.

Lastly, a summary sheet was compiled for the Cariboo Region. Using the sums for each Forest District we calculated the following:

- a) Regional R-value,
- b) Average winter mortality (adults, larval, and both combined),
- c) Mean attack density/sample,
- d) Mean attack density/square metre, and
- e) Mean number of live brood/sample.

4 RESULTS

The R-value determination for the sites, districts and region based on our calculations were significantly higher than those in 2015. The differences stemmed primarily from the lower-than-average gallery starts identified by us this year (0.45 gallery starts/sample in 2016 versus 1.96 gallery starts/sample in 2015). Lower-than-average gallery starts also affected the “mean attack density/sample” and “mean attack density/square metre” calculations resulting in significantly lower values.

To deal with this discrepancy the forest entomologist for the Cariboo Region computed the average gallery starts at the site level from 2002 to 2015. The long-term average number of gallery starts was 1.74 ± 0.52 (standard deviation) or ± 0.033 (standard error). The long-term gallery start value was multiplied by the number of samples at each site (10), and used as the denominator in all R-value calculations for the 2016 survey year. Using this correction factor brought exceedingly high R-values in line with previous years’ surveys and was considered a satisfactory solution.

From 2015 to 2016, overwinter survival R-values decreased in the Central Cariboo and Quesnel Forest Districts from 6.10 to 4.25, and 4.09 to 2.86, respectively (Figure 1 and 2). Conversely, the R-value in the Chilcotin Forest District increased slightly from 3.29 to 3.42 (Figure 1). The R-value in the 100 Mile House Forest District decreased from the last sampling period in 2013 (6.72) to 5.46 in 2016 (Figure 2).

Regional R-value decreased slightly from 2015, from 4.70 to 4.38, however it continues to be above the threshold for increasing beetle population (R-value > 1.35) (Figure 3).

The combined Douglas-fir beetle adult and larval average mortality represented as a percent shows a decreasing trend over the last three sampling years in the Chilcotin and Central Cariboo Forest Districts. The trend in the Quesnel Forest District shows a slight increase in average mortality since 2015 (Figure 4).

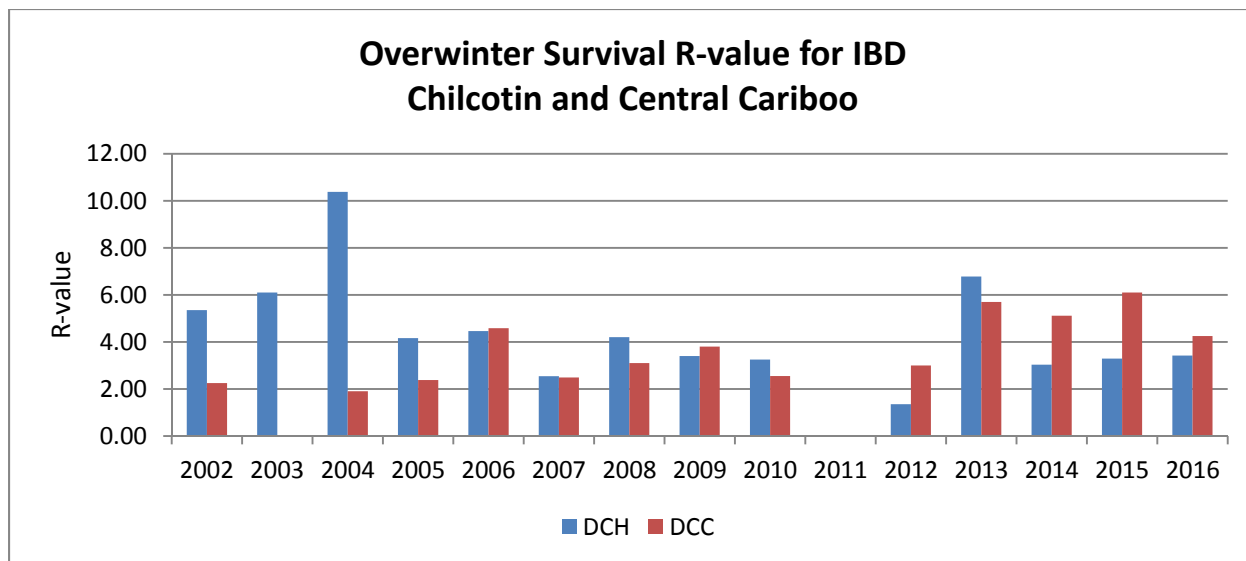


Figure 1. Overwinter survival R-values for Douglas-fir beetle (IBD) in the Chilcotin (DCH) and Central Cariboo (DCC) Forest Districts in British Columbia from 2002 – 2016 (no sampling occurred in 2011).

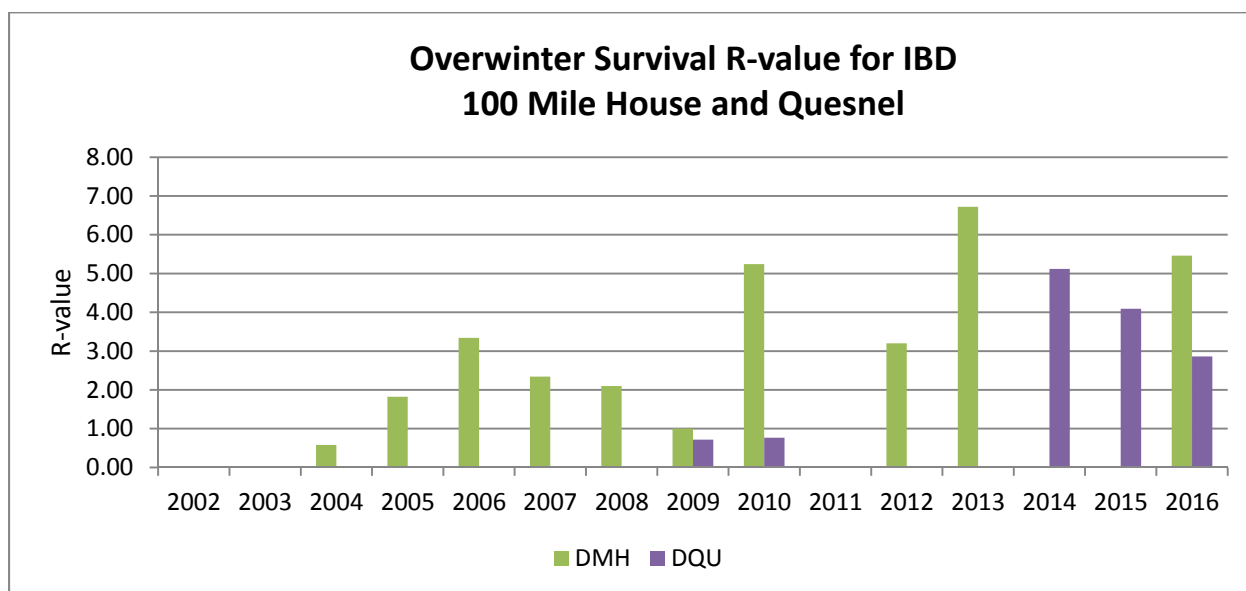


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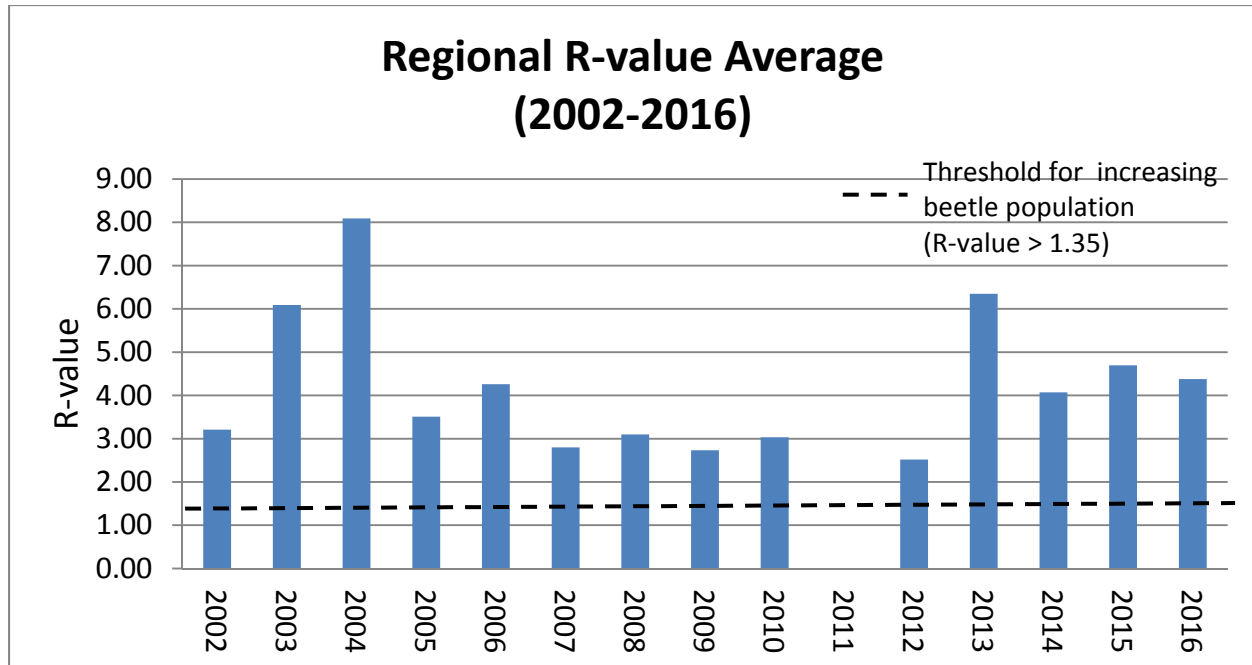


Figure 3. Overwinter survival R-values for Douglas-fir beetle (IBD) in the Cariboo Region in British Columbia from 2002 – 2016 (no sampling occurred in 2011).

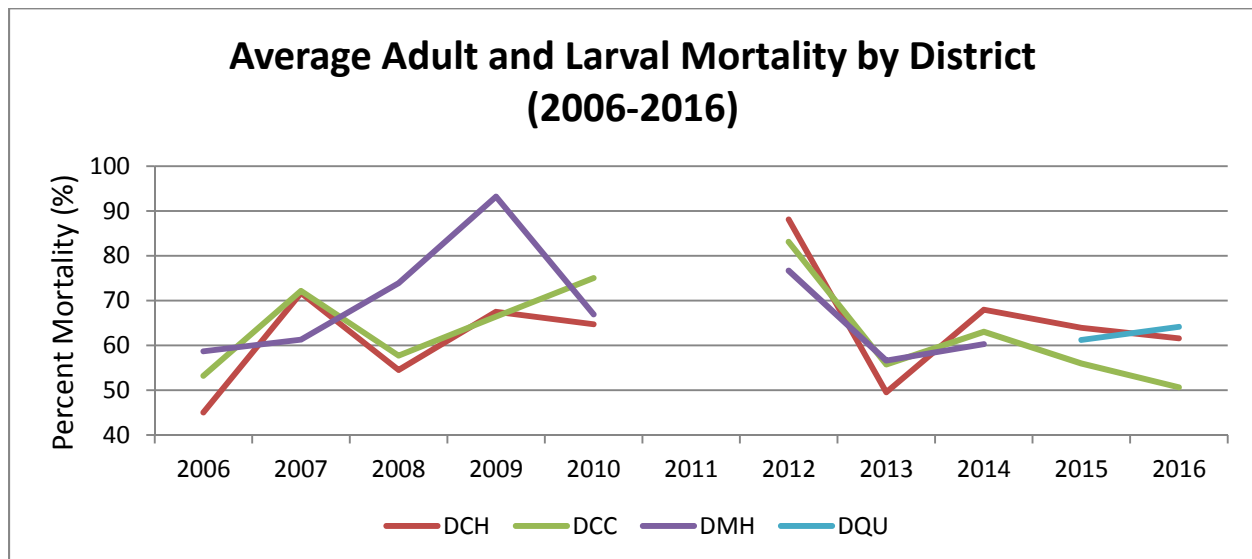


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Lastly, woodpecker predation was almost non-existent. Of the 200 samples assessed, one sample (Site 18, 100 Mile District, Tree 1-South) exhibited evidence of woodpecker foraging resulting in 40% of the bark sample being excavated.

5 ACKNOWLEDGEMENTS

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- Kimberly Kaytor, Forest Health Technician – Cariboo Region, British Columbia Ministry of Forests, Lands and Natural Resource Operations.

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7 APPENDIX

A collection of photographs of various insects found in the Douglas-fir bark samples. All photos courtesy of Barbara Zimonick ©2016.



Figure 5. Douglas-fir beetle larvae (L4).



Figure 6. Douglas-fir beetle pupae (Site 20, 100 Mile House District, Tree 10-South).



Figure 7. Flat-headed woodborer larvae.



Figure 8. Cleridae sp. larvae (Site 19, 100 Mile House District, Tree 5-North).



Figure 9. Cleridae sp. larvae placed on paper.



Figure 10. Cocoons of the parasitic wasp, Coeloides sp., at the end of Douglas-fir beetle larvae mines.



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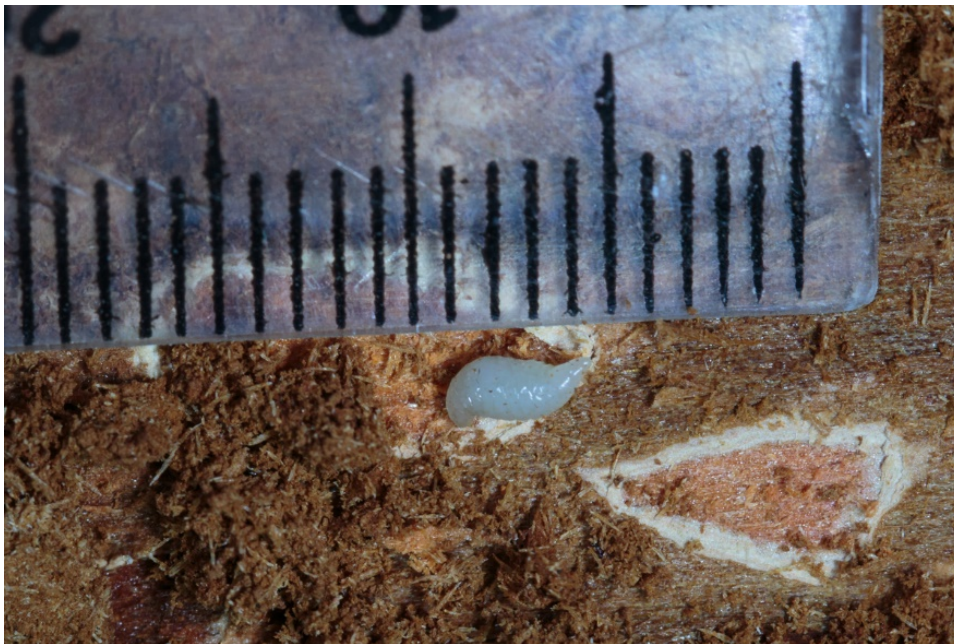


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