West Virginia
Department of Agriculture

Gypsy Moth Damage
Assessment Report

2005

S. Clark Haynes, WVDA; Quentin "Butch" Sayers, WVDA; Shawn McCauley, WVDA;
Jerry Judy, WVDA; Linda Carnell, WVDOF; Jim Hays, WVDOF Ret.;
Amy Onken, USDA-FS; and Dr. John Brooks, WVU-DOF

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S. Clark Haynes[1], Quentin Sayers[1], Shawn McCauley[1], Jerry Judy[1], Linda Carnell[2], Jim Hays[3], Amy Onken[4], and Dr. John Brooks[5]

[1] West Virginia Department of Agriculture, Plant Industries Division
[2] West Virginia Division of Forestry
[3] Retired, West Virginia Division of Forestry
[4] USDA Forest Service, State and Private Forestry
[5] West Virginia University, Division of Forestry

Introduction:

In 2005, the West Virginia Department of Agriculture (WVDA) initiated a gypsy moth damage assessment to evaluate the tree mortality associated with the record defoliation from 2000 to 2002 in which 322,892, 603,630, and 132,197 acres were defoliated, respectively. This report quantifies the tree mortality that occurred and compares these results to previous assessments from other defoliation events reported on by Atkins and Smallwood (1991) and Hicks and Mudrick (1996). The previous studies were conducted prior to the arrival of *Entomophaga maimaiga* in West Virginia.

Background:

Gypsy moth was first detected in West Virginia in 1972 using male moth traps. In 1978, the West Virginia Department of Agriculture (WVDA) made its first discovery of caterpillars, and defoliation was first observed and recorded in 1985. The continued progression of gypsy moth in West Virginia is marked by a trend of expansion from northeast to southwest, exemplified by trap catches for 2005 (figure 1). Gypsy moth populations in West Virginia have followed a 10-year cyclical trend. Defoliation occurred on 345,340 acres in 1990, increased dramatically in 2000, and reached its highest level to date in 2001 when 603,630 acres were defoliated (figure 2).

West Virginia has adopted two aggressive strategies in treating forest land threatened by gypsy moth defoliation (table 1). The first strategy includes the West Virginia Cooperative State-County Landowner Program (CSCL) where landowners are required to apply for treatment and pay 57 percent of the spray costs, the balance of which is covered by the USDA Forest Service under the Cooperative Suppression Program. The second approach is as a participant in the USDA Forest Service-funded Slow the Spread Program (STS) where the State pays 25 percent of the total costs for monitoring and treatment of low-level infestations.

Atkins and Smallwood (1991) studied the impacts of gypsy moth in West Virginia from 1985 to 1990 during a period when 81,427 acres were moderately to heavily defoliated.

Losses were valued at $209/acre with an overall impact of $17 million dollars. Hicks and Mudrick (1996) updated this assessment by inventorying an additional 55,000 acres that had been defoliated between 1988 and 1994 and showed evidence of tree mortality. Their findings indicated that more than $17 million dollars worth of timber was killed in the affected area alone, amounting to approximately $310 per acre.

The effects of the gypsy moth fungus, *Entomophaga maimaiga,* on gypsy moth populations in West Virginia were first noted in 1997, when defoliation was at its lowest level ever recorded (figure 2) and continued to drop for the next 2 years. *E. maimaiga* has since been effective in both high- and low-density gypsy moth populations and has played a significant role in the natural control of gypsy moth, especially in years with a wet spring. With several years of either low or no detectable gypsy moth defoliation, it was speculated that *E. maimaiga* might continue to maintain gypsy moth populations below defoliating densities. The dry, hot weather in the spring of 2000 and 2002, however, resulted in 3 consecutive years of widespread moderate to heavy defoliation, demonstrating that gypsy moth continues to be a major threat to West Virginia forest lands.

In 2005, the WVDA initiated a gypsy moth damage assessment to evaluate the tree mortality associated with this record defoliation. From 2000 to 2002, a total of 322,892, 603,630, and 132,197 acres was defoliated, respectively. The 2001 defoliated acreage was nearly double the previous high total of 345,340 acres in 1990. The bulk of the defoliation occurred in Grant, Hampshire, Mineral, Morgan, and Pendleton Counties located in the Eastern Panhandle region of the State. However, significant defoliation also occurred in 11 other counties in which defoliation was mapped (figures 3-1 to 3-3).

Methods:

The assessment involved conducting an inventory using a 20-factor prism to tally volume, then computing the volumes (International ¼ inch) of living and dead timber using the EZ CRUZ program developed by Brooks and Wiant. Aerial reconnaissance was conducted over the region to determine the extent of mortality in the areas previously defoliated. An ice storm in 2004 broke the tops out of living and dead trees, making it difficult to accurately assess mortality from the air. Aerial observers noted that mortality was widespread in areas that were defoliated before 2000, but appeared to be highest in areas receiving severe defoliation 2 out of the 3 years from 2000 to 2002. Initially, the stands were to be stratified and grouped based on the number of defoliations that occurred during the 3-year period from 2000 to 2002. However, that task proved to be impossible to achieve due to the limited number of stands inventoried and access to an equal number of stands in each defoliation class. Ultimately, 24 stands ranging in size from 50 to 228 acres and totaling 2,299 acres were selected (figure 4). Sampling points were established based on the size of the area surveyed. A minimum of 16 plots was established for areas of 50 acres or less. Two additional plots were established for every 5 additional acres above the 50-acre minimum. For areas greater than 120 acres, an additional 2 plots were established for every 10 acres. A total of 711 plots was established over the 2,299 acres inventoried. Trees falling in the 2- to 10-inch dbh size class were considered pulpwood while trees in the 12-inch size class and larger were consider sawtimber. The values for living and dead timber were based on actual stumpage values from north-central West Virginia.

Results:

Oaks represent the greatest volume (79.8 percent) for both live and dead sawtimber trees throughout the survey area. The relative abundance of oak species is as follows:

Chestnut oak	33.1%
Red oak	25.2%
Black oak	9.4%
White oak	6.7%
Scarlet oak	5.4%

Throughout the surveyed area, sawtimber mortality averaged 1,208 bd. ft. per acre, and pulpwood mortality averaged 6.2 cords per acre. The average sawtimber and pulpwood volume loss was 19.5 and 19.7 percent, respectively.

Sawtimber (Bd. Ft.)				
Total Volume	Avg. Bd. Ft./Ac (Total)	Dead Volume	Avg. Bd. Ft./Ac (Dead)	Average Mortality
14,286,513	6,214	2,776,846	1,208	19.5%

Pulpwood (Cords)				
Total Volume	Avg. Cds./Ac (Total)	Dead Volume	Avg. Cds./Ac (Dead)	Average Mortality
72,414	31.5	14,255	6.2	19.7%

The highest and lowest sawtimber volume losses due to mortality in individual stands was 69 and 67 percent and 2 and 4 percent, respectively. Oaks made up the vast majority of volume lost (94.2 percent). Mortality rates appeared to be higher in those stands defoliated twice in the 3-year period. However, many factors in addition to defoliation may affect mortality rates. These include, but are not limited to, stand density, aspect, soil type, and drought conditions preceding or occurring after defoliation.

Species	**% Mortality by Volume**
Chestnut Oak	44.4
Red Oak	21.7
Black Oak	13.6
Scarlet Oak	8.4
White Oak	6.1
TOTAL	94.2

Mortality rates were summarized by size class based on basal area. Significant mortality occurred throughout each size class; however, the 12- to 14-inch (small sawtimber) size class had the highest mortality rate (25.9 percent) and the 2- to 6-inch dbh size class the lowest (16.3 percent).

Percent Mortality by DBH Class				
2-6"	8-10"	12-14"	16-18"	20" +
16.3%	21.5%	25.9%	19.6%	16.6%

The total estimated value for dead sawtimber and pulpwood on the 2,299 acres sampled was $639,971 ($278.37/acre) and $125,341 ($54.52/acre), respectively.

Value of Sawtimber (Bd. Ft.)			
Total Volume	Per Acre (Total)	Dead Volume	Per Acre (Dead)
$3,162,295	$1,375.51	$639,971	$278.37

Value of Pulpwood (Cords)

Total Volume	Per Acre (Total)	Dead Volume	Per Acre (Dead)
$598,613	$260.38	$125,341	$54.52

Approximately 56,602 acres were heavily defoliated 2 of the 3 years between 2000 and 2002. The damage appraisal by Atkins and Smallwood from 1985 to 1990 revealed that an average of 25 percent of a stand's basal area had died or was vulnerable to mortality after just 1 year of defoliation. After 2 consecutive years of defoliation, 29 percent of the basal area had died or was vulnerable. Similar results have been reported by others (USDA 1995) where mortality rates increased to 27 percent after two successive heavy defoliations. A conservative estimate of the dollar value for the timber killed was arrived at by applying the 19.5 percent mortality rate to only those acres that received two or more heavy defoliations from 2000 to 2002. Based on the results from this assessment, the estimated value for timber killed on the 56,602 acres is $15,756,299 for sawtimber and $3,085,941 for pulpwood, for a grand total of $18,842,240. Undoubtedly, the actual dollar value of the timber killed was much greater because significant mortality was observed in stands defoliated only once during the 3-year period.

The damage appraisal by Hicks and Mudrick for the period 1988 to 1994 revealed that 18 percent of the sawtimber and 12 percent of the pulpwood had died as a result of defoliation. This compares to the 19.5 percent of the sawtimber and 19.7 percent of the pulpwood volume killed in the 2005 inventory. This study reveals that even though gypsy moth has been established in the Eastern Panhandle for more than 20 years, significant mortality can still be expected, particularly if severe defoliation occurs multiple times during a short span of time.

Special thanks go to the West Virginia Department of Agriculture Forest Health Protection Specialists and West Virginia Division of Forestry Service Foresters who participated in this study.

References:

Atkins, J. M.; Smallwood, H. 1991. Gypsy moth in West Virginia 1985-1990 and predicted future impact. WVDOF-TR-91-1. West Virginia Division of Forestry. 6 p.

Hicks, R. R.; Mudrick, D. 1996. Gypsy moth damage assessment in West Virginia 1988-1994. Report to West Virginia Department of Agriculture.

United States Department of Agriculture. 1995. Gypsy moth management in the United States: A cooperative approach. Appendix G. Ecological Risk Assessment: 2-16.

Figure 1. 2005 gypsy moth rate of spread based on male moth trap capture data from the Slow the Spread website: http://da.ento.vt.edu/.

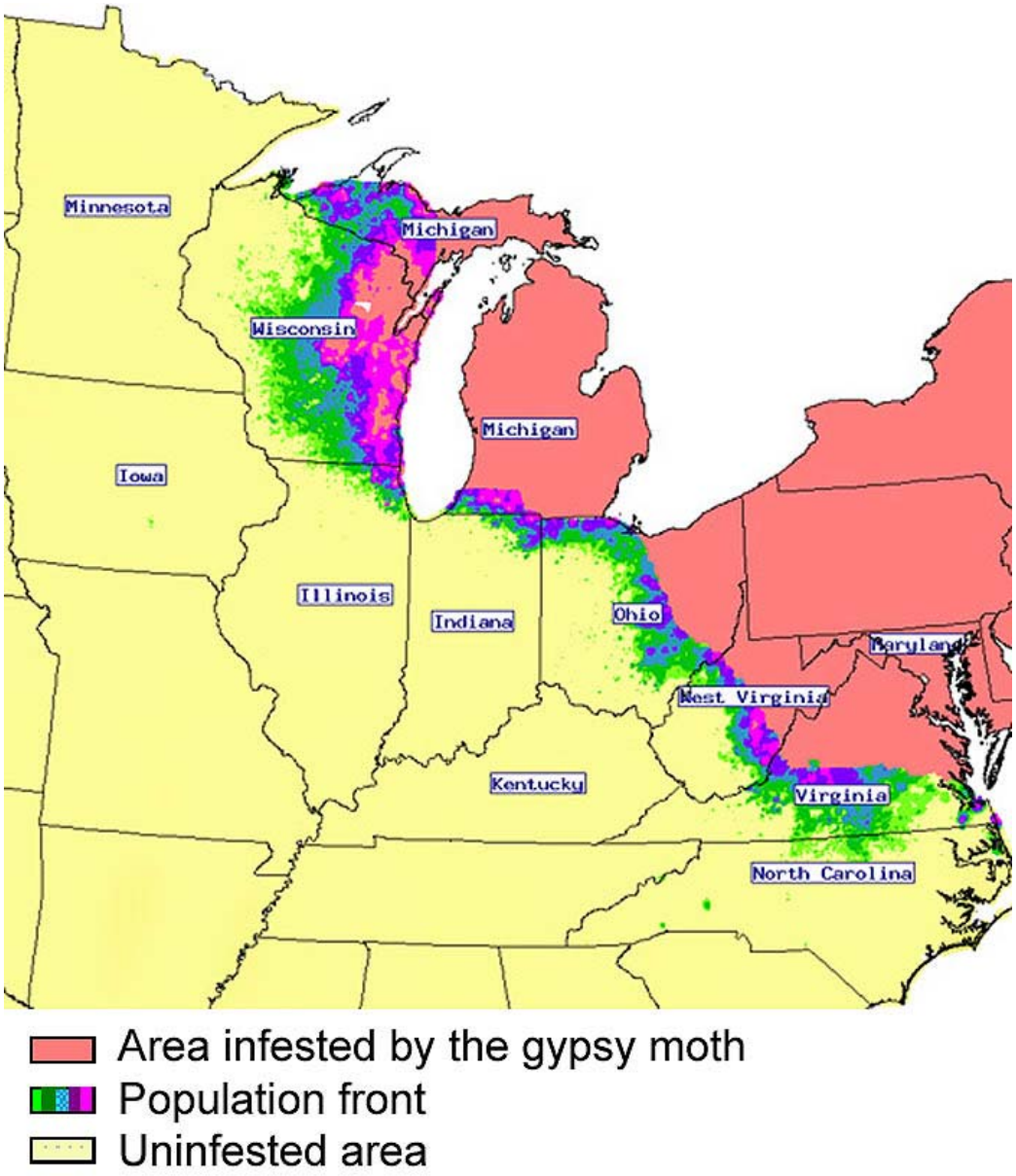

Figure 2. Acres defoliated by gypsy moth from 1985 to 2005.

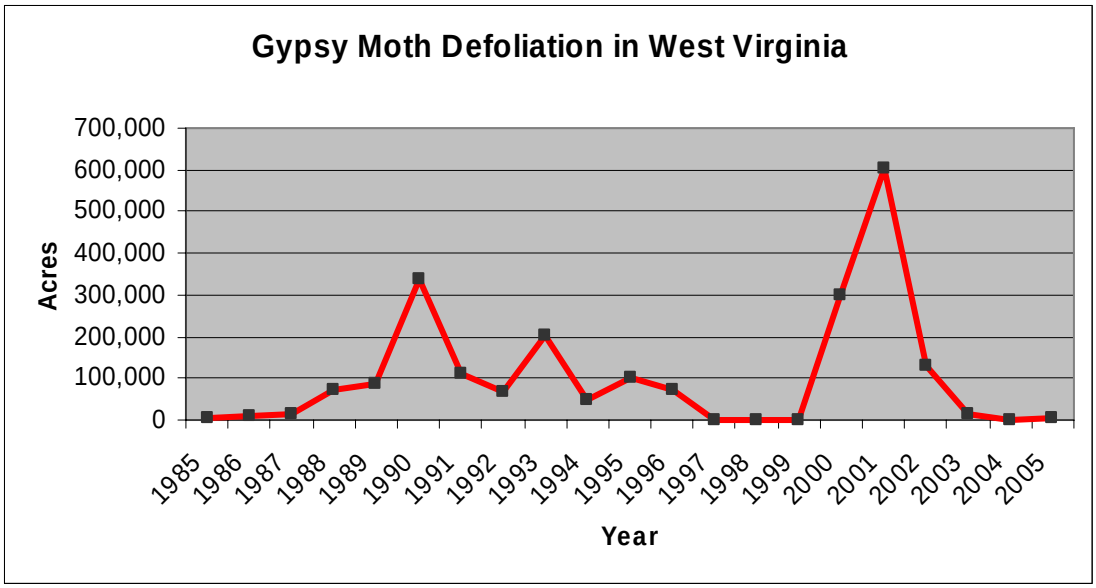

Figure 3-1.

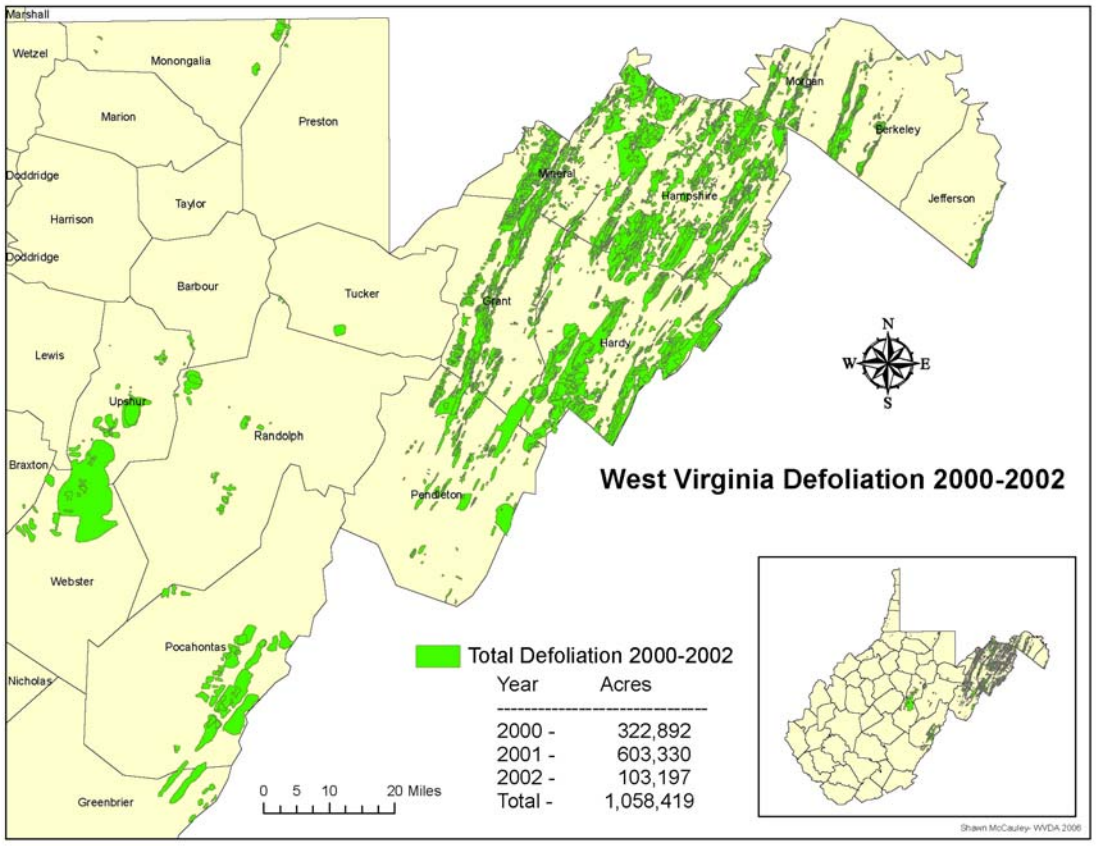

Figure 3-2

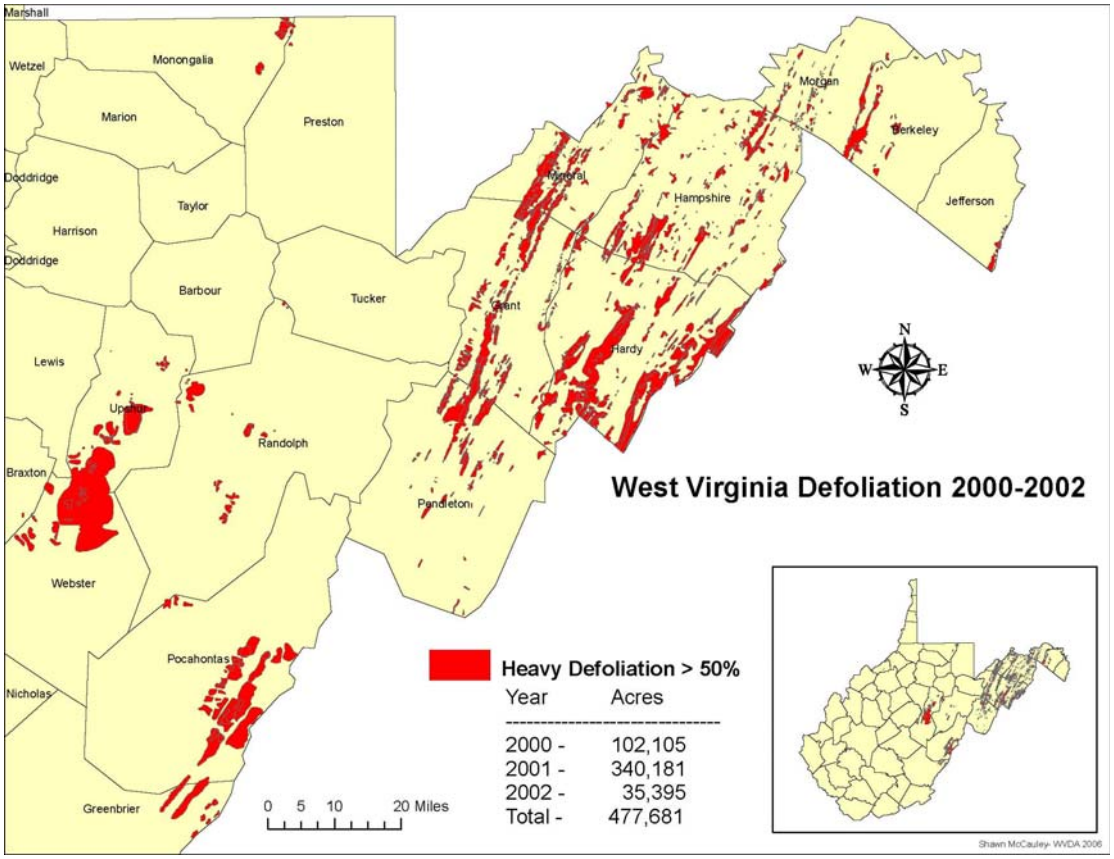

Figure 3-3

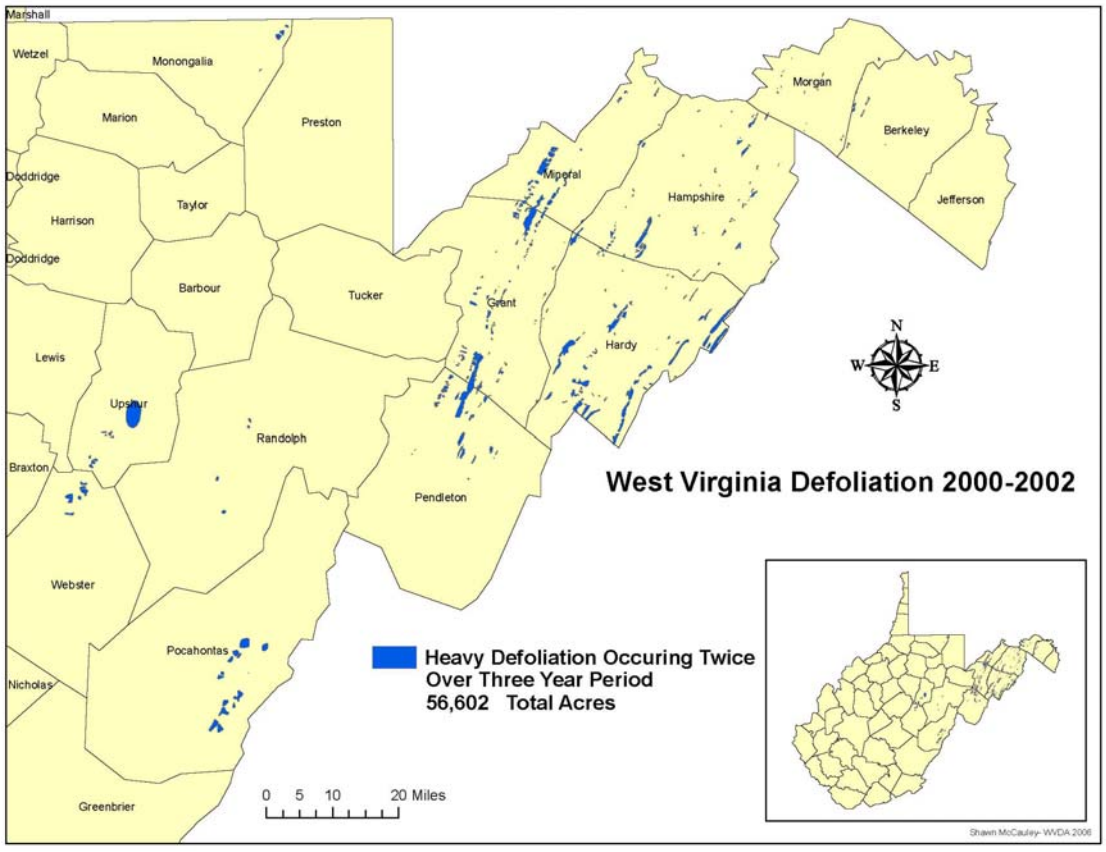

Figure 4

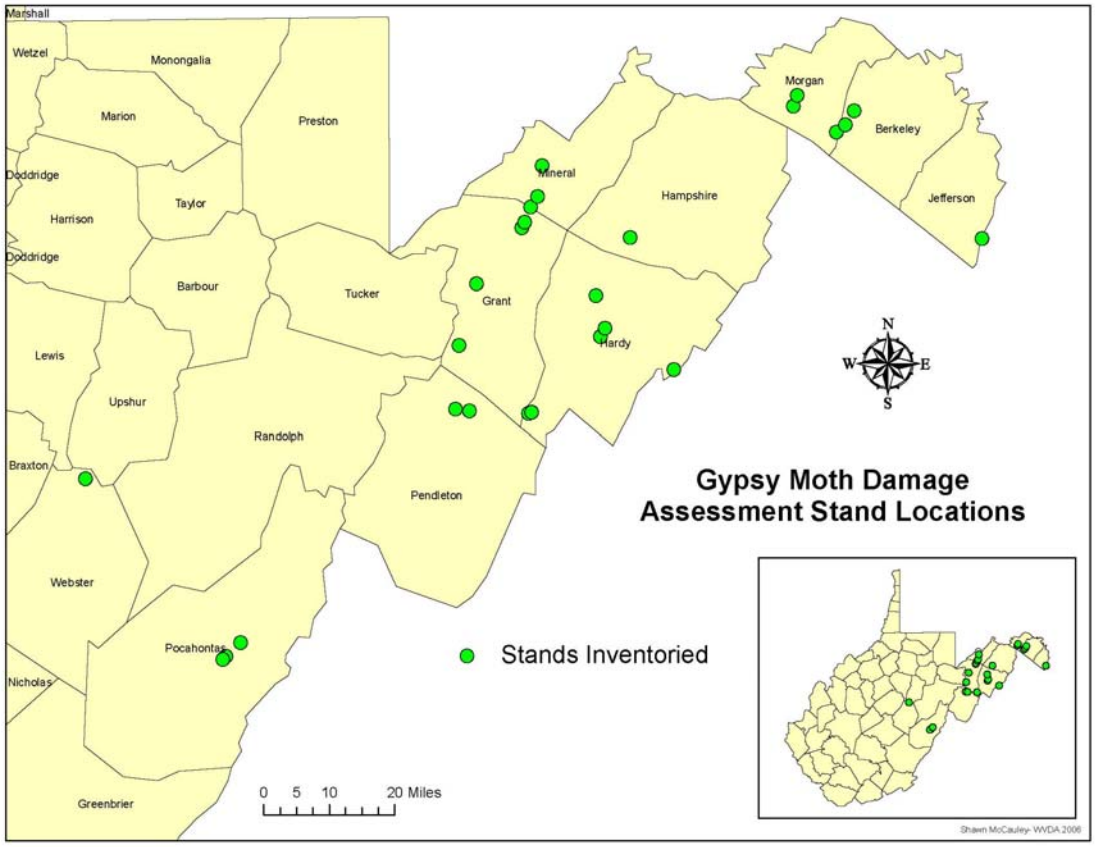
Marshall
Wetzel
Monongalia
Marion
Preston
Doddridge
Taylor
Harrison
Barbour
Tucker
Lewis
Upshur
Randolph
Braxton
Webster
Pocahontas
Nicholas
Greenbrier
Pendleton
Grant
Hardy
Mineral
Hampshire
Morgan
Berkeley
Jefferson
N
W
E
S
Gypsy Moth Damage
Assessment Stand Locations
Stands Inventoried
0 5 10 20 Miles
Shawn McCauley- WVDA 2006

Table 1. Acreage receiving gypsy moth treatment in West Virginia from 1983 to 2005.

Year	CSCL*	Transition Zone	AIPM**	STS***	Regulatory	Federal	TOTAL
1983	16,735						16,735
1984	46,992						46,992
1985	54,020						54,020
1986	83,410						83,410
1987	85,000						85,000
1988	33,541	105,583					139,124
1989	51,039		23,727			930	75,696
1990	78,820	107,931	177,704				364,455
1991	28,154		68,119				96,273
1992	29,924		47,663				77,587
1993	61,505			238	120	10,155	72,018
1994	103,034			16,259	211		119,504
1995	51,397			9,487		15,171	76,055
1996	67,847			17,951			85,798
1997	11,201			6,310			17,511
1998	0			5,645			5,645
1999	0			4,215			4,215
2000	7,417			18,899			26,316
2001	136,900			36,600		15,208	188,708
2002	74,244				340		74,584
2003	4,270			114,225		4,283	122,778
2004	0			14,400			14,400
2005	0			13,650			13,650

* Cooperative State-County Landowner Area (CSCL)
** Appalachian Integrated Pest Management Project (AIPM)
*** Slow the Spread Program (STS)