United States Department of Agriculture

Forest Service

Southern Forest Experiment Station

Research Note

SO-361
May 1990

Status and Trends in Gypsy Moth Defoliation Hazard in Tennessee

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SUMMARY

The gypsy moth, *Lymantria dispar* (L.), a major defoliator of eastern hardwood forests, has become established in Virginia and is moving towards Tennessee. In preparation for its inevitable arrival, Tennessee's timberlands are hazard rated to identify those areas most susceptible to gypsy moth defoliation. Tree, stand, and site characteristics associated with gypsy moth defoliation are used to identify USDA Forest Service, Southern Forest Inventory and Analysis, survey plots with a high hazard to gypsy moth defoliation. One-quarter of the State's timberland, containing 30 percent of the State's hardwood inventory, is classified as high hazard. These high-hazard acres are unevenly distributed across the State and can change over time. Hazard rating provides useful information in planning gypsy moth detection, monitoring, and prevention activities.

Keywords: Survey plot, susceptibility, timberland.

INTRODUCTION

The gypsy moth, *Lymantria dispar* (L.), is a major pest of eastern hardwood forests. Defoliation by this moth causes tree mortality, tree growth reductions, and species composition changes that affect the timber, wildlife, recreation, and aesthetic values of forests. Since its introduction into this country in 1869, the gypsy moth has been spreading southward from the northeast. Currently, the gypsy moth is infesting the northern and eastern portions of Virginia. This continuing spread is threatening the vast oak-hickory and Appalachian hardwood forests of the Central and Southern States.

Tennessee's hardwood forests are directly in the path of this oncoming threat. Male gypsy moths have been trapped in the State, and isolated gypsy moth infestations have been found in neighboring portions of North Carolina and Virginia. In light of these facts, it would be prudent to identify those areas of Tennessee's forests not susceptible to gypsy moth defoliation. This can be accomplished by hazard rating.

Hazard rating attempts to identify those combinations of tree, stand, and site conditions that favor the gypsy moth and discourage its natural enemies (Hicks and others 1987, Mason 1987). Hazard rating models have been developed for forests in the northeast that have been repeatedly defoliated and those that have not yet been defoliated (Gansner and others 1987, Herrick and Gansner 1986, Houston and Valentine 1985, Mason 1987). Although these models cannot be directly applied to Tennessee's forests, they were used to identify general tree, stand, and site conditions associated with gypsy moth defoliation.

METHODS

Gypsy moth defoliation is usually associated with stands consisting of larger trees, containing a large component of preferred host trees, and growing on poorer sites such as ridgetops. Trees growing under these conditions provide an abundance of food and protective niches that favor the survival and development of the gypsy moth. Conversely, the lack of understory vegetation and low litter accumulation commonly associated with these conditions discourage the gypsy moth's natural enemies. These general conditions formed the basis for hazard rating Tennessee's forests to gypsy moth defoliation because a specific hazard rating model was not available.

Specific screening criteria were developed to identify those USDA Forest Service, Southern Forest Inven-

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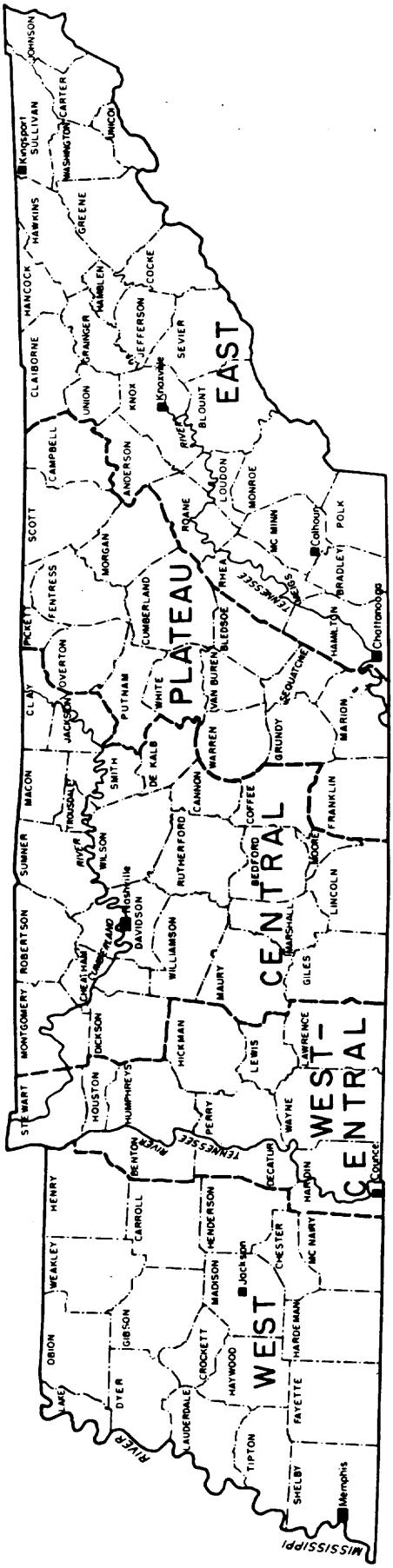

Figure 1.— *The Southern Forest Inventory and Analysis survey units of Tennessee, with their respective counties.*

tory and Analysis (SOFIA), survey plots having a high hazard to gypsy moth defoliation. Only plots meeting the following criteria were considered to be of high hazard:

1. Those with the plurality of stocking in oak trees, one of the most preferred food trees of the gypsy moth (Gansner and Herrick 1985, Mosher 1915).
2. Those on poor sites with an annual growth potential of less than 85 cubic feet per acre.
3. Those on upland or pine sites.
4. Those with stands of pole or sawtimber size.

High-hazard plots were further screened to account for the dispersal mechanisms of the gypsy moth. The female gypsy moth is flightless. This, together with suppression and eradication efforts, has slowed the spread of the gypsy moth. However, gypsy moths have unknowingly been spread long distances by vehicles and cargoes moving from infested to noninfested areas of the country. This hitchhiker dispersal mechanism increases the hazard of forests located near roads.

The main means of natural dispersal is when young larvae, after climbing onto vegetation and spinning down on silken threads, are blown by the wind to new areas. Mason and McManus (1981) have shown that in nonmountainous terrain, 99 percent of wind-dispersed larvae travel no further than 1 kilometer of where they hatched. Therefore, to account for the gypsy moth's two main means of dispersal, high-hazard plots were further screened to identify those within 3,300 feet of a road.

Tennessee's forests were hazard rated to gypsy moth defoliation for two points in time using 1980 and 1989 SOFIA data. In using SOFIA plot data in hazard rating, it must be emphasized that the plots are part of a low-intensity sample designed to provide State-level estimates of forest resource conditions. The plots are spaced across the State on a 3- by 3-mile grid, and each forested plot represents approximately 5,760 acres of timberland. These plots cannot be used to identify individual high-hazard stands, but can be used to assess the relative hazard of large areas of timberland, such as whole counties, SOFIA survey units, or States (fig.1).

RESULTS

Today, over 90 percent of Tennessee's timberland supports hardwood or mixed (hardwood/softwood) forests, and hardwood tree species comprise over 80 percent of its inventory volume. Clearly, the State has a lot at stake should the gypsy moth become established. Based on 1989 SOFIA survey data, one-quarter of the State's timberland is classified as having a high

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Table 1.—*Area of timberland and volume of hardwood classified as susceptible to gypsy moth,* Lymantria dispar *(L.), defoliation, Tennessee, 1989*

SOFIA* survey unit	County	Total timberland	Susceptible timberland			Growing-stock volume		Board-foot volume	
			1980	1989	Within 3,300 feet of a road	Total hardwood	Susceptible hardwood	Total hardwood	Susceptible hardwood
		Thousand acres				*Million cubic feet*		*Million board feet*	
West	Carroll	169.1	48.9	46.6	46.6	233.7	57.7	721.8	144.5
	Chester	99.4	24.4	14.9	14.9	73.4	16.4	180.3	28.6
	Crockett	15.1	17.6	7.6	7.6	33.0	23.5	165.2	126.9
	Dyer	40.4	0.0	10.1	10.1	51.5	16.1	225.9	71.2
	Fayette	152.0	19.3	21.7	21.7	180.9	27.5	593.2	110.9
	Gibson	36.4	15.2	0.0	0.0	47.0	0.0	155.9	0.0
	Hardeman	247.1	61.9	74.1	68.0	239.1	91.9	748.5	288.2
	Haywood	71.2	0.0	0.0	0.0	122.5	0.0	488.5	0.0
	Henderson	158.4	19.0	11.3	11.3	175.0	19.0	541.5	63.4
	Henry	176.1	45.0	45.6	45.6	228.2	79.1	826.6	256.1
	Lake	18.0	0.0	0.0	0.0	33.2	0.0	146.5	0.0
	Lauderdale	88.8	0.0	0.0	0.0	114.2	0.0	518.1	0.0
	Madison	140.7	48.9	36.7	36.7	201.1	59.2	709.4	184.7
	McNairy	224.4	45.8	57.5	57.5	154.7	59.0	377.8	140.6
	Obion	67.6	0.0	0.0	0.0	128.5	0.0	545.9	0.0
	Shelby	111.6	0.0	0.0	0.0	187.4	0.0	671.0	0.0
	Tipton	50.9	16.7	0.0	0.0	76.6	0.0	280.7	0.0
	Weakley	95.9	0.0	7.4	7.4	118.9	4.7	448.3	18.5
	Unit total	1,963.1	362.7	333.5	327.4	2,398.9	454.1	8,345.1	1,433.6
West-central	Benton	172.7	68.8	76.8	70.4	161.4	85.0	431.1	239.4
	Decatur	134.8	40.3	43.1	43.1	181.8	63.0	571.9	220.4
	Hardin	219.9	25.8	43.0	38.2	192.4	36.1	520.6	40.6
	Hickman	297.2	124.2	151.4	145.8	332.0	180.6	867.3	497.8
	Houston	94.2	31.6	29.0	29.0	113.4	46.6	357.6	148.9
	Humphreys	241.2	105.3	108.6	108.6	268.8	133.7	770.9	351.7
	Lawrence	199.8	62.7	75.8	75.8	173.3	90.5	480.9	239.9
	Lewis	158.0	75.3	70.2	70.2	163.2	101.5	425.6	251.2
	Perry	223.6	106.0	126.1	108.9	240.5	157.2	615.3	417.4
	Stewart	219.7	106.2	100.4	69.0	230.1	132.2	748.5	487.1
	Wayne	372.6	149.5	138.9	139.0	311.0	154.6	759.7	388.2
	Unit total	2,333.7	895.7	963.3	898.0	2,367.9	1,181.0	6,549.4	3,282.6
Central	Bedford	74.6	0.0	0.0	0.0	46.4	0.0	136.6	0.0
	Cannon	88.5	6.0	10.4	10.4	83.1	13.5	234.4	48.7
	Cheatham	118.2	47.1	47.3	47.3	140.5	71.0	426.1	207.9
	Clay	105.1	37.3	16.2	16.2	85.2	16.1	204.2	46.6
	Coffee	114.2	22.4	25.9	25.9	154.3	27.5	486.6	67.1
	Davidson	108.1	20.1	25.4	19.1	110.0	31.6	374.5	112.2
	De Kalb	114.2	8.1	11.4	11.4	153.2	16.6	501.6	52.8
	Dickson	174.3	79.8	72.1	72.1	215.6	102.1	738.3	375.8
	Giles	171.8	12.7	19.6	19.6	146.3	29.8	334.1	82.7
	Jackson	135.9	5.1	5.2	5.2	156.4	9.1	564.1	30.4
	Lincoln	136.7	5.0	5.9	5.9	104.4	7.0	271.4	16.3
	Macon	77.0	0.0	0.0	0.0	104.9	0.0	378.0	0.0
	Marshall	89.6	4.2	5.0	5.0	45.7	3.2	146.8	2.8
	Maury	133.0	16.5	13.3	13.3	107.8	23.2	241.8	63.9
	Montgomery	136.9	28.2	24.9	24.9	134.6	34.0	385.6	97.4
	Moore	36.6	8.0	10.5	10.5	52.6	26.0	185.5	104.4
	Robertson	53.0	6.4	0.0	0.0	65.9	0.0	260.7	0.0
	Rutherford	155.7	6.5	0.0	0.0	40.6	0.0	89.0	0.0
	Smith	81.0	6.9	6.8	6.8	74.9	8.5	201.4	17.4
	Sumner	88.2	0.0	0.0	0.0	75.8	0.0	271.1	0.0
	Trousdale	30.0	0.0	0.0	0.0	20.6	0.0	49.3	0.0
	Williamson	142.0	13.5	15.8	15.8	149.1	23.9	521.9	90.0
	Wilson	97.0	15.2	10.2	10.2	36.7	11.4	76.9	32.9
	Unit total	2,461.6	349.0	325.9	319.6	2,304.6	454.5	7,079.9	1,449.3

Table 1.—*Area of timberland and volume of hardwood classified as susceptible to gypsy moth,* Lymantria dispar *(L.), defoliation, Tennessee, 1989—Continued*

SOFIA* survey unit	County	Total timberland	Susceptible timberland			Growing-stock volume		Board-foot volume	
			1980	1989	Within 3,300 feet of a road	Total hardwood	Susceptible hardwood	Total hardwood	Susceptible hardwood
		Thousand acres				*Million cubic feet*		*Million board feet*	
Plateau	Bledsoe	186.3	88.3	93.1	87.3	117.6	97.3	277.2	238.2
	Campbell	250.2	36.1	52.4	52.4	297.6	68.9	1,143.6	254.2
	Cumberland	320.3	141.3	151.4	139.8	295.2	167.2	839.1	467.2
	Fentress	244.1	61.6	69.7	40.7	235.1	75.6	654.5	200.9
	Franklin	183.0	74.2	45.8	45.8	171.4	60.3	568.2	225.3
	Grundy	165.9	63.0	51.5	51.5	162.5	45.7	448.1	82.9
	Marion	251.7	100.4	125.9	89.9	224.3	124.3	695.5	376.5
	Morgan	276.2	75.4	101.5	84.5	279.2	103.5	972.5	353.6
	Overton	170.4	40.6	40.9	40.9	259.9	73.2	927.5	250.6
	Pickett	68.4	7.3	6.8	6.8	85.9	5.5	271.9	15.6
	Putnam	152.3	18.7	10.9	10.9	183.9	8.5	633.8	23.5
	Scott	300.3	105.8	98.3	71.0	383.1	142.9	1,168.6	412.7
	Sequatchie	137.3	33.4	40.0	40.0	80.3	28.3	211.7	61.9
	Van Buren	135.4	15.5	21.7	21.7	107.5	20.8	343.2	48.8
	Warren	93.6	11.8	10.4	10.4	111.6	7.9	370.5	10.0
	White	129.4	15.7	16.9	16.9	172.3	25.2	631.8	88.2
	Unit total	3,064.8	889.1	937.2	810.5	3,167.4	1,055.1	10,157.7	3,110.1
East	Anderson	124.0	31.1	32.6	26.1	159.8	58.0	628.6	256.2
	Blount	69.9	35.7	21.3	21.3	69.3	30.9	214.4	112.1
	Bradley	92.5	16.1	0.0	0.0	61.7	0.0	234.9	0.0
	Carter	155.5	70.3	62.6	62.6	235.6	88.4	794.9	288.0
	Claiborne	167.5	31.3	43.7	43.7	184.8	56.2	614.2	187.1
	Cocke	163.4	42.4	49.3	49.3	190.4	62.1	618.2	189.7
	Grainger	102.6	21.1	32.4	27.0	138.0	38.0	468.5	118.4
	Greene	171.8	31.2	41.1	22.8	205.2	62.2	727.4	205.3
	Hamblen	32.8	0.0	0.0	0.0	49.2	0.0	198.2	0.0
	Hamilton	210.7	77.3	65.8	65.8	156.8	77.4	526.9	300.1
	Hancock	92.9	7.2	5.8	5.8	61.6	3.4	202.2	6.1
	Hawkins	177.3	52.4	45.8	45.8	164.1	45.2	531.4	104.6
	Jefferson	62.2	6.5	17.0	17.0	82.7	44.6	317.0	185.4
	Johnson	144.4	51.8	53.8	40.3	162.9	60.0	489.1	149.1
	Knox	127.0	20.5	23.8	23.8	129.9	35.8	516.1	136.0
	Loudon	62.3	18.2	22.7	22.7	54.2	35.1	223.8	137.7
	McMinn	36.5	17.8	11.2	11.2	107.1	10.8	362.6	29.3
	Meigs	82.9	33.1	35.5	35.5	71.1	39.7	201.4	113.9
	Monroe	279.0	40.1	47.9	44.3	275.9	66.5	844.3	180.8
	Polk	214.1	46.6	40.1	40.1	128.2	37.9	426.5	121.6
	Rhea	126.4	37.8	33.0	33.0	136.0	48.2	401.5	122.4
	Roane	153.1	58.1	52.8	52.8	182.7	73.0	538.3	172.3
	Sevier	127.4	35.7	47.2	47.2	114.4	44.6	376.5	150.7
	Sullivan	123.6	31.9	37.8	37.8	126.8	47.3	366.6	135.5
	Unicoi	89.4	23.6	18.7	18.7	123.7	26.0	396.0	90.0
	Union	102.5	35.0	21.6	21.6	100.0	26.9	358.6	111.6
	Washington	50.3	25.9	22.5	18.3	76.1	34.5	288.0	126.3
	Unit total	3,442.0	898.7	886.0	834.5	3,548.2	1,152.7	11,866.1	3,730.2
	State total	13,265.2	3,395.2	3,445.9	3,190.0	13,787.0	4,297.4	43,998.2	13,005.8

*SOFIA=Southern Forest Inventory and Analysis.

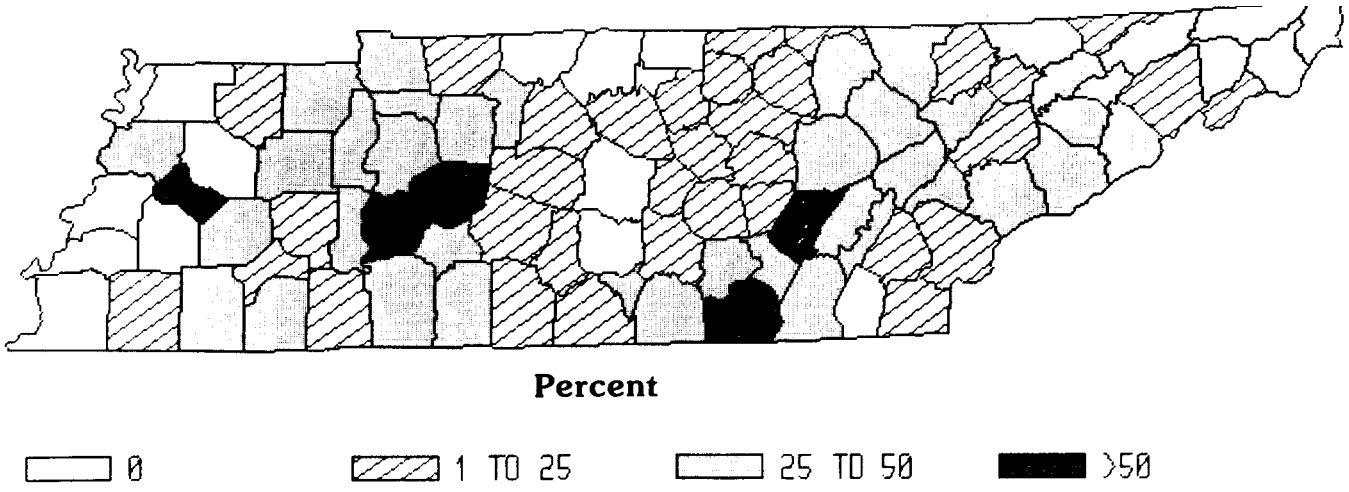

Figure 2.— *Percentage of timberland with high hazard to gypsy moth,* Lymantria dispar *(L.), defoliation, Tennessee, 1989.*

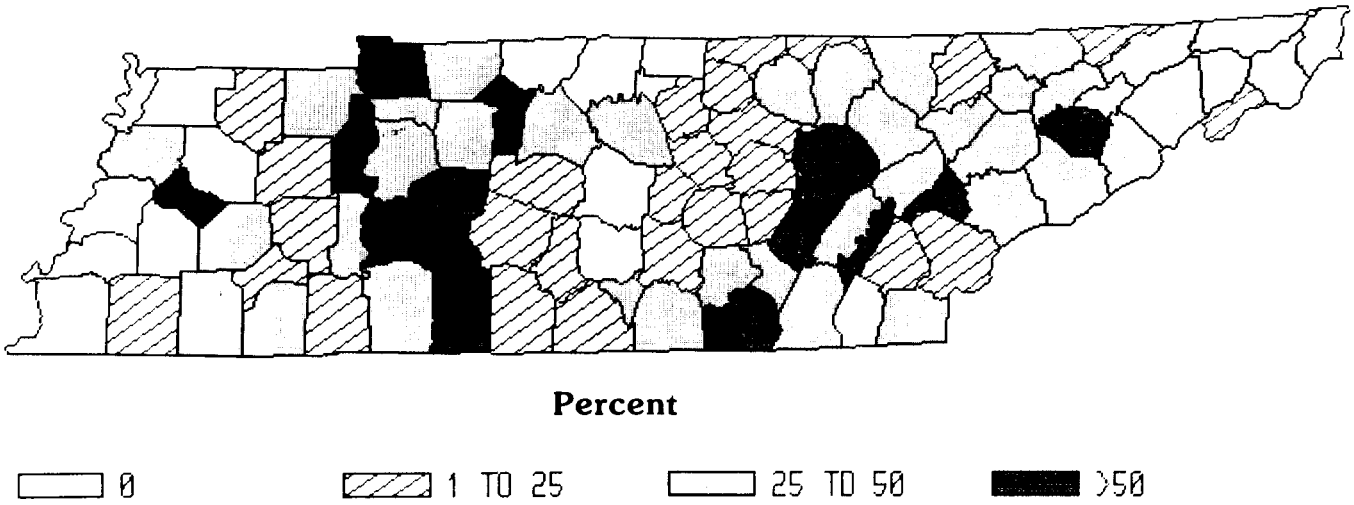

Figure 3.— *Percentage of hardwood growing-stock volume with high hazard to gypsy moth,* Lymantria dispar *(L), defoliation, Tennessee, 1989.*

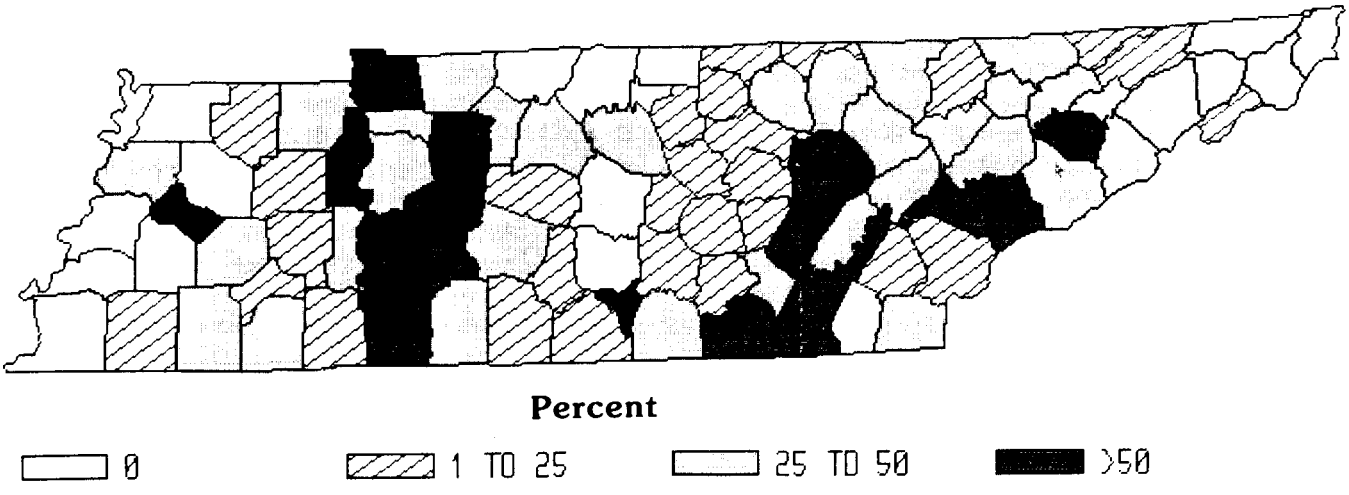

Figure 4.— *Percentage of hardwood board-foot volume with high hazard to gypsy moth,* Lymantria dispar *(L), defoliation, Tennessee, 1989.*

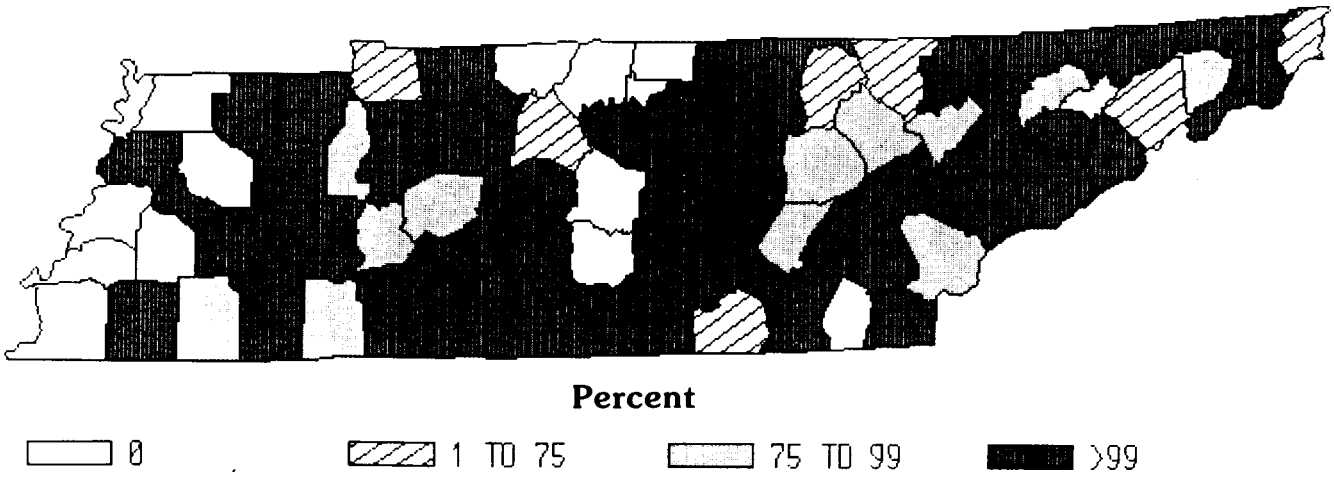

Figure 5.— *Percentage of area with high hazard to gypsy moth,* Lymantria dispar *(L), defoliation within 3,300 feet of a road, Tennessee, 1989.*

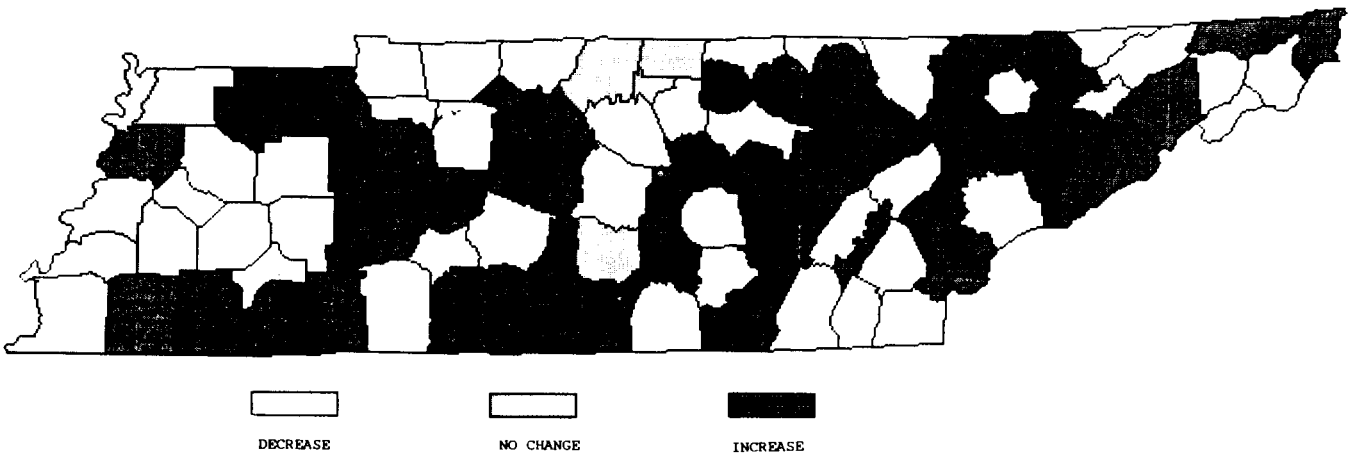

Figure 6.—*Change in area with high hazard to gypsy moth,* Lymantria dispar *(L), defoliation, Tennessee, 1980–89.*

hazard to gypsy moth defoliation (table 1). These acres are the most likely to be defoliated should the gypsy moth become established in the State. Thirty percent of the State's hardwood inventory volume is found on these high-hazard acres (table 1). Neither the high-hazard acres nor inventory volumes are evenly distributed across the State, but they are concentrated in SOFIA survey units and counties where forest conditions are similar to those associated with gypsy moth defoliation (figs. 2, 3, 4). This is especially true of the counties in the west-central SOFIA survey unit, where over 40 percent of the timberland and half of the hardwood inventory volume are classified as high hazard (table 1).

Over the entire State, 93 percent of the high-hazard acres fall within 3,300 feet of a road, making them even more susceptible to gypsy moth defoliation. These acres are concentrated in the more developed areas of the State and have their lowest proportions in the more remote sections of the west-central and plateau SOFIA survey units and mountain counties of the eastern SOFIA survey unit (fig. 5).

Since the 1980 survey, the number of high-hazard acres in the State has increased by less than 2 percent. However, the State total masks the fact that all of the increase was found in the west-central and plateau SOFIA survey units (table 1). Changes in gypsy moth hazard are more evident at the county level (fig. 6), where normal stand development and wood harvesting practices have combined to shift species composition and stand size structure, resulting in some dramatic shifts in gypsy moth defoliation hazard over time (table 1). Even though individual county hazards have changed since 1980, high-hazard acres in 1989 are still generally concentrated in the same areas as in 1980.

Although the number of high-hazard acres in the State has increased only slightly since 1980, hardwood inventory volumes on these acres have increased substantially, increasing by 16 percent for

growing-stock and 23 percent for sawtimber. These increases are in line with the general maturation of Tennessee's timberlands since 1980. Despite these increases, the proportion of susceptible inventory volume to total inventory volume in the State has remained essentially the same over time.

CONCLUSIONS

Hazard rating Tennessee's timberlands using SOFIA survey data provides a useful tool in preparing for the gypsy moth's inevitable arrival. Hazard rating provides an assessment of the quantity and extent of the forest resource susceptible to the gypsy moth. It also identifies areas of the State where gypsy moth detection and evaluation activities as well as possible gypsy moth preventative actions should be concentrated for maximum effectiveness and efficiency. Hazard rating with data from successive SOFIA surveys reveals that the gypsy moth hazard is dynamic and changes as forest conditions are influenced by natural and man-caused factors. The recognition that gypsy moth hazard can be influenced by both natural and man-caused factors provides a basis for developing forest practices aimed at preventing gypsy moth defoliation (Gottschalk 1987). As dynamic as it is, gypsy moth hazard rating needs to be periodically updated in order to insure the maximum effectiveness and efficiency of any gypsy moth planning efforts or management activities.

DEFINITIONS

Timberland.—Forest land that is producing, or capable of producing, crops of industrial wood and not withdrawn from timber utilization.

Hardwood growing-stock volume.—The cubic-foot volume of sound wood from a 1-foot stump to a minimum 4.0-inch top diameter, or point where the central stem breaks into limbs, on live trees of commercial species that are at least 5 inches in diameter at breast height, have one 12-foot log or two 8-foot logs, now or prospectively, and meet regional specifications for freedom from defect.

Hardwood sawtimber volume.—The board-foot volume (International 1/4-inch rule) of sound wood from a 1-foot stump to a minimum 9.0-inch top diameter, or point where the central stem breaks into limbs, on live trees of commercial species that are at least 11.0 inches in diameter at breast height, have one 12-foot log or two 8-foot logs, and meet regional specifications for freedom from defect.

LITERATURE CITED

Gansner, David A.; Herrick, Owen W. 1985. Host preference of gypsy moth on a new frontier of infestation. Res. Note NE-330. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 3 p.

Gansner, David A.; Herrick, Owen W.; Mason, Garland N.; Gottschalk, Kurt, W. 1987. Coping with the gypsy moth on new frontiers of infestation. Southern Journal of Applied Forestry. 11(4): 201–209.

Gottschalk, Kurt W. 1987. Prevention: the silvicultural alternative. In: Fosbroke, Sandra; Hicks, Ray R., Jr., eds. Proceedings of coping with the gypsy moth in the new frontier; 1987 August 4–6; Morgantown, WV. Morgantown, WV: West Virginia University Books: 92–104.

Herrick, Owen W.; Gansner, David A. 1986. Rating forest stands for gypsy moth defoliation. Res. Pap. NE-583. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.

Hicks, R.R., Jr.; Coster, J.E.; Mason, G.N. 1987. Forest insect hazard rating. Journal of Forestry. 85(10): 20–26.

Houston, David R.; Valentine, Harry T. 1985. Classifying forest susceptibility to gypsy moth defoliation. Agric. Handb. 542. Washington, DC: U.S. Department of Agriculture. 19 p.

Mason, C.J.; McManus, M.L. 1981. Larval dispersal of the gypsy moth. In: Doane, C.C.; McManus, M.L., eds. The gypsy moth: research toward integrated pest management. Agric. Tech. Bull. 1584. Washington, DC: U.S. Department of Agriculture. 161–202.

Mason, Garland N. 1987. Rating stand susceptibility to gypsy moth defoliation. In: Fosbroke, Sandra; Hicks, Ray R., Jr., eds. Proceedings of coping with the gypsy moth in the new frontier; 1987 August 4–6; Morgantown, WV. Morgantown, WV: West Virginia University Books. 65–72.

Mosher, F.H. 1915. Food plants of the gypsy moth in America. Agric. Bull. 250. Washington. DC: U.S. Department of Agriculture. 39 p.