Whitebark pine health of Southern BC

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Background:

Whitebark pine populations are in decline across its range due to four main threats:

- White Pine Blister Rust
- Mountain Pine Beetle
- Seral Replacement due to Fire Suppression
- Global Climate Change

Across BC the level of impacts are highly variable and the level of decline has been geographically described by others (e.g. Campbell and Antos 2000, Zeglen 2002). **Identifying areas in greatest decline is important, <u>regardless of cause</u>, in order to prioritize recovery efforts and research.** This project summarized health plots and transects established in 2015 and is not an exhaustive portrayal of health across the BC range.

Methods:

Permanent health plots were established in six regions of BC: Chilcotin, South Chilcotin, Lillooet, Manning Park, Okanagan, West Kootenay, East Kootenay, and Crown of the Continent.

These plots were of two types, health transects (10m x 50m) (Tomback et al. 2005) and larger health plots (ca. 50m x 50m). In each plot relevant data was collected regarding: blister rust infection, mountain pine beetle attack, tree sizes (DBH), and competing tree composition. Diameters for each tree was converted to basal area (BA.)

Two complementary approaches to analysis were taken. The first, and most common approach, looked at infection as a percentage of stems. In this approach all trees in the sample are equal in contributing to the level of infection present. The second approach looked at the BA of each infected tree, this approach can be used to identify what size of trees are infected and link directly to cone production and other attributes associated with tree size.

Percent of Stems Approach

- Health ranged from 0% to 99% healthy
- Average across all plots was 56% healthy

Basal Area Approach

- Health ranged from 0% to 99% healthy
- Average across all plots was 43% healthy

Figure 1. Comparison of healthy stems and Basal Area approaches.

The difference between the percent stems and BA approach is illustrated in Figure 1. In this example, 50% of the stems are healthy but less than 5% of basal area is healthy. Although half of the trees are healthy, most of the ecological function has been lost from the stand through the loss of the large mature tree.

Table 1. Summary of whitebark pine and

Plot	Location	n	Percent of Stems Healthy	Whitebark BA Total (m2/ha)	Whitebark BA Living (m2/ha)	Whitebark BA Healthy (m2/ha)	Percent of Basal Area Healthy	Rank % Stems	Rank % BA
Upper Vic's	Chilcotin (7)	112	88.0%	26.25	26.25	25.87	98.6%	1	1
Falls Creek	Chilcotin (7)	97	97.0%	21.36	21.36	20.88	97.8%	2	2
Tchaikazan	Chilcotin (7)	76	64.0%	38.18	37.54	37.14	97.3%	3	3
Mount Nemaia	Chilcotin (7)	25	92.0%	2.47	2.47	2.34	94.7%	4	4
Buck Mountain	Chilcotin (7)	65	95.0%	17.45	16.23	15.19	87.0%	5	5
Yohetta Lodge	Chilcotin (7)	78	99.0%	20.94	19.45	15.12	72.2%	8	7
Lower Vic's	Chilcotin (7)	33	77.0%	16.92	16.45	7.34	43.4%	17	18
Porcupine	South Chilcotin (8)	73	0.0%	19.05	17.69	13.96	73.3%	6	6
Sunshine	South Chilcotin (8)	115	0.0%	23.05	18.85	11.97	51.9%	16	11
Poison	South Chilcotin (8)	52	27.0%	11.52	11.52	5.95	51.6%	11	12
Buck	South Chilcotin (8)	59	60.0%	19.60	18.25	9.70	49.5%	15	13
Big Dog Mountain	South Chilcotin (8)	44	62.0%	18.80	18.29	6.84	36.4%	22	22
Downton	South Chilcotin (8)	57	6.0%	34.69	33.75	10.17	29.3%	10	26
Green Mountain	South Chilcotin (8)	64	52.3%	10.13	7.92	2.45	24.2%	29	28
Holbrook	South Chilcotin (8)	58	16.6%	25.46	22.41	4.21	16.5%	23	31
Mt. Carson	Lillooet (5)	79	66.1%	13.21	11.07	6.45	48.8%	26	14
Second Creek	Lillooet (5)	59	71.9%	18.84	13.95	9.19	48.8%	24	15
Molybdenite1	Lillooet (5)	78	42.2%	10.22	9.74	3.86	37.8%	9	21
Molybdenite2	Lillooet (5)	36	51.7%	46.21	18.17	2.19	4.7%	27	34
Blustry	Lillooet (5)	30	74.4%	11.22	4.67	0.22	2.0%	35	36
Blackwall Peak	Manning Park (2)	74	47.2%	14.39	9.19	6.56	45.6%	28	17
Paintbrush Trail	Manning Park (2)	45	48.1%	18.21	6.01	3.60	19.8%	31	29
Apex	Okanagan (1)	102	71.1%	6.15	6.15	4.32	70.2%	7	8
Red Mountain	West Kootenay (7)	90	82.2%	1.03	1.03	0.67	65.0%	13	9
Bluejoint	West Kootenay (7)	68	50.8%	2.05	1.79	1.27	62.0%	14	10
Wheaties Ridge	West Kootenay (7)	39	66.1%	5.00	4.47	1.91	38.2%	20	20
Ventigo	West Kootenay (7)	25	43.0%	2.40	2.26	0.83	34.6%	12	23
Moraine	West Kootenay (7)	17	38.0%	4.94	4.56	1.49	30.2%	21	25
Sorcerer2	West Kootenay (7)	20	53.0%	35.26	34.63	6.97	19.8%	25	30
Sorcerer1	West Kootenay (7)	19	26.0%	25.72	25.07	1.09	4.2%	34	35
Bootleg	East Kootenay (4)	70	50.0%	18.88	16.65	9.08	48.1%	19	16
Bootleg 2	East Kootenay (4)	45	68.0%	22.86	12.87	9.58	41.9%	18	19
Findlay	East Kootenay (4)	102	56.0%	27.62	11.13	7.14	25.9%	30	27
Puddingburn	East Kootenay (4)	614	78.4%	18.13	18.10	2.28	12.6%	32	32
Baldy	Crown of the Continent (4)	56	66.2%	8.85	7.14	2.85	32.2%	33	24
Mt. Stevens	Crown of the Continent (4)	82	41.2%	32.86	12.95	1.67	5.1%	36	33
Alexander	Crown of the Continent (4)	30	28.5%	16.79	8.69	0.00	0.0%	37	37
Crown	Crown of the Continent (4)	12	67.8%	10.90	7.93	0.00	0.0%	38	38

Results and Discussion

Although the differences between % of stems and BA can be minimal on some plots, it is most important to consider the two approaches together. At 14 of the 38 plots analyzed, % of Stems and BA analyses were within 5% of each other (Figure 2, Table 1); at these sites infection was well distributed among size classes. Most of these sites represented the extremes of the surveys with the majority being very healthy or very infected. At six sites, the difference between %stems and BA was greater than 30%, all where the BA approach yielded poorer health than % of stems. **At these sites, larger trees are being lost with probable impacts to regeneration and wildlife.**

As an example, consider the Downton site where 72% of stems were healthy, but only 29% of basal area was healthy; at this site most of the larger and ecologically contributing trees are infected illustrating that the % of stems approach portrayed a healthier ecosystem than is actually present.

Further, consider that by including BA in the analysis, cone production thresholds can be monitored to identify when potential ecological tipping points may be approaching. Barringer et al. 2012 identified that basal area of 2.0 m^2/ha were required to meet cone production requirements to support nutcracker visitation. **At present only Red Mountain and Bluejoint in the West Kootenay are below this threshold, but an additional eight sites may fall below this threshold if observed infection manifests into mortality in the near future.**

When evaluating stand health, basal area should be included in summaries as the percent infection alone does not convey the full story of stand health. By including basal area changes in absolute values and percentage, managers can better identify what ecological ramifications may be present.

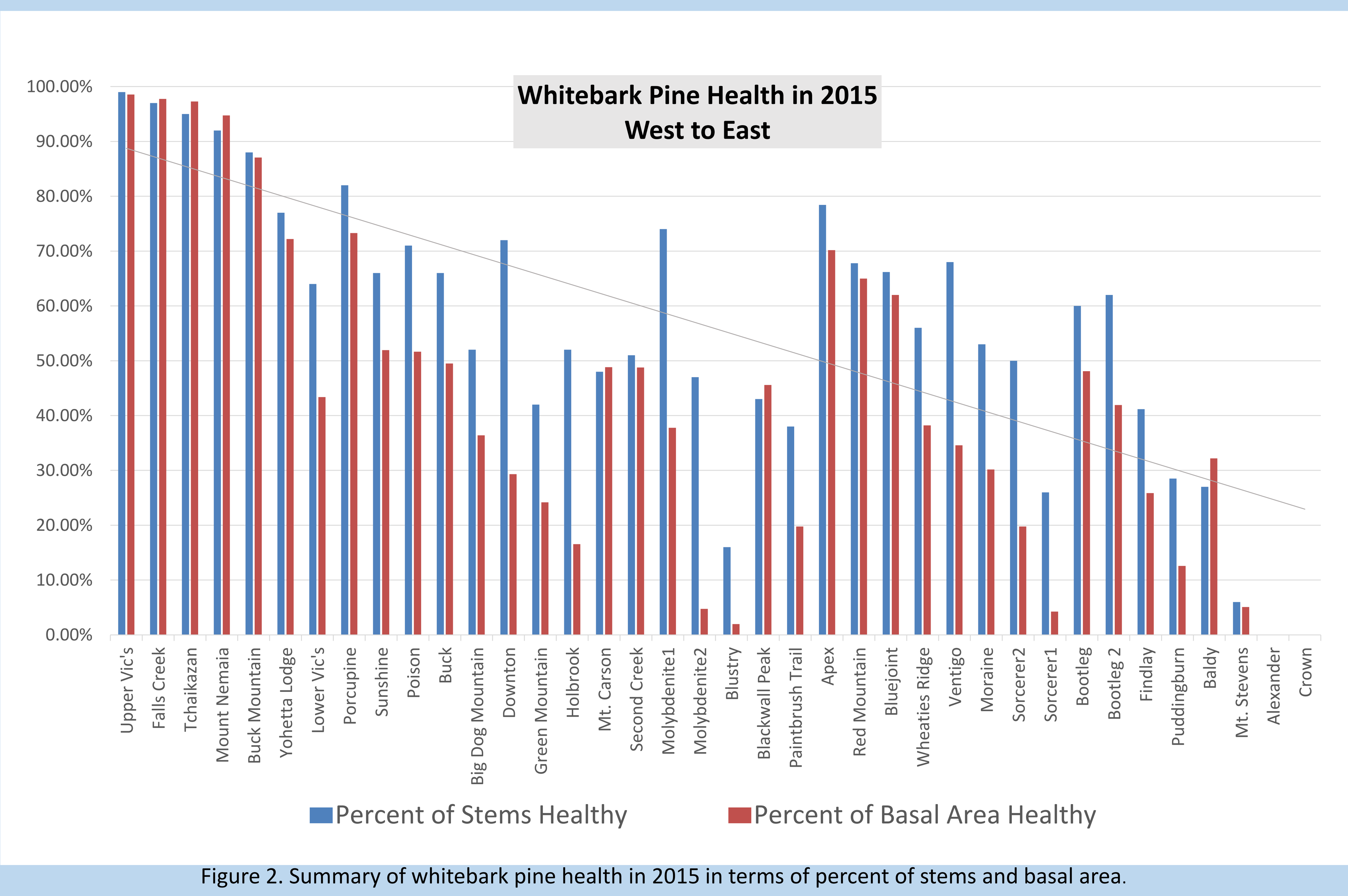

Figure 2. Summary of whitebark pine health in 2015 in terms of percent of stems and basal area.

Whitebark Pine in the Crown of the Continent

The health of Whitebark pine generally declines moving from west to east (Figure 2). Four of the 38 plots were considered to be within the Crown of the Continent: Baldy, Mt. Stevens, Alexander, and Crown. These were some of the most infected stands surveyed, being respectively ranked 33rd, 36th, 37th and 38th in terms of health from a % stems perspective and 24th, 33rd, 37th and 38th from a BA perspective (Table 1). Collectively, this area was the most unhealthy of all regions in the province with less than 10% of the trees healthy from both a % stems and basal area perspective (Figure 3). This health trend echoes previous findings. Zeglen (2002) found the most unhealthy stands to be in the Southern Rockies (includes Crown of the Continent Ecosystem). Campbell and Antos (2000) observed infection rates greater than 61% in all plots. Smith and others (2008) found the Crown area to be comparatively less healthy than northerly Divide stands averaging 44-78% of trees infected.

While all sites were very unhealthy, at Alexander and Mt. Stevens mortality was exceedingly high, killing over 50% of BA in the plots (even greater outside of the Mt. Stevens plot) (Table 1, Figure 4). **These high mortality rates indicate a dire need for restoration in the region. The high infection rates present an opportunity to for cone collections from parent trees that are already under high selection pressure for rust resistance.**

Figure 4. Dead Whitebark Pine forest outside of sample plot on Mount Stevens.

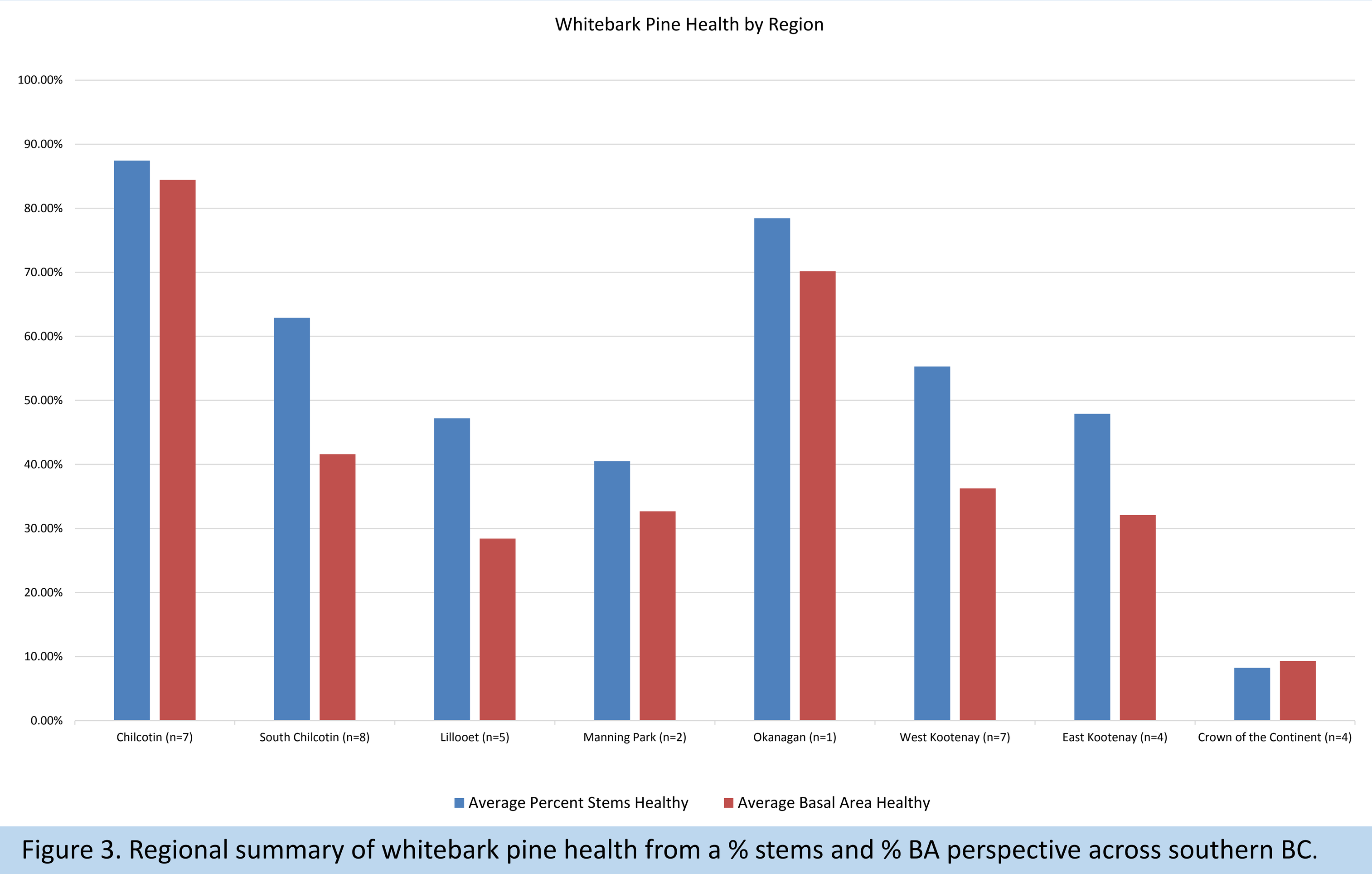

Figure 3. Regional summary of whitebark pine health from a % stems and % BA perspective across southern BC.

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Tomback, D.F., Keane, R.E., McCaughey, W.W. and Smith, C., 2005. Methods for surveying and monitoring whitebark pine for blister rust infection and damage. *Whitebark Pine Ecosystem Foundation, Missoula, Mont. Available from whitebarkfound. org/monitoring. html [accessed 8 December 2006]*.

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