

Correlating the Occurrence and Frequency of Balsam Woolly Adelgid (BWA) Impacts within Maine's Biophysical Regions



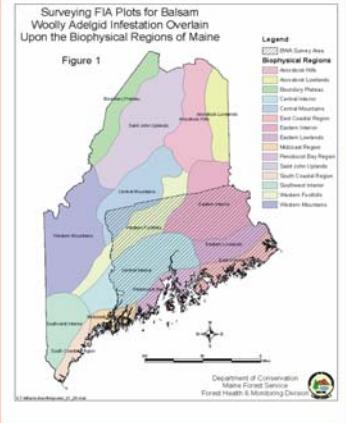
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Abstract

Recent expansion and intensification of *Balsam Woolly Adelgid* populations and damage in Maine has raised a concern about the negative impacts on stands with a concentration of balsam fir. In 2004, during the normal course of FIA phase 2 data collection, all 219 FIA plots within a 5.4 million acre survey area were assessed for BWA impacts. Crews used PDA's to record ancillary information on all sampled and merchantable-sized fir trees. In addition, each microplot was categorically assessed for individual BWA impacts on saplings and seedlings. The hypothesis is that the spatial distribution of BWA mortality and damage is related to the distance from the coast, increasing plot distance from the coast (**Figure 1**). Eight biophysical regions were substituted as a surrogate for mimicking this distance from the coast. Biophysical regions reside within the current BWA survey area and they were a priori grouped into three tiers (**Figure 2**). Risk analysis traditionally uses basal area as the basis for determining impact levels. That said, it was maintained to determine the relationship between merchantable size basal area (area of BWA damage per top, or overall) and specific BWA damage or mortality. The risk analysis clearly shows a spatial distribution and a very significant impact. This initial impact analysis is a work in progress that will be better buttressed with more data as Maine continues to collect re-measure data on individual trees. Questions remain as to how to minimize future impacts on fir.



Analysis

Since the 2004 FIA data for Panel 1 is not yet available, the BWA data was merged to the respective plot point, and tree data collected in the initial measurement of Panel 1 in 1999. This resulted in a temporary capability to analyze data on new and old trees to calculate impacts based on the current data. The BWA data were aggregated and calculated as percent basal area per acre and basal areas per acre at the condition level. The 219 plots expand to a total of 231 timberland conditions. The basal area calculations are based on the measured dbh in 1999, a common basis for trees that remained alive, were cut, or had subsequently died by the time of the 2004 measurement.

FIA plots were initially aggregated into their respective biophysical region and averaged for basal area impacts for any observed damage (trunk, top, or overall) and deduced BWA mortality. After completing this initial assessment it was obvious that a further aggregation into three tiers was appropriate and beneficial for better describing the spatial distribution (**Table 2**). An example of the actual data points are shown in **Figure 3**.

Each of the microplots was assessed using 1 of 5 categorical assignments to describe the absence/presence of fir and the absence/presence of BWA gout or mortality on the entire microplot. This assessment was done individually for saplings (1.0"-4.9" dbh) and seedlings (6" height - 0.9" dbh). The frequency of occurrence of each regeneration code was summarized for the three biophysical tiers (**Figure 3**).

Table 2. Average merchantable basal area per acre for FIA conditions within BWA survey area, by biophysical region and tier
 Data collected in 2004 on Panel 1's phase 2 plots
 Subsets represent net changes in balsam fir trees from the 1999 measurement to the BWA assessment in 2004 (5 years)

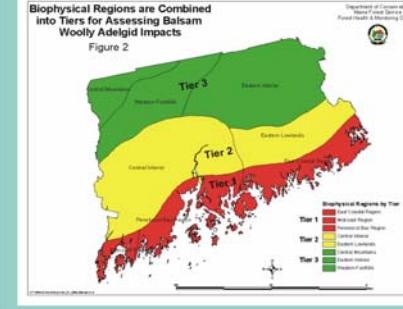
Merchantable (1.0"-4.9" dbh) Basal Area									
General Location	Biophysical Region	FIA Condition	All Species	Balsam Fir	Balsam Fir subset	Balsam Fir subset BWA Mortality	BWA Change	Balsam Fir subset BWA Mortality	Total BWA Impact
Tier #1 - Coastal	Eastern Coastal	23	141.32	15.51	0.98	0.43	-0.23	7.7%	87%
	Penobscot Bay	42	100.42	10.41	0.82	0.40	-0.18	4.9%	53%
	Midcoast	143	142.32	16.64	3.57	0.92	0.15	3%	27%
Tier #1 - Average		51	103.58	15.76	1.22	1.31	0.61	10.2%	65%
Tier #2 - Interior	Central Interior	83	122.48	9.94	2.94	1.49	0.18	3.6%	41%
	Eastern Lowlands	31	102.78	8.63	0.81	0.90	0.45	2.7%	56%
	Average	52	112.64	9.24	2.03	1.20	0.30	4.4%	51%
Tier #3 - Foothills	Central Mountains	7	85.64	8.97	3.44	3.21	0.32	33%	9%
	Western Foothills	24	102.44	12.79	9.81	1.18	0.68	4.2%	34%
	Average	28	98.08	10.38	3.34	2.19	0.49	2.8%	31%
Overall BWA Survey Area		351	117.28	9.45	2.32	1.14	0.57	4.5%	49%

Table 1. Acreage distribution by biophysical region within the balsam woolly adelgid survey area

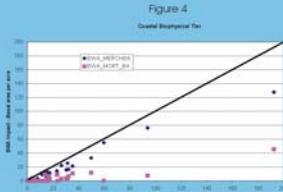
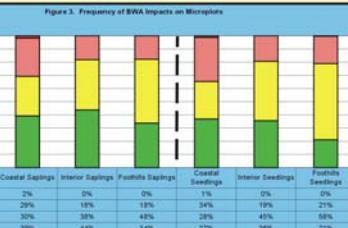
General Location	Biophysical Region	Acreage by FIA Plot Expansion	Share of BWA Survey Area
Tier #1 - Coastal	Eastern Coastal	77,710	12%
	Penobscot Bay	531,637	8%
	Midcoast	156,816	2%
Tier #1 - Sum		1,464,963	23%
Tier #2 - Interior	Central Interior	1,665,218	26%
	Eastern Lowland	816,265	13%
	Average	2,481,483	39%
Tier #2 - Sum			
Tier #3 - Foothills	Central Mountains	212,674	3%
	Eastern Interior	1,450,156	25%
	Western Foothills	772,596	12%
Tier #3 - sum		2,450,626	38%
Overall BWA Survey Area		6,397,072	

Methods

Based on some preliminary sampling in 2003, protocols were designed to collect a few suites of BWA impacts on fir trees in 2004. The demarcated survey area, based on expansion of FIA plots contains 6.4 million acres with 5.6 million acres meeting the FIA definition of timberland (**Table 1**). As an aside, MFS measured the survey area using a GIS approach and calculated 7.2 million acres of total area (**Figure 2**). Within the survey area, field crews were provided with pre-printed PDA's to directly collect BWA impact data as they completed the remaining portion of the 219 plots in Panel 1. For each merchantable sized (5.0" dbh) balsam fir killed, the following variables were assessed: **BWA tree status**, **Trunk Phase** (live trees only), **Top Damage-BWA**, and **Overall BWA Damage** (see tallysheet below for additional detail). In addition, each of the microplots were individually assessed for BWA impacts to saplings and to seedlings.



BWA Damage Assessment Tallysheet									
Black Tree Status	Live tree	Dead tree	Live tree						
Top Phase (One tree only)	Worst	Bad	Worst	Bad	Worst	Bad	Worst	Bad	Worst
Top Phase (Two tree only)	Worst	Bad	Worst	Bad	Worst	Bad	Worst	Bad	Worst
Top Phase (Three tree only)	Worst	Bad	Worst	Bad	Worst	Bad	Worst	Bad	Worst
Damage (One tree only)	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching
Damage (Two tree only)	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching
Damage (Three tree only)	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching	Live tree due to short branching	Live tree due to long branching
Assessing Saplings (One only)	Count live and dead saplings	Count live and dead saplings	Count live and dead saplings	Count live and dead saplings	Count live and dead saplings	Count live and dead saplings	Count live and dead saplings	Count live and dead saplings	Count live and dead saplings
Assessing Seedlings (One only)	Count live and dead seedlings	Count live and dead seedlings	Count live and dead seedlings	Count live and dead seedlings	Count live and dead seedlings	Count live and dead seedlings	Count live and dead seedlings	Count live and dead seedlings	Count live and dead seedlings
Regeneration	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9



Discussion

The biophysical regions and tiers provide an adequate surrogate for discriminating the current magnitude of BWA damage and mortality. BWA damage rapidly drops off from 65% of the fir basal area in Tier #1 to 44% and 33% respectively in Tier #2 and #3. The deduced BWA mortality is highest in Tier #1 with 16% of the fir basal area dead, and it again tapers off to 6% and 3% respectively in Tier #2 and #3.

This initial analysis is limited by available data. With the complete acquisition of the current Panel 1 FIA data, there are multiple additional analyses that can be conducted.

- Incremental growth rates should be assessed on remeasured trees to determine BWA-related productivity impacts.
- Correlation between local site conditions and BWA impacts should be analyzed to provide additional discrimination in risk assessment.
- Field crews observe that co-dominant and dominant trees are more likely than sub-dominant trees to be infested by BWA.
- Some of the worst damage has been observed in pre-commercially thinned stands.

The completion of these and other analyses will help craft a reactive silvicultural management prescription to address future vulnerability and susceptibility to BWA.

