Adjusting the Provincial Forest Inventory to Reflect Mountain Pine Beetle Impacts, Fires and LiDAR Data Acquisition in the 2015 Annual Forest Inventory Release

The 2015 Forest Inventory release reflects a number of changes to the forest inventory to account for the large natural losses due to the Mountain Pine beetle (MPB) and for wildfires since 2007. It also reflects the integration of a LiDAR project on northern Vancouver Island to improve the estimates of stand height and a Landscape Visual Inventory in the Cariboo. This link http://www.for.gov.bc.ca/hts/vridata/download/MPB_Changes_to_VEG_2015.pdf provides in-depth details of the methodology used for the adjustment made to the provincial forest cover for the 2015.

The provincial forest inventory is a strategic level photo estimates inventory that is maintained in an operational database in a system known as VRIMS (Vegetation Resource Inventory Management System). This operational database is updated for disturbances, projected for annual growth and subjected to a number of data quality assurance processes. Annually the data is 'published' from this operational database to DATA BC to be available for resource management decisions by government, industry, and the public.

The methodology used to account for the MPB changes to the inventory for the past 5 years had been accomplished by projecting the inventory attributes, calculating volume and then *depleting* the projected inventory volume by the MPB predicted mortality. This methodology required a great deal of manual intervention and changes to stand structure were only reflected in the forest tree volumes and stand density and not to the stand species composition, basal area, or other stand attributes.

With the 2015 Forest Inventory release we implemented some infrastructure changes to the operational database (VRIMS) and projection model (VDYP7) to accommodate the proposed changes for the MBP impacts. First a new Layer 'D' or dead layer was created in the VRIMS operational database. This uses the same data model as is used for new inventories to be able to keep track of dead trees in inventory stands. Changes to the natural stand projection tool VDYP7 were done to allow the calculation of the tree volume for the live and dead layers.

The 2015 Forest inventory release includes our standard data product as well as a few new products as described below:

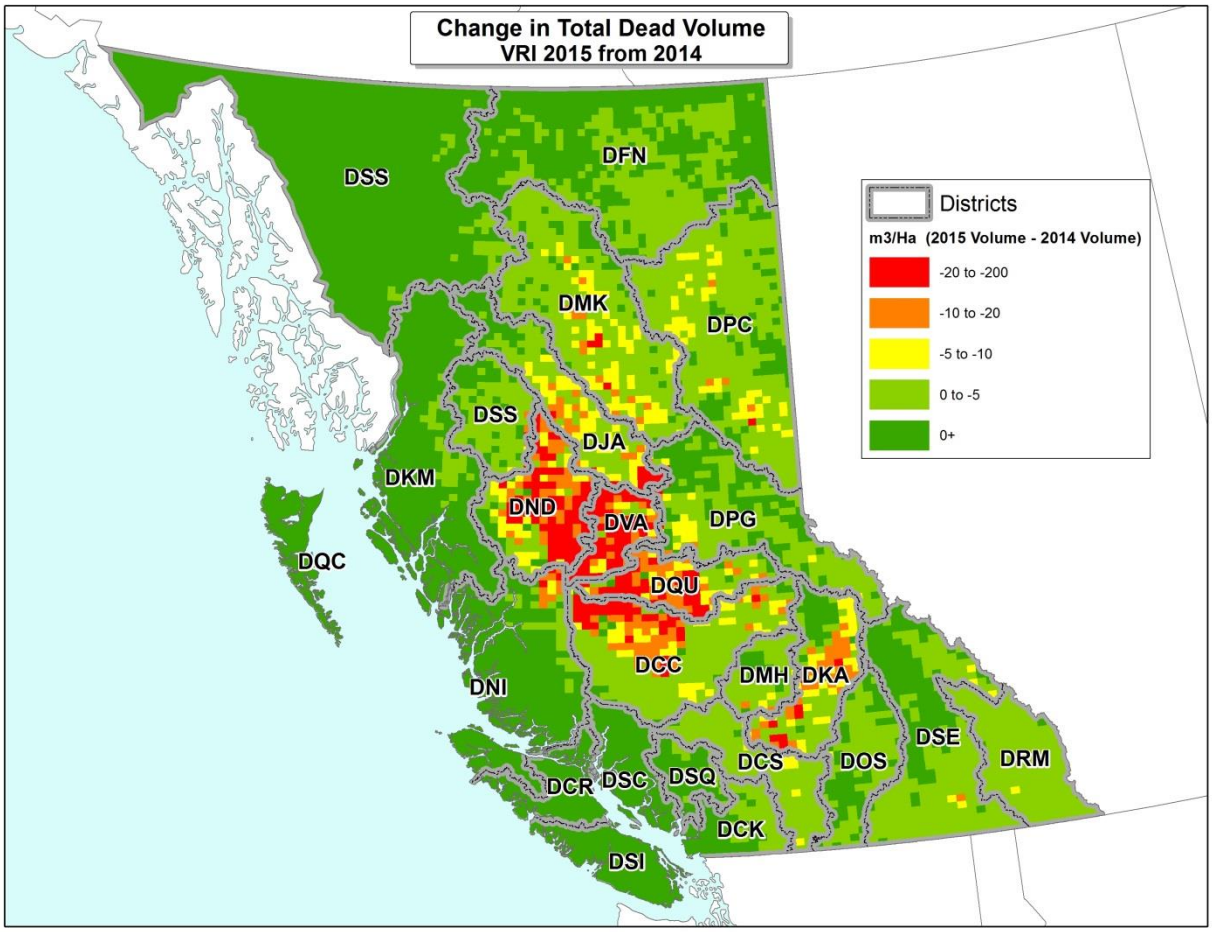
VEG_COMP_LYR_R1_POLY (our standard product): provides the estimates of forest inventory for the rank 1 tree layer. This is the workhouse dataset for almost all analysis and it has the total dead volume for the polygon identified in the attribution as well as the attribution for the dominant (Rank 1) stand composition

The **VEG_COMP_POLY** and the **VEG_COMP_LAYER**: are new table products that will provide analysts with the spatial forest cover estimates for all layers identified including the Dead layer (Layer_D). This provides more information for the stands following the MPB outbreak, other stands with a significant dead component from other causes, and other live tree layers that were not provided to the public previously requires the use of a one to many join to the polygon for analysis.

The 2015 Forest Inventory differs from the 2014 Forest Inventory to reflect changes in growing stock of the forests, in areas updated for harvest and fire and for attribute adjustments to account for the MPB. The overall impact of these changes and the change in methodology for MPB results in an increase to live stand volume of 215 million m^3 and a reduction to dead stand volume of 272 million m^3 for a net total volume reduction of 64 million m^3 or 0.6% of the total 2015 volume.

	2014 (vol in(million m^3)	2015 (vol in(million m^3)	Change (million m^3)
Live volume	8,833	9,048	215
Dead volume	937	658	-272
Total volume	9,770	9,706	-64

TOTAL VOLUMES			
District	2015 Live Volume	2014 Live Volume	Change
Central Cariboo	291,323,407	294,510,472	-3,187,065
Chilliwack	350,720,150	352,390,380	-1,670,230
Campbell River	258,122,373	260,974,703	-2,852,330
Cascades	202,366,281	199,701,473	2,664,808
Fort Nelson	643,633,417	641,691,878	1,941,539
Fort St James	347,340,529	333,225,483	14,115,046
Kamloops	312,158,129	320,714,082	-8,555,953
Kootenay Mountain	768,978,641	766,060,623	2,918,018
100 Mile House	123,181,540	123,911,552	-730,012
Mackenzie	435,422,489	421,977,964	13,444,524
Nadina	300,100,778	285,684,411	14,416,367
North Island	774,186,401	737,488,961	36,697,440
Okanagan Shuswap	341,638,206	342,099,544	-461,338
Peace River	649,582,215	638,815,120	10,767,096
Prince George	521,838,151	509,533,586	12,304,565
Haida Guaii	263,247,870	261,906,604	1,341,266
Quesnel	154,730,725	136,676,001	18,054,724
Rocky Mountain	234,719,786	233,235,075	1,484,711
Sunshine Coast	212,123,867	212,270,910	-147,043
Selkirk	698,453,171	614,287,565	84,165,606
South Island	194,617,852	196,068,294	-1,450,441
Squmish	141,083,384	142,042,604	-959,220
Sitka Stikine	723,139,127	725,041,862	-1,902,735
Vanderhoof	105,568,633	82,721,943	22,846,690
TOTAL	**9,048,277,121**	**8,833,031,086**	**215,246,035**



The change in dead volume between 2014 and 2015 is significant and is due to a number of factors as outlined in the table below:

- In areas with new inventory the photo interpreted dead pine component is getting much harder to distinguish. This is most apparent in Kamloops, Nadina, Fort St James, Quesnel and Cariboo Natural Resource Districts with a difference between 2014 and 2015 inventories of about 143 million m^3.
- The attribute adjustment for of the dead layer was removed from areas with wildfire activities as this would have resulted in an over estimate of dead volume available in the 2014 projection,
- Areas where new inventory data is expected this year have not been adjusted for MPB impacts which results in an underestimate of about 8 million m^3 from 2014
- Updates to the inventory to reflect harvest activities account for a difference of 20 Million m^3.
- The change in MPB impact methodology to re-align the adjustment with the photo estimation procedures has reduced the dead volume estimates by about 45 million m^3. We are continuing ground sampling this year to determine if further refinement to the process is warranted.
- The calculation of dead volume to the year of death in the projection has reduced the estimate of dead by an additional 33 million m^3. . This was an over estimate in the 2014 projection.

- A number of spatial errors caused problems in the re integration of the adjusted forest cover. These errors will be integrated into the operational data over the next year adding to the dead volume estimate by about 12 million m^3.

The following table shows the differences in dead volume between 2014 and 2015 by districts.

Natural Resource District	Difference in dead volume due to new inventories	Difference in dead volume due to Fire Update	pre beetle Inv with new inventory pending	update to forest cover	MPB UPDATE 2015	Outside of 2015 adjustment parameters	Not integrated into VRIMS (Bad Spatial Data)	total dead volume difference from 2014	total 2015 live and dead volume
Central Cariboo	-24,066,190	-361,255	-2,484,280	-222,805	-2,919,599	-4,993,987	-38,086	-35,086,203	339,868,759
Chilliwack	0	-164	-25,841	-6,345	-78,654		-315,326	-426,329	351,853,799
Campbell River	0	0	0	0	0	-305,689	305,689	0	258,122,373
Cascades	-31,938	-6,879	-386,966	-208,639	-1,686,621	-2,559,957	-285,742	-5,166,742	222,647,851
Fort Nelson	0	-848	-25,098	-254	-245,508	-434,973	4,710	-701,971	645,927,696
Fort St James	-10,668,031	-6,449	-442,121	-395,123	-5,364,832	-4,498,254	-147,573	-21,522,383	423,788,339
Kamloops	-905,820	-311	-2,342,737	-3,408,703	-248,506	-7,852,265	-3,898,337	-18,656,680	330,413,831
Kootenay Mountain	36,002	0	-3,686	-949	-24,846	-23,027	1	-16,505	769,242,216
100 Mile House	0	0	-597,077	-718,346	-747,019	-12,301	8,586	-2,066,157	139,126,141
Mackenzie	0	-64,596	-397,798	-327,250	-9,359,823	-4,571,170	-2,442,516	-17,163,154	542,539,520
Nadina	-44,152,391	-5,380,308	-34,144	-4,135,659	-257,621	-2,923,776	-275,183	-57,159,083	367,910,469
North Island	-1,873	-20,506	-108,637	0	-1,675,801	-1,914,029	88,804	-3,632,042	802,744,921
Okanagan Shuswap	-1,389	-13,873	-269,096	-328,454	2,000,881	-1,559,491	-37,101	-208,523	355,754,982
Peace River	0	-14,032	-462,392	-497,789	-8,409,783	-3,945,309	-192,346	-13,521,650	706,807,410
Prince George	-3,803,339	-6,325	-714,273	-392,261	1,608,311	-4,294,378	-48,430	-7,650,694	584,481,423
Haida Guaii	0	0	0	0	0	-946	0	-946	263,247,870
Quesnel	-26,204,485	-615,451	-270,003	-968,830	-3,209,630	-5,484,782	-1,284,498	-38,037,680	215,084,178
Rocky Mountain	0	-5,108	-333,059	-110,482	-1,112,742	-1,291,752	-13,460	-2,866,603	244,272,601
Sunshine Coast	0	0	-253	-178	0	-1,564	0	-1,996	212,123,867
Selkirk	0	-1,670	774,851	-123,108	-1,704,572	2,025,684	-4,072,870	-3,101,685	715,335,980
South Island	0	0	0	0	0		0	0	194,617,852
Squmish	0	-6	-31,979	-8,262	111,211	-200,040	-997	-130,074	142,002,563
Sitka Stikine	-1,832,795	0	-104,320	-134,445	37,245	-643,954	3,341	-2,674,927	729,046,241
Vanderhoof	-31,562,603	-2,326,576	-208	-8,063,512	6,243	-102,252	10,145	-42,038,763	149,354,596
Total	-143,194,854	-8,824,356	-8,259,116	-20,051,392	-33,281,667	-45,588,215	-12,631,189	-271,830,789	9,706,315,479

(vol in million m^3)

Questions about the forest cover and adjustment process can be forwarded to

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