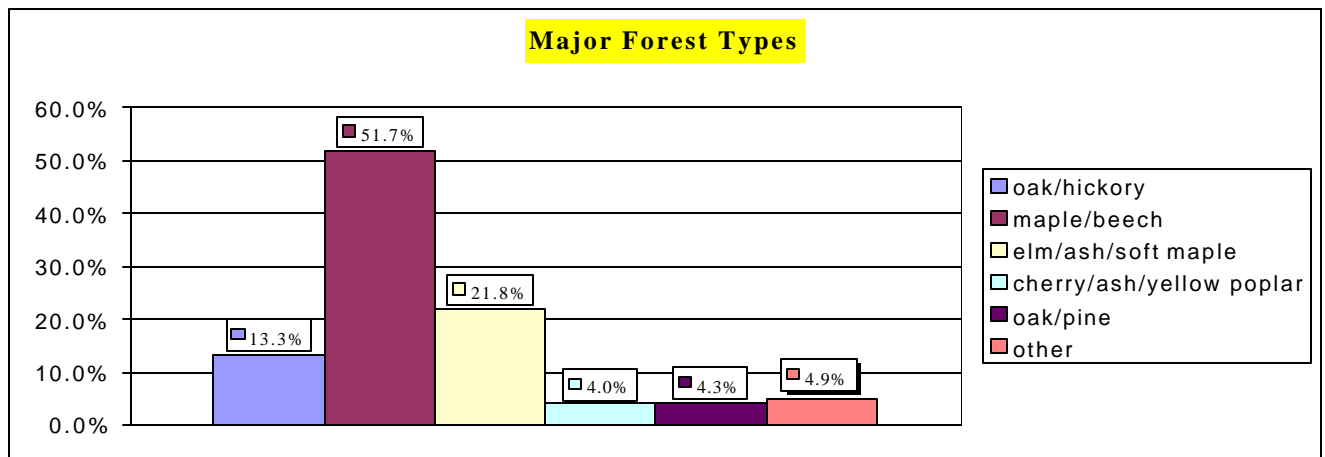


FOREST HEALTH HIGHLIGHTS – INDIANA - 1999

THE RESOURCES

Indiana ranks third nationally in hardwood lumber production adding over \$4 billion to the state's economy. Of the over 1000 business and manufacturers in the forest products industry, 59,000 people are employed with a total payroll over \$1 billion annually.

The forest products industry is the fifth largest manufacturing industry in the state. To support the industry, approximately 500 million board feet were harvested in the most recent year for which statistics are available. For the second quarter of 1997, lumber/wood product exports totaled \$57 million an increase of 22% from the first quarter. Indiana continues to grow approximately 40% more material (14% more in sawlog volume) than is utilized to produce sawtimber, veneer, handles, pulp and cooperage. However, from 1986 to 1997, this margin has narrowed from 2.5 to 1.0 as a result of increased global and domestic demands for Indiana hardwood products. Since 1907, forestland increased approximately 430,000 acres, and from 1967 to 1998, the volume of timber increased from 3,800 to 6,900 million cubic feet. Hardwoods account for 95% of the forest that is identified into 13 forest types. Good sites (ability to produce >85 ft³/yr) represent 63% of the forest, which is privately owned (85%).

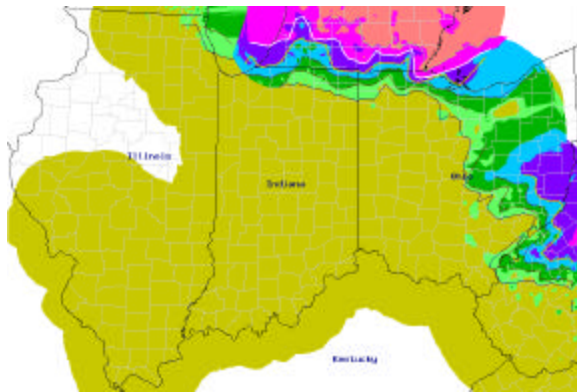


Indiana Forest Statistics	
Total acres	22,957,400
Forested acres	4,501,300
Percent forested - all land	20%
Percent timberland - all land	19%
Percent timberland - forest land	96%
Reserved acres 159,100 or 3.5% of forest land	

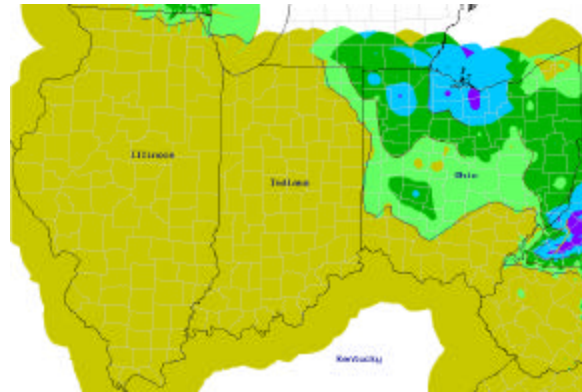
SPECIAL ISSUES

GYPSY MOTH 1/6TH OF 1998.

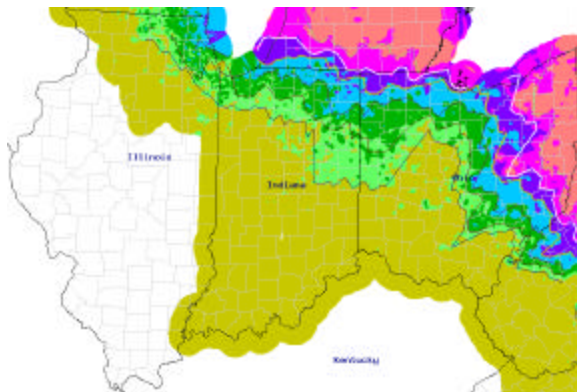
The question in 1997 was “Where did they come from?” The 1998 survey responded by saying “They came from a larval blow in.” Now the 1999 question is “Where did they go?” The 1999 **Cooperative Statewide Gypsy Moth (GM) Survey** detected 13,498 male moths, which is only 1/6th of the 81,995 moths caught in 1998, 1/5th of the 61,194 moths caught in 1997 and twice as many as 1996. The maps below show the progression/regression of GM from 1996 to 1999 (note: 1996 & 1997 maps based on average moth/trap/county. The 1998 & 1999 maps based on STS analysis from GPS referenced traps).



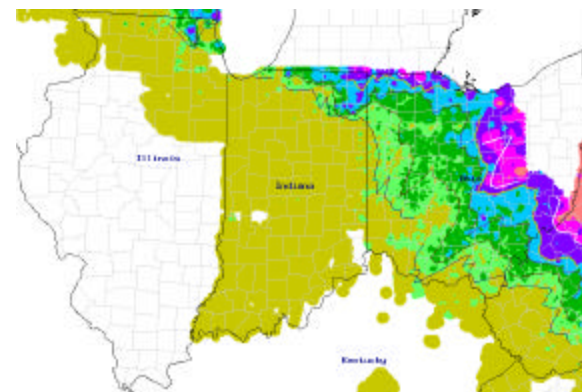
Map 1. The location of GM advance in 1996



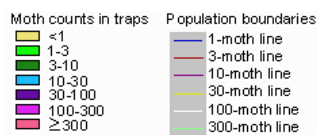
Map 2. The location of GM advance in 1997



Map 3. The location of GM advance in 1998



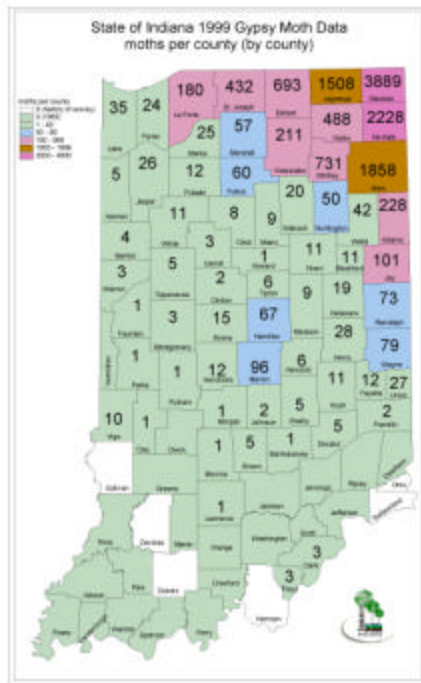
Map 4. The location of GM advance in 1999.



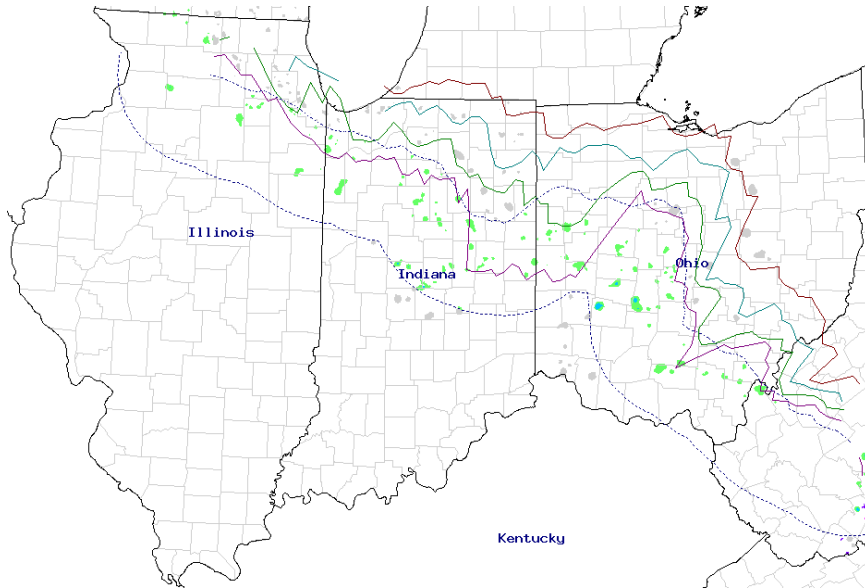
Year	1996	1997	1998	1999
Number of Male Moths Caught	5,798	61,994	81,995	13,498

The 1999 Cooperative Gypsy Moth Survey completed its twelfth year of the statewide survey, extended the use of new technologies with the first application of pheromone flakes and recorded four additional quarantine counties - Allen, Elkhart, LaGrange and Porter. Trap locations were geographically referenced for the second straight year using Global Positioning Satellite (GPS) units and submitted to the GM Slow-The-Spread (STS) web site (<http://www.gypsymoth.ento.vt.edu/STS/>). The 13,498 moths were detected in 65 counties with the count ranging from 1 to 3,889 moths per county. The maps below shows the moth catch for Indiana and the STS zone.

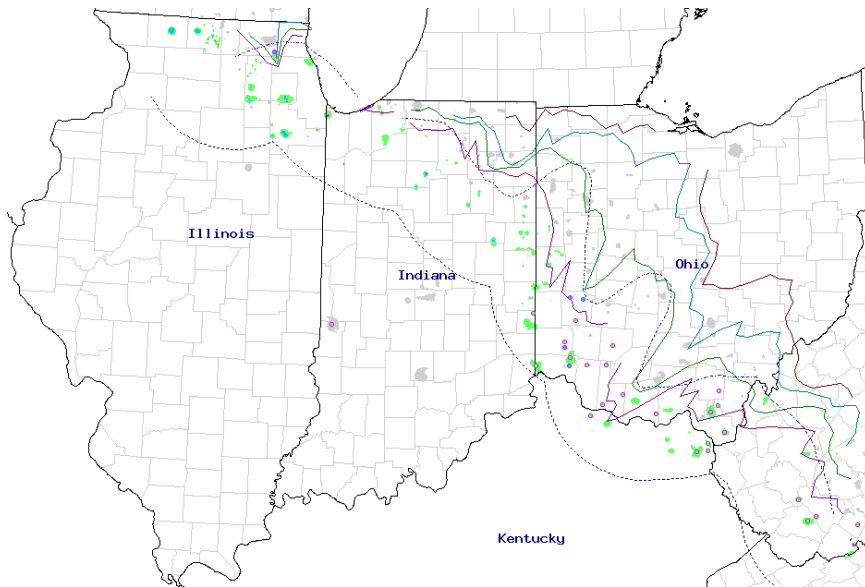
Spray treatments using B.t. (Foray 48B) were conducted on thirteen sites in May. A total of 3,735 acres were treated twice at seven-day intervals. Two sites totaling 3,934 acres in Porter County received one application of pheromone flakes for mating disruption at the end of June. Intensive trapping was conducted within the sites treated with B.t., while intensive trapping in the sites treated with pheromone flakes will be conducted during the 2000 survey.



STS moth lines and Action zone for 1999 from 1998 survey data.



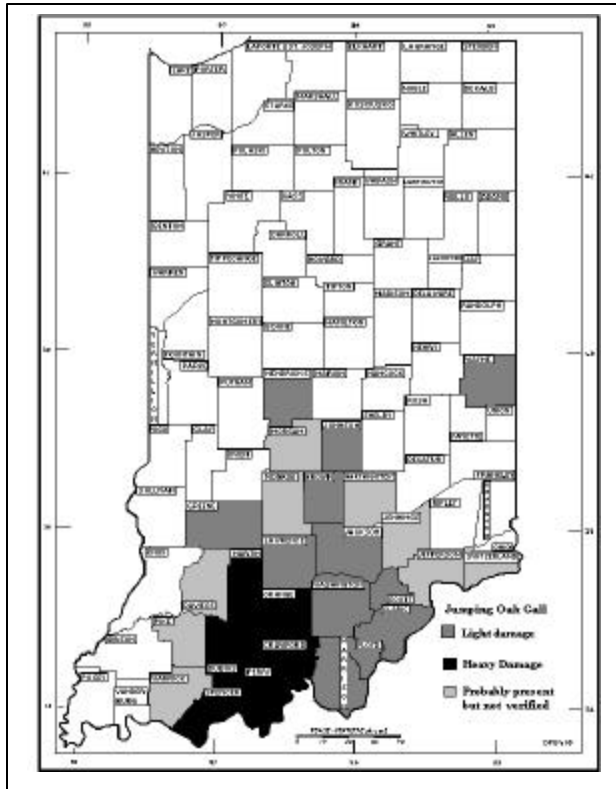
STS moth lines and Action zone for 2000 from 1999 survey data.



30 moth line = top line
10 moth line = 2nd line down from top
3 moth line = 3rd line down from top
1 moth line = 5th line down from top
Between dashed lines = Action zone

Jumping Oak Gall Turns White Oak Foliage Brown.

The white oak in the forest of south central Indiana turned brown in color earlier than normal. In late



May and early June, the galls formed on the underside of the foliage by one or more species of a Cynipid wasp (*Neuroterus spp.*) caused the leaves to yellow than turn brown. The damage started along the Ohio River and went north through Perry County extending to Martin and Lawrence counties and east to Washington County. Additional reports of the gall occurred in the middle part of the state – Johnson, Hendricks and Wayne counties. An aerial survey estimated that discoloration occurred to white oak on 1,000,000 acres of forestland (see map).

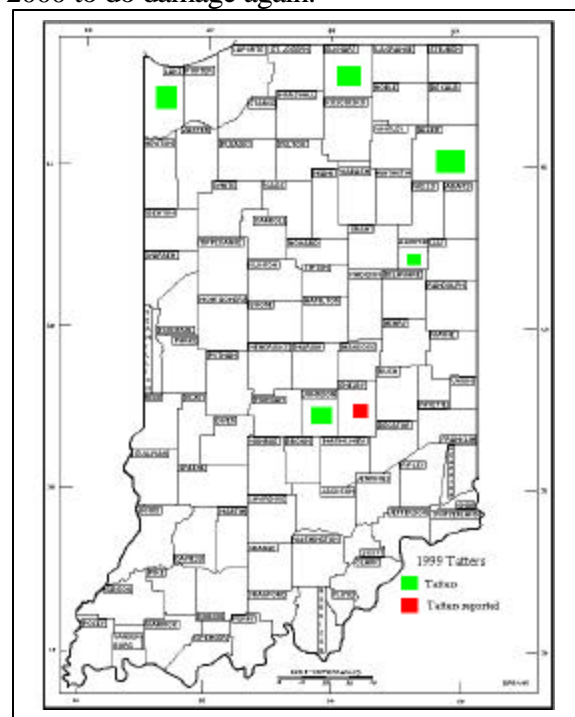
The wasp creates a round gall on the underside of the leaf which results in a small yellow spot that turns brown. With several hundred spots per leaf, eventually the leaf turns totally brown. This is equal to defoliation like the feeding of caterpillars on leaves. The leaf is not able to produce food for the tree and the tree is weakened. With the summer drought adding stress to the tree, the

question is what will happen to white oak in 2000. They are expected to survive in a weaker state than normal, and the jumping oak gall is expected to return in 2000 to do damage again.

Oak Tatters returns.

The tattered foliage of oak has been reported in Indiana since 1983. The tattered foliage of primarily white oak, and other oaks (burr, swamp white, red, black and shingle), was noticeable in 1999 in the northern part of the state as in prior years. Tatters was reported in scattered counties but was more widespread than the map indicates.

Tattered foliage loses the tissue between the leaf veins, which gives the leaf a “tattered appearance”. Heavily tattered trees appear defoliated or with sparse foliage. Commonly found on white oak, tatters occurs on other oaks and occasionally on other hardwoods. Although defoliation to the tree, damage such as mortality has not been widespread.

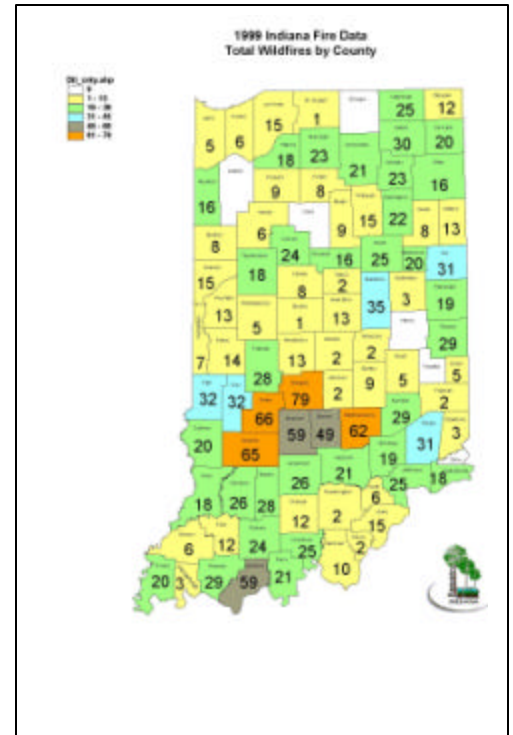


Tatters occurs to the first flush of foliage in the spring. To date, the cause of tatters has not been verified, however temperature injury, insect feeding or oviposition, and herbicide have been suggested as causes. Tatters is not limited to Indiana, damage has occurred from Ohio west to Iowa.

Drought conditions increase wildfires.

Not since 1988 has Indiana had drought conditions like the summer and fall of 1999. The drought increased the number of forest fires and resulted in a statewide burning ban in September and October. The Indiana Division of Forestry, Fire Section has been working with the State Emergency Management Agency (SEMA) to manage the forest fires that included several arson fires and two peat bog fires.

Fire Cause	Number of Fires	Acres Burned
Arson	33	73.35
Campfires	45	249.00
Children	15	909.60
Debris Burning	995	5214.32
Equipment	386	5385.17
Lightning	7	30.00
Miscellaneous	70	805.82
Railroads	18	263.65
Smoking	136	1439.41
Totals	1705	14370.32



Foliage Transparency

	% Normal - <30%	% moderate/severe - >30%
Hardwoods	97	
Softwoods	92	
Maple		0.9
Elm		2.0
Oak		2.5
Ash		6.5

For **foliage transparency**, which is used to indicate defoliation, the survey found 97% of the hardwoods and 92% of the softwoods had normal transparency (<30%). Only maple, oak, elm and ash had any trees with moderate to severe transparency (30-50% & >50%).

Dieback is the amount of current years twigs that have died in the outer tree crown. No dieback was found on 84% of the hardwoods and 96% of the softwoods. Light dieback (6-20%) was observed on 13.7% of the hardwoods. Moderate to severe dieback (21-50% & >50%) was recorded on 1.6% of the hardwoods. By genus/species, Oak, elm, maple, ash and yellow poplar had the most dieback recorded.

	Hardwoods (%)
No Dieback	84
Light Dieback (6-20%)	13.7
Moderate/Severe (21-50% & >50%)	1.6

Crown density is the amount of foliage, twigs, branches, and seeds in the crown. The survey found 98.7% of all trees had average to good density (21-50% & >50%). Only hardwoods - elm, yellow poplar and black walnut - recorded trees with poor density (<20%). By genus/species, ash, aspen, and beech had more trees with average density than a good density. Maples had the highest percent of trees with good density for the hardwoods.

Genus/species	Average (21-50%)	Good (>50%)	Genus/species	Average (21-50%)	Good (>50%)
Sweetgum	16.7	83.3	Elm	38.8	57.1
Maple	22.5	77.5	Oak	48.2	51.8
Yellow poplar	22.7	75.0	Beech	53.8	46.2
Walnut	25.0	68.8	Ash	57.6	42.4
Basswood	33.3	66.7	Aspen	62.5	37.5
Hickory	37.7	62.3	Other hwds	46.1	50.8

For hardwoods, 64% of the trees had **Live Crown Ratios** greater than 40%; whereas the softwoods had 87% of the trees greater than 40%. Examining individual genus/species, there may be concern with

ash, yellow poplar, black walnut and elm that had 40%, 58%, 57% and 66%, respectively, of the trees sampled with LCR >40%. This may indicate a problem in the “health” of this genus/species.

Live Crown Ration (Percent of Trees)

	LCR >40% (%)
Hardwoods	64
Softwoods	87
Ash	40
Yellow poplar	58
Black Walnut	57
Elm	66

Damage indicators are cankers, open woods, decay conks, broken bole, brooms, dead terminals, discolored foliage and more. Decay indicators represented 70% of the damages recorded. The survey found no damage on 70% of the hardwoods and 91% of the softwoods. By genus/species, of all trees sampled, maple, ash, oak, hickory, elm, yellow poplar and beech had damage recorded more than other species. Within a genus/species, beech, maple and ash had the highest percentage of trees with damage. In the hardwoods, 8% of the trees sample had more than one damage.

From the initial data, the “health” of ash, yellow poplar, elm and perhaps maple and oak in Indiana needs to be monitored for future change. The live crown ratio, crown density, crown transparency and crown dieback data for these genus/species indicate they may have a greater “health” concern than other genus/species