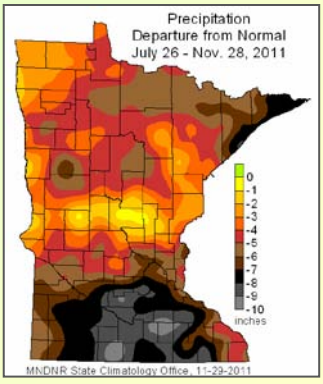
Minnesota Forest Health Annual Report

2011

DNR-Forestry
Forest Health Unit



THE FOREST RESOURCES OF MINNESOTA

In Minnesota there are approximately 16.3 million acres of forested land, of which 14.9 million acres are classified as "timberland" or lands capable of producing timber. An additional 960,000 acres are not included in productive timberland due to their inclusion in the Boundary Waters Canoe Area Wilderness or other reserved land category. Forest land ownership is 46% private, 27% state, 14% county, 12% National Forest and 1% other federal ownership. (Source of data is the Minnesota 2001 Eastwide Database provided by the USFS-NCFES.)

Two major industries depend on Minnesota's forested lands: forest industry and tourism. Fforest industry is Minnesota's second largest manufacturing industry, employing more than 55,000 people. The value of forest products manufactured in Minnesota exceeds $7 billion and accounts for 16% of all manufacturing dollars generated in Minnesota. The tourism industry is Minnesota's second largest employer employing over 140,000 people and accounting for a payroll in excess of $3 billion. Gross receipts from tourism exceed $6 billion. Over 70% of people who took at least one spring or summer trip in Minnesota rated "observing natural scenery" as the most important activity of their trip.

FOREST HEALTH STAFF - 2011

Olin Phillips
Section Manager
500 Lafayette Rd.
St. Paul, MN 55155
(651) 259-5282

Val Cervenka
Forest Health Unit Coord.
500 Lafayette Rd.
St. Paul, MN 55155
(651) 259-5296

Susan Burks
Invasive Terr. Plants Coord.
500 Lafayette Rd
St. Paul, MN 55155
651-259-5251

Jana Albers
NW Forest Health Specialist
1201 E. Hwy. # 2
Grand Rapids, MN 55744
(218) 327-4234

Mike Albers
NE Forest Health Specialist
1201 E. Hwy. # 2
Grand Rapids, MN 55744
(218) 327-4115

Neville Wilson
Seasonal Plant Health Specialist
1200 Warner Rd.
St. Paul, MN 55106

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AERIAL SURVEY RESULTS 2011

Since the early 1950's, aerial survey has been a valuable tool for monitoring the activities of forest insects and pathogens across the 16 million acres of forest land in Minnesota. For the past fourteen years, these surveys have been accomplished through the collaboration of DNR Forest Health and Resource Assessment Units and USFS, State and Private Forestry. The Forest Health staff plans the scope, timing and intensity of the surveys, trains Resource Assessment staff, provides ground-truthing, analysis and dissemination of survey data. Resource Assessment staff conducts the aerial sketch-mapping, digitizes the data and produces digital shape files. In addition to being used in Minnesota, the survey results are incorporated into the USFS's national database since our procedures and products comply with national standards.

Due to a three week State of Minnesota government shutdown, the state portion of the aerial survey was delayed this year. Normally the aerial survey would start by mid-June and finish by in late July. In 2011 the survey did not begin until June 26th and was not completed until Sept 5th. This made it more difficult to map some of the early season events such as defoliation by forest tent caterpillar and oak wilt mortality. As a result of this, comparing results of previous years' surveys with this year survey is more difficult. For example, the reduced acres of defoliation by forest tent caterpillar mapped in 2011 compared to 2010 does not necessarily mean we had less forest tent caterpillar this year.

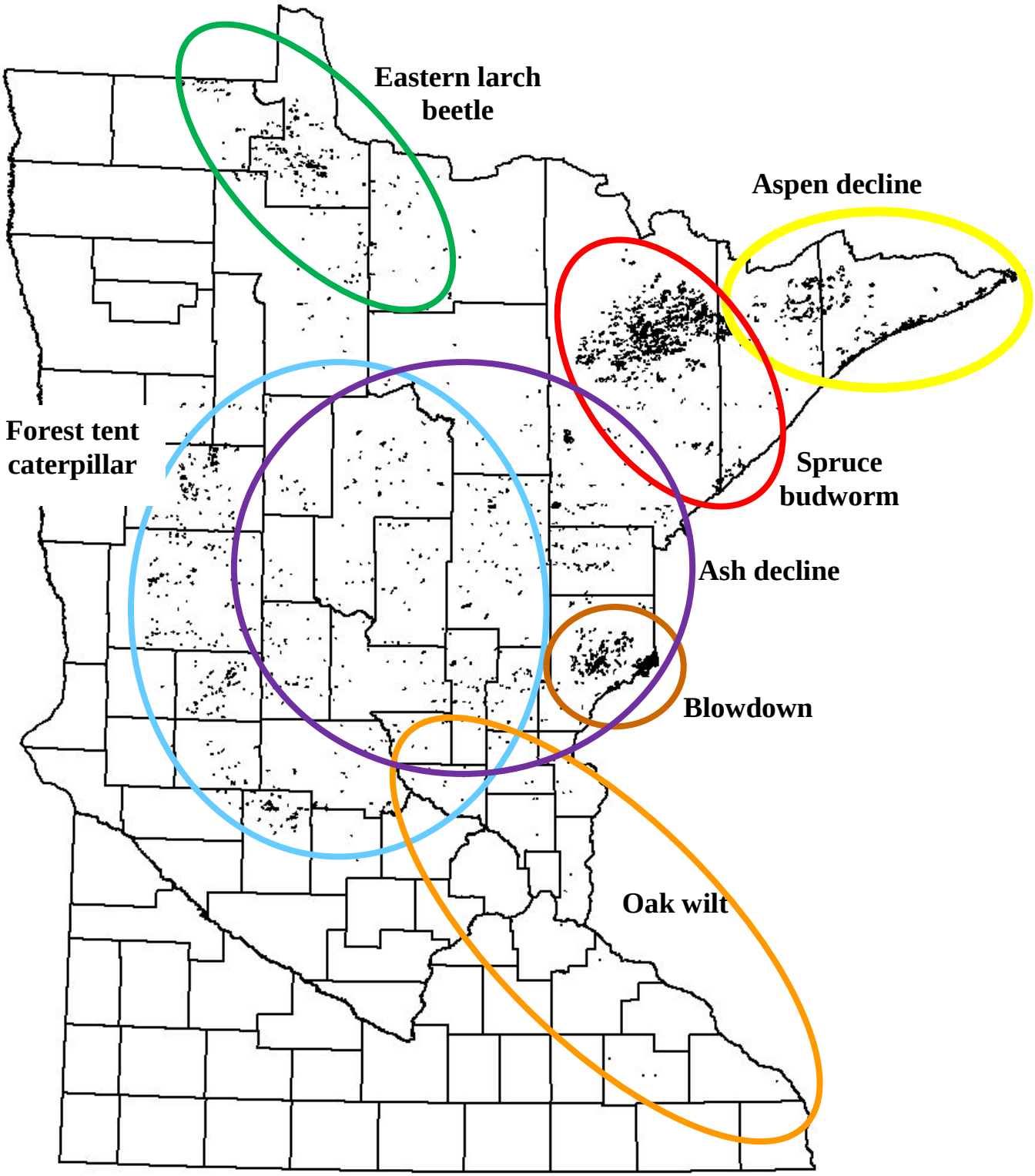
In addition to the lateness of the survey, we also dropped 5 quads from the survey in order to complete it as early as we did. The polygons dropped were: Fosston, Grygla, Hallock, Angle Inlet and Oak Island, all of which are in the north west portion of MN.

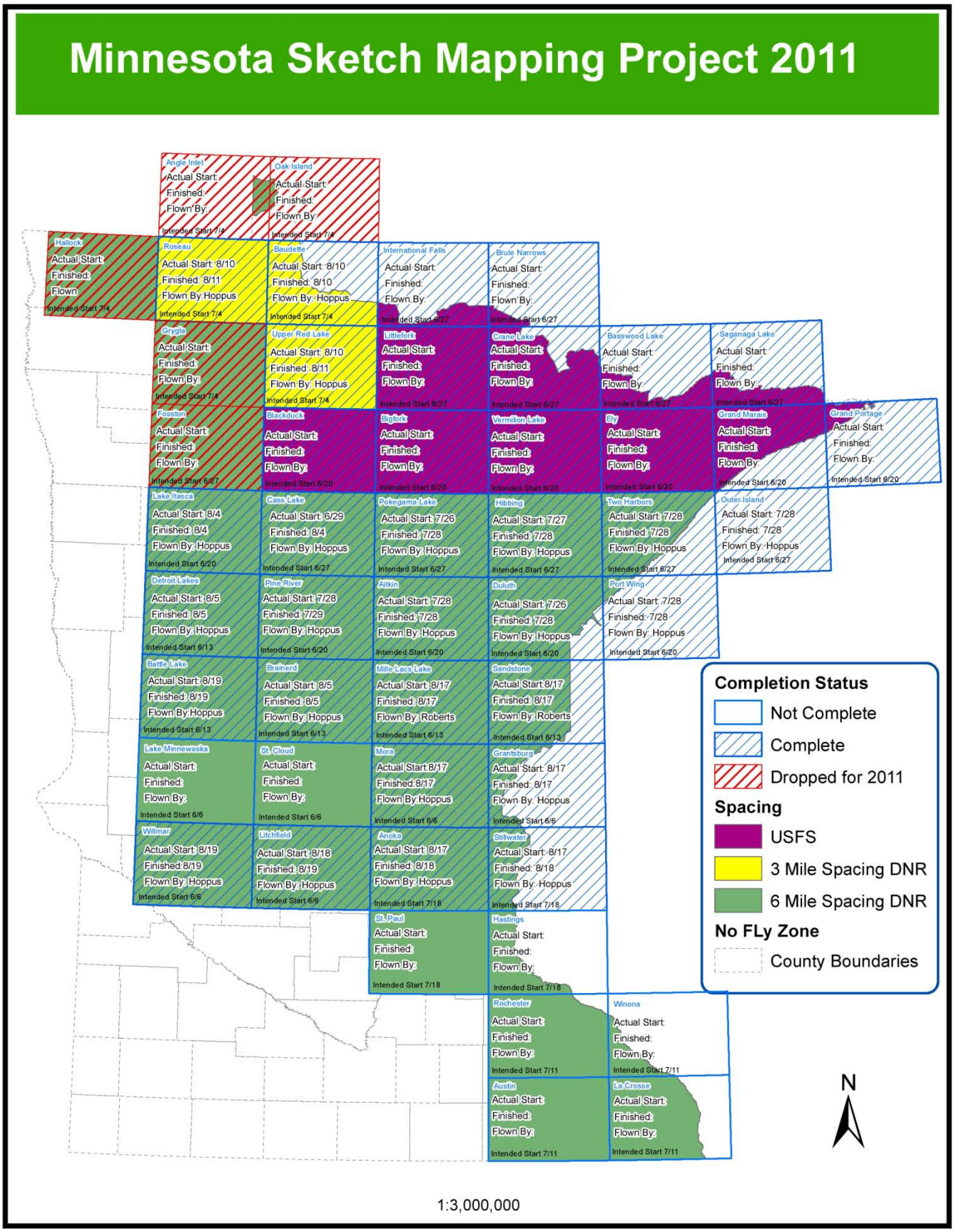
In an effort to help us complete the survey, Marc Roberts flew and mapped two additional polygons (Sandstone and Mille Lacs Lake) in the central part of the state. This also served as aerial sketch map training for a DNR employee, Gentry Carlson, who manages the shapefile and is being trained as an aerial survey sketchmapper.

Thanks to Mike Hoppus and Gentry Carlson, Resource Assessment's sketch-map team, who accomplished this year's aerial survey and data processing. Thanks also to Marc Roberts, USFS-S&PF, for mapping the federal lands and helping us out during the government shutdown. Thanks to Quinn Chavez, USFS-S&PF, for post-flight map rectification and the final review meeting.

Agent	Number of polygons	Number of acres
Ash decline	519	25,672
Aspen decline	164	57,702
Aspen leaf rollers	12	690
Bark beetles	122	580
Beaver	7	262
Dutch elm disease	646	481
Eastern larch beetle	1693	29,028
Fire	10	224
Flooding	42	463
Forest tent caterpillar	639	61,419
Hail damage	70	27,397
Hardwood decline	0	0
Jack pine budworm	0	0
Larch casebearer	72	11,404
Oak wilt	1785	1522
Snow/ ice damage	0	0
Spruce budworm	476	136,066
Two-lined chestnut borer	78	59
Wind damage/ tornado	71	25,397
Winter injury	0	0
Unknown	40	3,106
Totals	**6446**	**381,472**

Aerial survey polygons and locations of infestations




Minnesota Sketch Mapping Project 2011
Angle Inlet
Actual Start:
Finished:
Flown By:
Intended Start 7/4
Oak Island
Actual Start:
Finished:
Flown By:
Intended Start 7/4
Hallock
Actual Start:
Finished:
Flown
Intended Start 7/4
Roseau
Actual Start: 8/10
Finished: 8/11
Flown By: Hoppus
Intended Start 7/4
Baudette
Actual Start: 8/10
Finished: 8/10
Flown By: Hoppus
Intended Start 7/4
International Falls
Actual Start:
Finished:
Flown By:
Intended Start 6/27
Brule Narrows
Actual Start:
Finished:
Flown By:
Intended Start 6/27
Grygla
Actual Start:
Finished:
Flown By:
Intended Start 7/4
Upper Red Lake
Actual Start: 8/10
Finished: 8/11
Flown By: Hoppus
Intended Start 7/4
Littlefork
Actual Start:
Finished:
Flown By:
Intended Start 6/27
Crane Lake
Actual Start:
Finished:
Flown By:
Intended Start 6/27
Basswood Lake
Actual Start:
Finished:
Flown By:
Intended Start 6/27
Saganaga Lake
Actual Start:
Finished:
Flown By:
Intended Start 6/27
Fosston
Actual Start:
Finished:
Flown By:
Intended Start 6/27
Blackduck
Actual Start:
Finished:
Flown By:
Intended Start 5/20
Bigfork
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Finished:
Flown By:
Intended Start 6/20
Vermilion Lake
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Flown By:
Intended Start 6/20
Ely
Actual Start:
Finished:
Flown By:
Intended Start 6/20
Grand Marais
Actual Start:
Finished:
Flown By:
Intended Start 6/20
Grand Portage
Actual Start:
Finished:
Flown By:
Intended Start 6/20
Lake Itasca
Actual Start: 8/4
Finished: 8/4
Flown By: Hoppus
Intended Start 6/20
Cass Lake
Actual Start: 6/29
Finished: 8/4
Flown By: Hoppus
Intended Start 6/27
Pokegama Lake
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Flown By: Hoppus
Intended Start 6/27
Hibbing
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Two Harbors
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Intended Start 6/27
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Finished: 7/28
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Intended Start 6/27
Detroit Lakes
Actual Start: 8/5
Finished: 8/5
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Intended Start 6/13
Pine River
Actual Start: 7/28
Finished: 7/29
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Aitkin
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Intended Start 6/20
Duluth
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Intended Start 6/13
Brainerd
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Mille Lacs Lake
Actual Start: 8/17
Finished: 8/17
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Intended Start 6/13
Sandstone
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Lake Minnewaska
Actual Start:
Finished:
Flown By:
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St. Cloud
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Flown By:
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Mora
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Rochester
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Flown By:
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Flown By:
Intended Start 7/11
Austin
Actual Start:
Finished:
Flown By:
Intended Start 7/11
La Crosse
Actual Start:
Finished:
Flown By:
Intended Start 7/11
Completion Status
Not Complete
Complete
Dropped for 2011
Spacing
USFS
3 Mile Spacing DNR
6 Mile Spacing DNR
No FLy Zone
County Boundaries
N
1:3,000,000

2011 Cheatsheet for Coding Damage Polygons in ArcView

File Names: Store successive shapefile versions as skm06v01.xxx, skm06v02.xxx, etc. in S:\sketchmp\dmg_polys_06

Items coded: Arrange data fields in the following order and format:

Polygon ID: Name of 1:100,000 quad on which polygon is first delineated , plus 3-digit number: e.g. LakeItasca025. Numbering starts at 001 in every quadrangle. Once assigned, this ID will not change. Character field, width 25.

ID No: Only the numerical portion of Polygon ID above. Numeric field, width 3, no decimal.

Damage type code: Use severest type if more than one may apply. Flight map coding may indicate agent only; e.g. FTC = forest tent caterpillar = defoliation, or OW = oak wilt = mortality. Numeric field, width 2, no decimal.

Defoliation (D)	1	Branch breakage (Br)	6
Mortality (M)	2	Stembreak/uproot (St)	7
Discoloration (Dc)	3	Branch flagging (Bf)	8
Dieback (Db)	4	Other damage (0)	10
Topkill (Tk)	5	Old mortality (OM)	11

State severity code: Coding default is L unless otherwise specified. Character field, width 2.

Trace, 5%-25% affected	T	Moderate, 51%-75% affected	M
Light, 26%-50% affected	L	Heavy, > 75% affected	H

Federal severity code: Derived from state severity code. Numeric field, width 2, no decimal.

T, L	1	M, H	2

Pattern code: Coding default is 1 unless otherwise specified. Numeric field, width 2, no decimal.

Where host cover > 50% and damage is:		Where nonhost cover > 50% and damage is:	
Cg = Contiguous	1	C = Continuous	3
P = Patchy	2	Sc = Scattered	4

Agent code: Following are common; see Aerial Survey Handbook for anything else. Coding default = Unknown (90000) where agent is not specified. Numeric field, width 6, no decimal. Based on Aerial survey gis hdbk apx E Revised 11/2007

Bark beetles (BB)	11000	Dutch elm disease (DED)	24022
Larch beetle (LB)	11010	Fire (F)	30000
Large aspen tortrix (LAT)	12037	Porcupine damage	41006
Spruce budworm (SBW)	12038	Abiotic (A)	50000
Jack pine budworm (JPB)	12041	Flooding (~~F~~, Fl)	50004
Larch casebearer (LCB)	12047	Snow/ice	50011
Forest tent caterpillar (FTC)	12096	Wind damage (WD)	50013
Two-lined chestnut borer (TLC)	15005	Winter injury (WI)	50014
Decline(DC)	24008	Herbicide damage (HD)	70001
Oak wilt (OW)	24021	Unknown	90000

Agent Name: Common name of causal agent exactly as given in Handbook. Character field, width 40.

Host code: Following are common; see Handbook for others. Use Hardwoods, Softwoods (= conifers) or Both if more than one species is involved. Numeric field, width 4, no decimal.

Hardwoods (Hw)	001		Scotch pine	130
Softwoods (Sw)	002		White-cedar	241
Both	003		Birch	370
Unknown	999	(Don't use unless necessary.)	Ash	540
Balsam fir	012		Black ash	543
Tamarack	071		Aspen	746
White spruce	094		Balsam poplar	741
Black spruce	095	(In bogs.)	Oaks	800
Jack pine	105		Willow	920
Red pine	125		Basswood	950
White pine	129		Elm	970

Host name: Common name of host exactly as given in Handbook. Character field, width 40.

Acres: Calculate with Theme-Utilities > Calculate Area/Perimeter/Length in DNR Tools. Numeric field, width 16, 2 decimal places. Delete Area, Perfeet and Perimeter fields, retain Acres only.

Numeric coding examples: damage type, state severity, federal severity, pattern, agent code, host code

1. SBWL plt. = light spruce budworm in a plantation. Code: 1, L, 1, 1, 12038, 094
2. CMF = Conifer mortality, flooding. Code: 2, L, 1, 1, 50004, 002
3. FTCL-P = Forest tent caterpillar, light, patchy. Code: 1, L, 1, 2, 12096, 746 (Assume FTC implies aspen host unless otherwise specified.)
4. ADbM = Aspen dieback, moderate. Code: 4, M, 2, 1, 90000, 746
5. FTCLHw-Sc = Forest tent caterpillar, light, scattered in hardwoods (i.e. other hosts besides aspen.) Code: 1, L, 1, 4, 12096, 001
6. HWMT = Hardwood mortality, trace, unknown agent. Code: 2, T, 1, 1, 90000, 001
7. JPBWH = Jack pine budworm, heavy. A defoliator. Code: 1, H, 2, 1, 12041, 105
8. LCBM = Larch casebearer, moderate. A defoliator. Larch = tamarack. Code: 1,M, 2, 1, 12047, 071
9. SBWL-C = Spruce budworm, light, continuous through nonhost stands. Defoliator; default host is balsam fir. Code: 1, L, 1, 3, 12038, 012
10. TML = Tamarack mortality, light, unknown agent. Code: 2, L, l, 1, 90000, 071
11. WD-Hw = Windthrow (wind damage) of hardwoods. Code: 7, L, 1, 1, 50013, 001

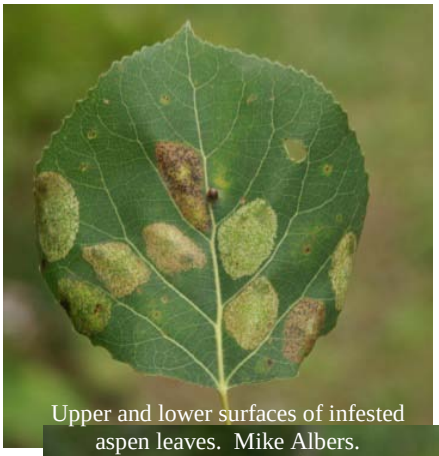
Larch beetle infestation. Mike Hoppus, DNR-Resource Assessment.

INSECTS

Aspen blotch miner

Phyllonorycter apparella

Hosts	Aspen
Setting	Forests
Counties	Cook, Lake, St. Louis and other northern counties
Survey methods	Ground
Acres affected	Not determined
Narrative	



Upper and lower surfaces of infested aspen leaves. Mike Albers.

Heavy populations of aspen blotch miner developed in many locations in the northern part of the state, especially along the North Shore. Aspen blotch miner damage looked like light yellow blotches on aspen leaves in August but they quickly turned brown as the weather became drier. The tiny moths flew in August and overwintered in sheltered locations such as under loose bark scales of jack pine trees.

Bark beetles

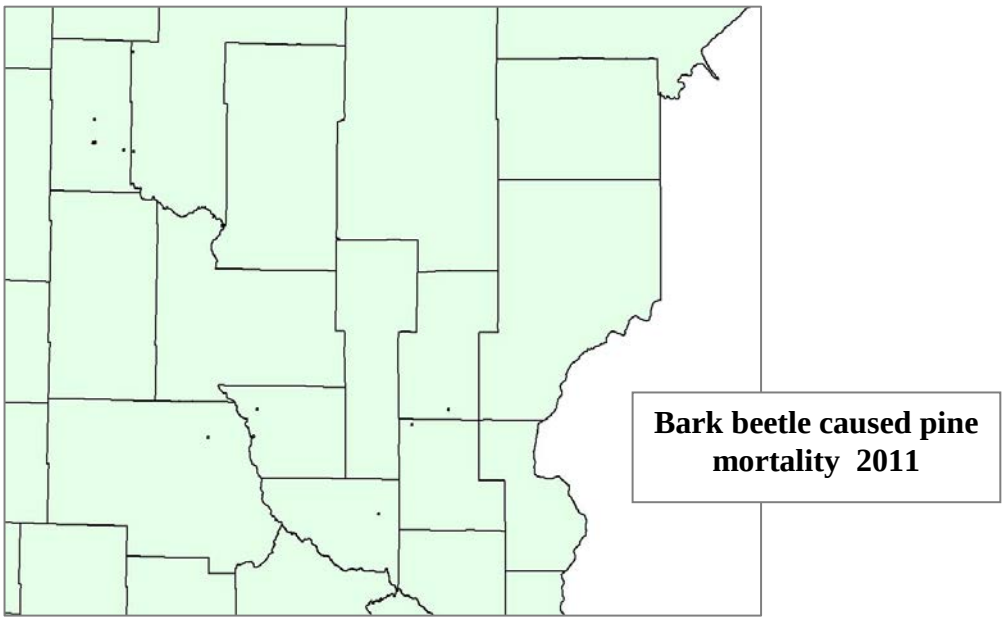
Ips spp. and *Dendroctonus* spp.

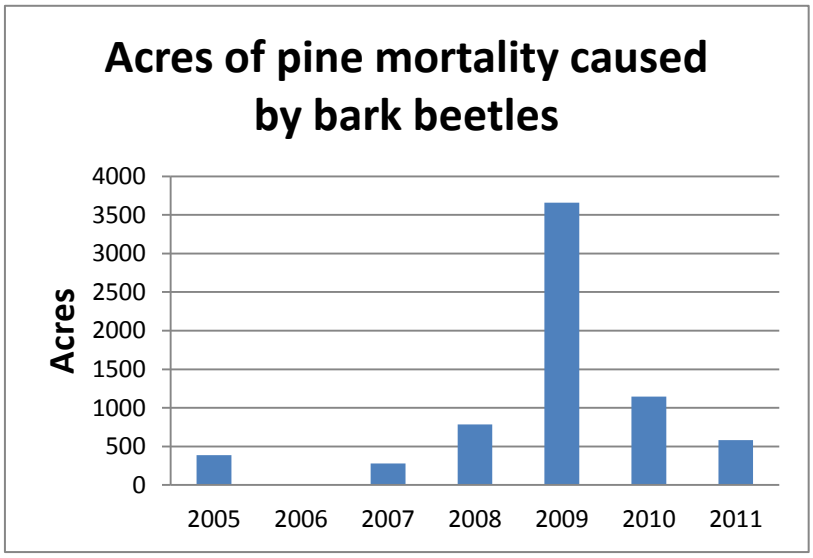
Hosts	Red and jack pines
Setting	Rural and urban forests
Counties	See map below
Survey methods	Aerial and ground
Acres affected	580 ac
Narrative	

This summer 580 acres of bark beetle caused mortality were detected during the aerial survey. See table and map. This was less than half of the acreage found last year and 1/7th of the acreage found in 2009. See table for other comparisons. This decrease can be attributed to the abundant rainfall during the spring and summer n most of the state for the past two springs and early summers.

Comparison of bark beetle polygons between 2009 and 2011.

	2009	***2010***	***2011***
Number of polygons	218	175	122
Total acres	3,657	1,146	580
Average acres per polygon	21.7	6.5	4.8
Maximum size of polygons detected	953	70	32





Birch leaf miner

Fenusa pusilla

Hosts	Paper birch
Setting	Forests and shade trees
Counties	Cook, Lake and St. Louis
Survey methods	Ground
Acres affected	Not determined

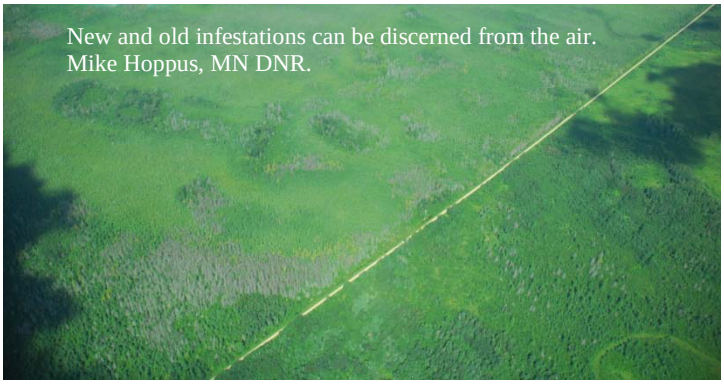
Narrative

Heavy populations of birch leaf miner turned leaves of paper birch tan along the north shore of Lake Superior by late July. Outbreaks of birch leaf miner sometimes occur in the forest like this year along the North Shore, but they tend to be most damaging, in the form of stress, to open growing trees in yards in urban areas.

There are a couple of different birch leaf miner sawflies in North America. All of them are naturalized exotics. Adult birch leaf miners are black, about 3 mm long and look like a small fly or wasp. With high populations the larvae may mine out much of the infested leaves. As summer progresses, the mined areas turn tan or brown. Then mature the larvae drop out of the leaf onto the ground. Depending on the miner species and the length of the growing season, there can be from one to four generations per year. Larvae from the final generation of miners overwinter in the soil.

Eastern larch beetle

Dendroctonus simplex


New and old infestations can be discerned from the air.
Mike Hoppus, MN DNR.

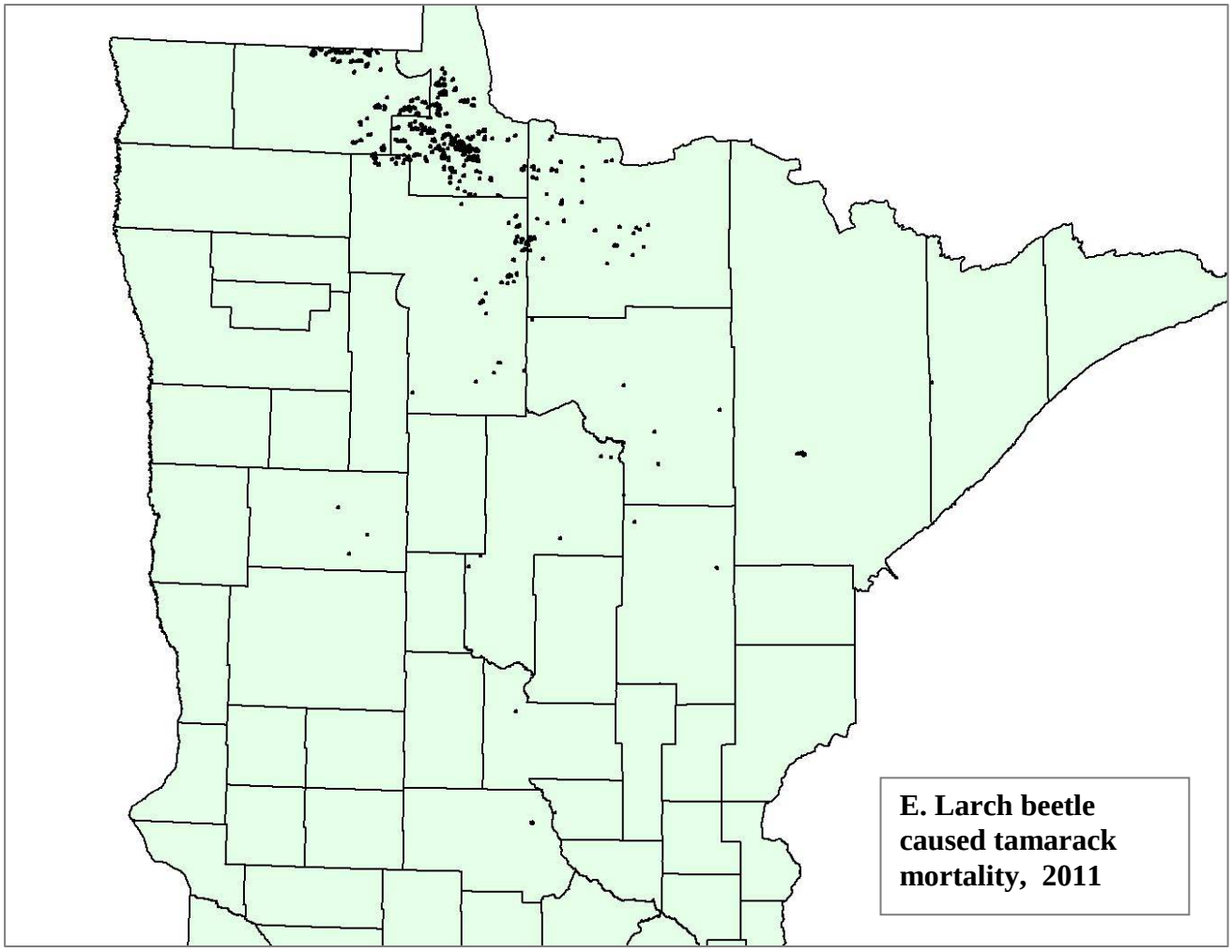
Hosts	Tamarack
Setting	Rural forests
Counties	See map.
Survey methods	Aerial detection
Acres affected	29,028 ac

Narrative

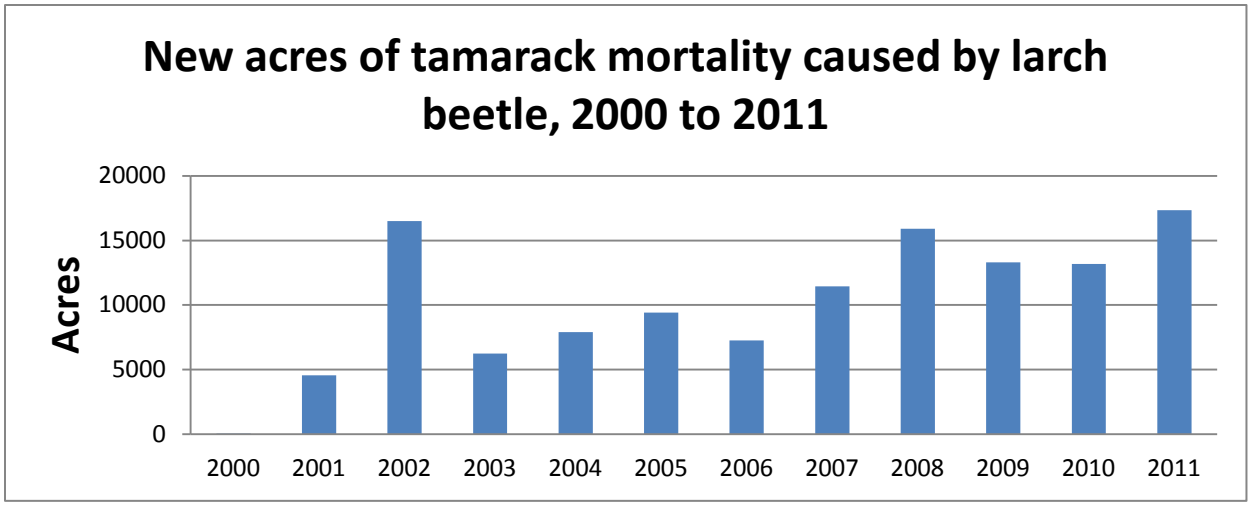
20,028 acres with tamarack mortality were mapped during the aerial survey. This is about equal to the number of acres mapped in 2008. Most of the mortality mapped this year was in northwestern Minnesota in Lake of the Woods, Roseau, Koochiching and Beltrami Counties. Scattered mortality was also found throughout the range of tamarack in the state. See charts and map. There were 17, 353 new acres of mortality in 2011 that were determined by comparison to all other polygons of mortality since 2000 by using GIS techniques.

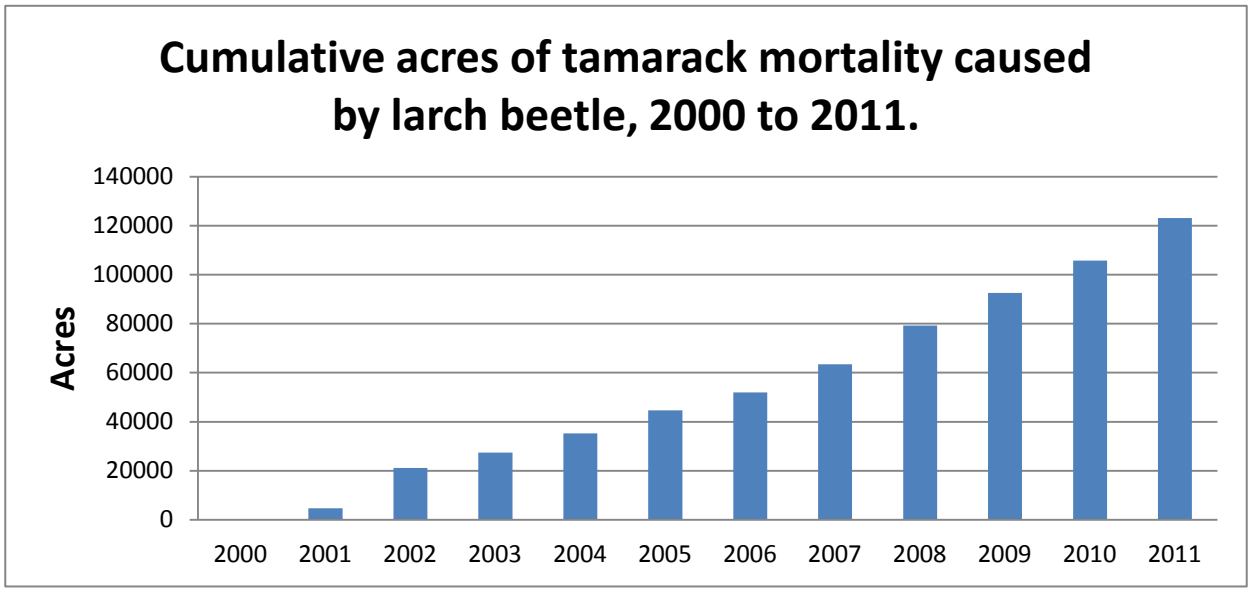
A number of stress factors are likely contributing to the current mortality. Droughts and resulting fluctuating water levels in 2002-2003 and 2006-2009 are likely involved. Warmer winter temperatures may also be involved. Since the larch beetles overwinter in the above ground parts of the tree warmer winter temperatures appear to allow more to survive the winter building up larger populations resulting in more tree mortality.

A benefit of late season aerial detection was discerned this year in August, when chlorotic tamaracks were visible from the air. This will give foresters and researchers an indication of which stands and clumps of trees are already infested with larch beetles and are destined to die overwinter or early the next year. Old infestations, dead trees, look gray from the ground and air.



Current infestations of E. larch beetle are chlorotic yellow as detected from the gound and air in late August. Mike Hoppus, MN DNR.





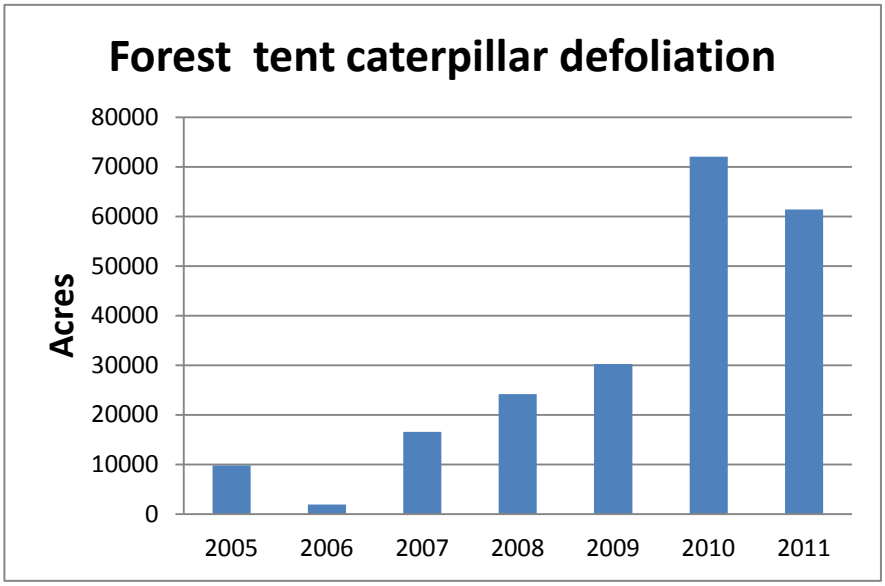
Forest tent caterpillar

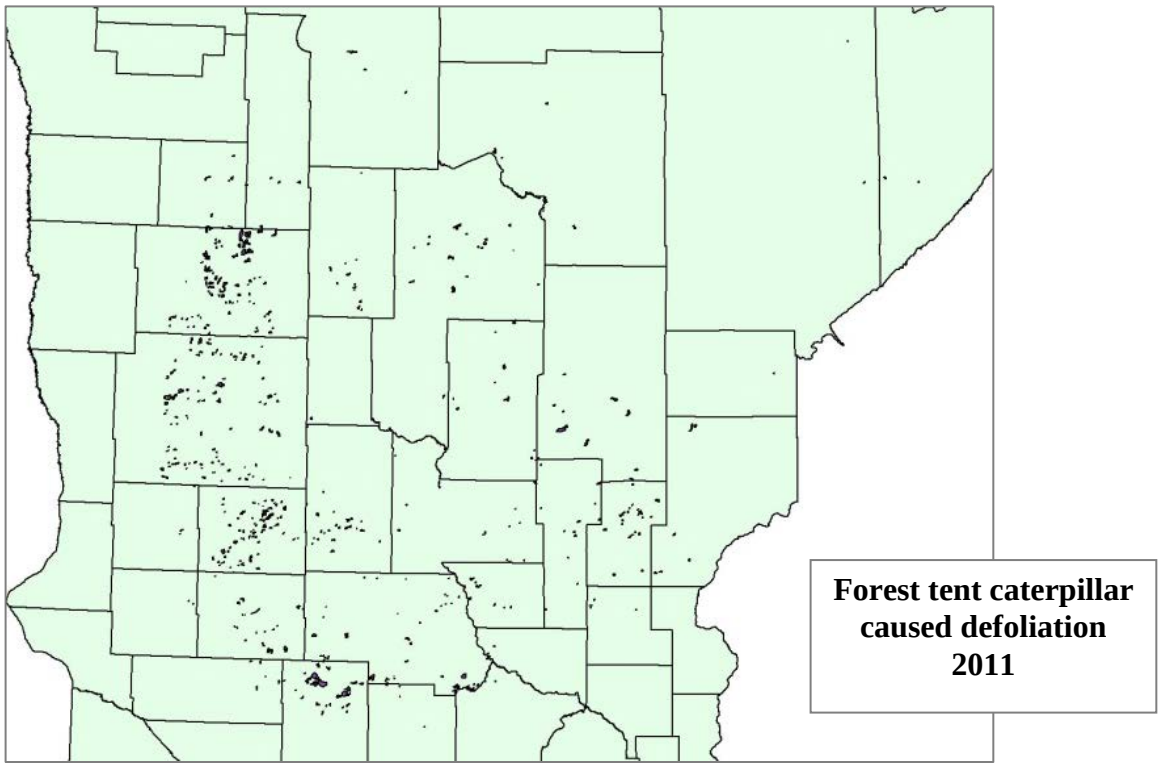
Malacosoma disstria

Hosts	Aspens, oaks, birches and other hardwoods
Setting	Rural forests
Counties	See map
Survey methods	Aerial survey
Acres affected	61,419 ac
Narrative	

Due to the government shutdown during peak aerial survey season, hardwood defoliators, like FTC, were undoubtedly under-reported. In fact our aerial sketch-mappers found many stands that had already refoliated. That said, we think the acreage reported is very conservative.

FTC populations are maintaining themselves in central Minnesota. The number of acres defoliated is climbing steadily with increases being found in all of the central counties. This year, 61,149 acres of aspen and hardwoods were defoliated. See chart and map.





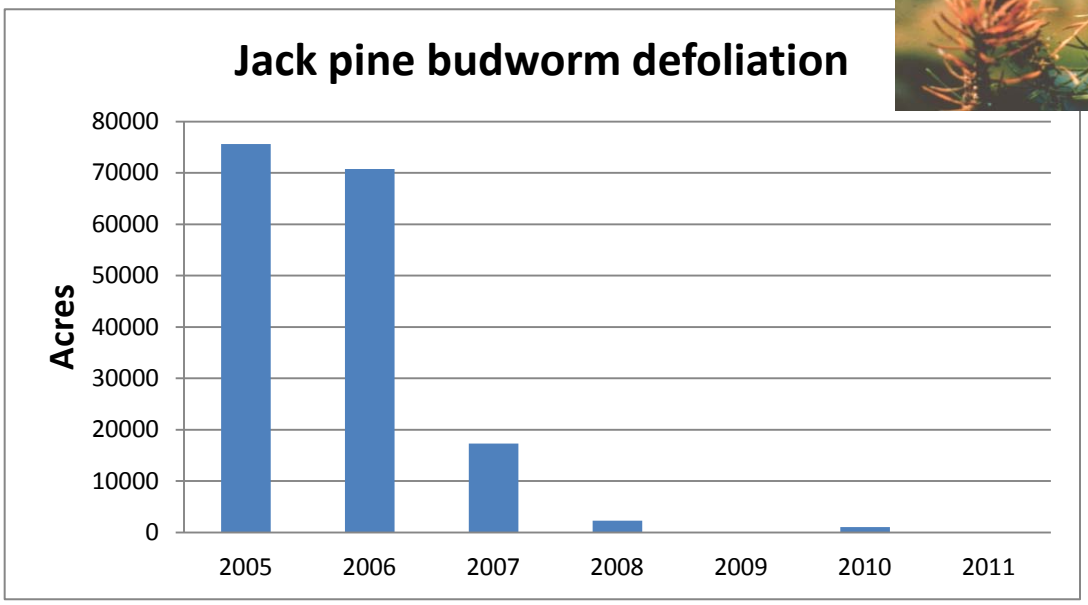
Jack pine budworm

Choristoneura pinus pinus

Hosts	Jack pine; rarely red pine, white pine and white spruce
Setting	Rural forests
Counties	None
Survey methods	Aerial survey
Acres affected	No defoliated acres

Narrative

Last year, jack pine budworm defoliation was observed and mapped on 1,052 acres in Roseau Co. Two small polygons were found in Mahnomen and Cass Counties. If current population trends are similar to historical ones, we should have no mappable defoliation for the next one or two years before another outbreak is initiated.

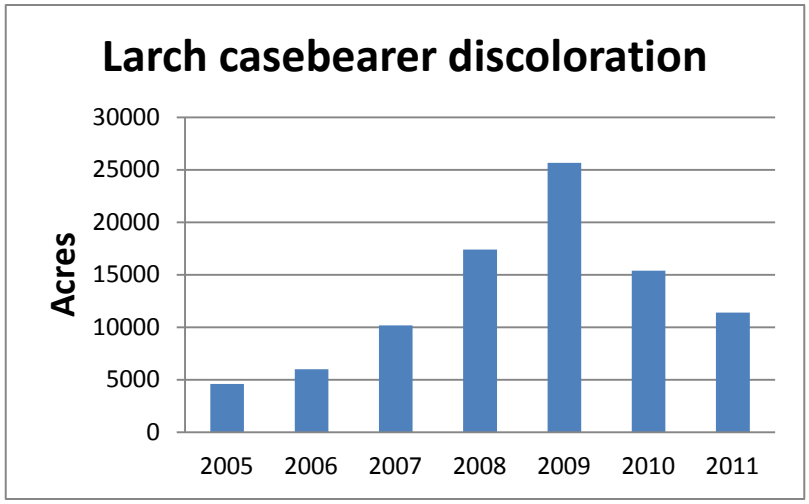


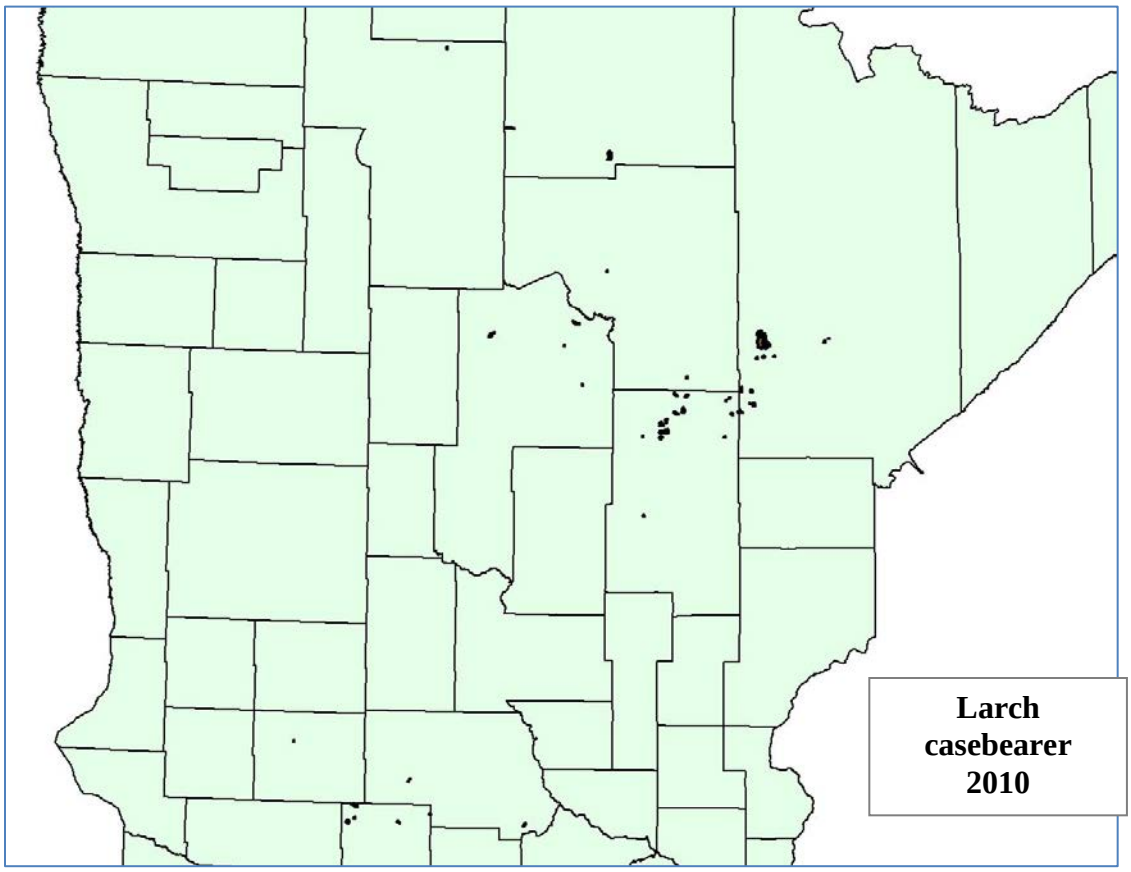
Larch casebearer

Coleophora laricella

Hosts	Tamarack
Setting	Rural forests
Counties	See map.
Survey methods	Aerial survey
Acres affected	11,404 acres
Narrative	

Larch casebearer discoloration occurred on 11,404 acres this year, significantly down when compared to 2009's acreage. See chart and map.



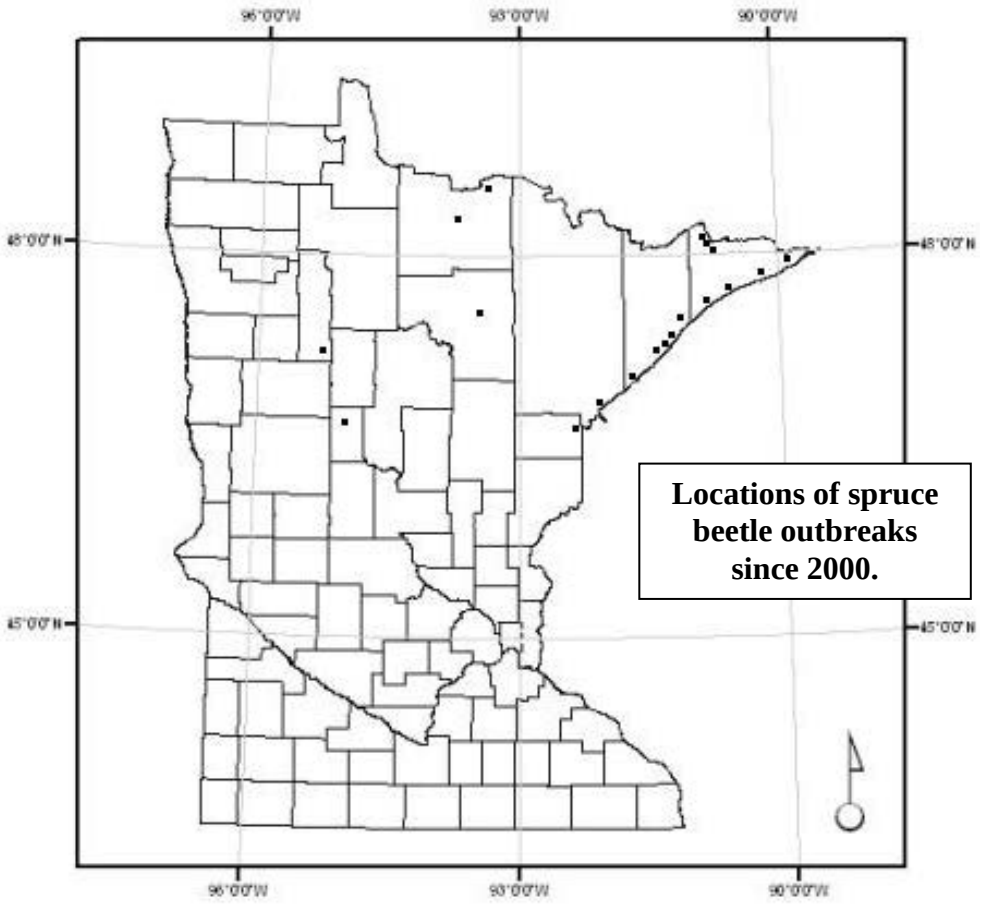


Spruce beetle

Dendroctonus rufipennis

Hosts	White spruce
Setting	Rural forests, campgrounds, windbreaks
Counties	Cook, Lake, St Louis, Carlton, Itasca, Koochiching, Wadena and Clearwater
Survey methods	No surveys were conducted for spruce beetle in 2011. In the past, survey methods used included ground, funnel traps and general observation.
Acres affected	Not determined
Narrative	

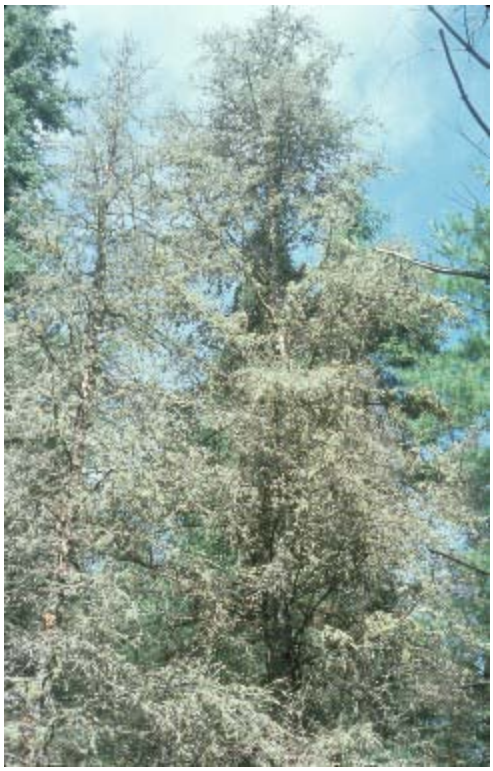
Spruce beetle occurs naturally in northern Minnesota. Significant mortality has been found in State Parks and campgrounds along the shore of Lake Superior where slightly over 10% mortality was found some years in the early 2000's. Low levels of scattered mortality continue to occur in campgrounds. Significant mortality was found in a couple white spruce plantations in Koochiching County also in the early 2000's. Mortality due to spruce beetle was estimated at approximately 20%. The beetle population was thought to have built up on blown down white spruce and then spread to live standing trees.



Locations of spruce beetle outbreaks since 2000.

Spruce budworm

Choristoneura fumiferana

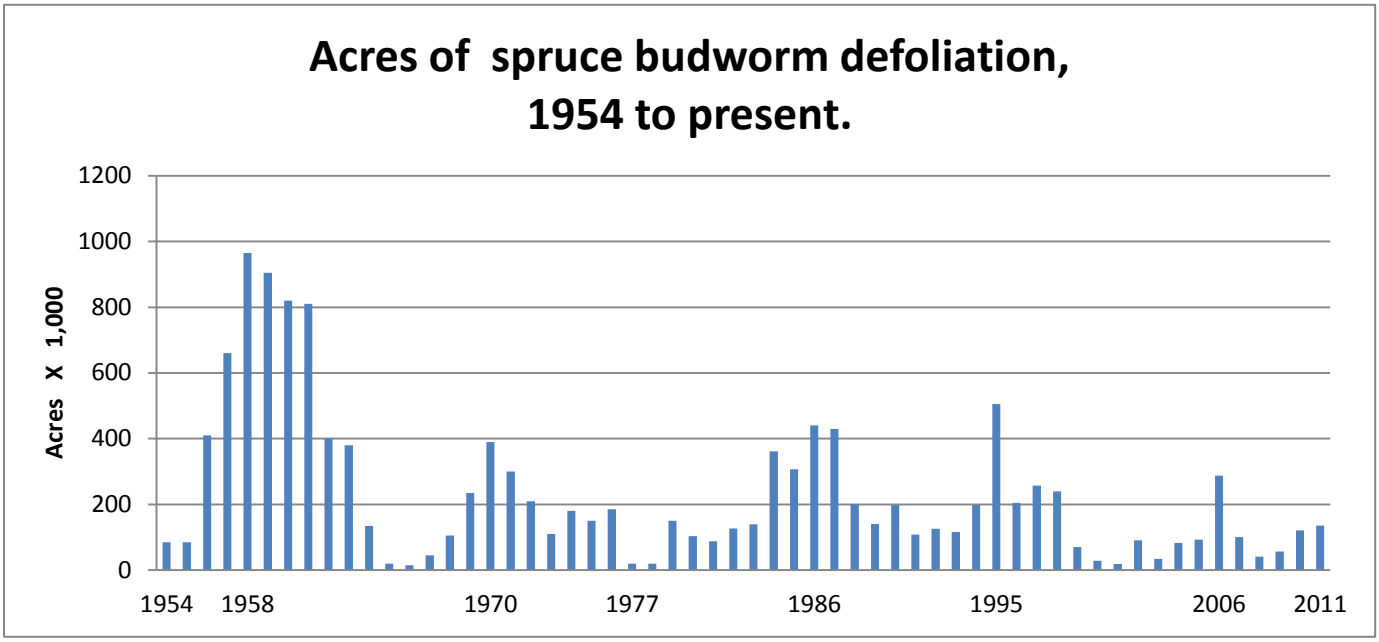


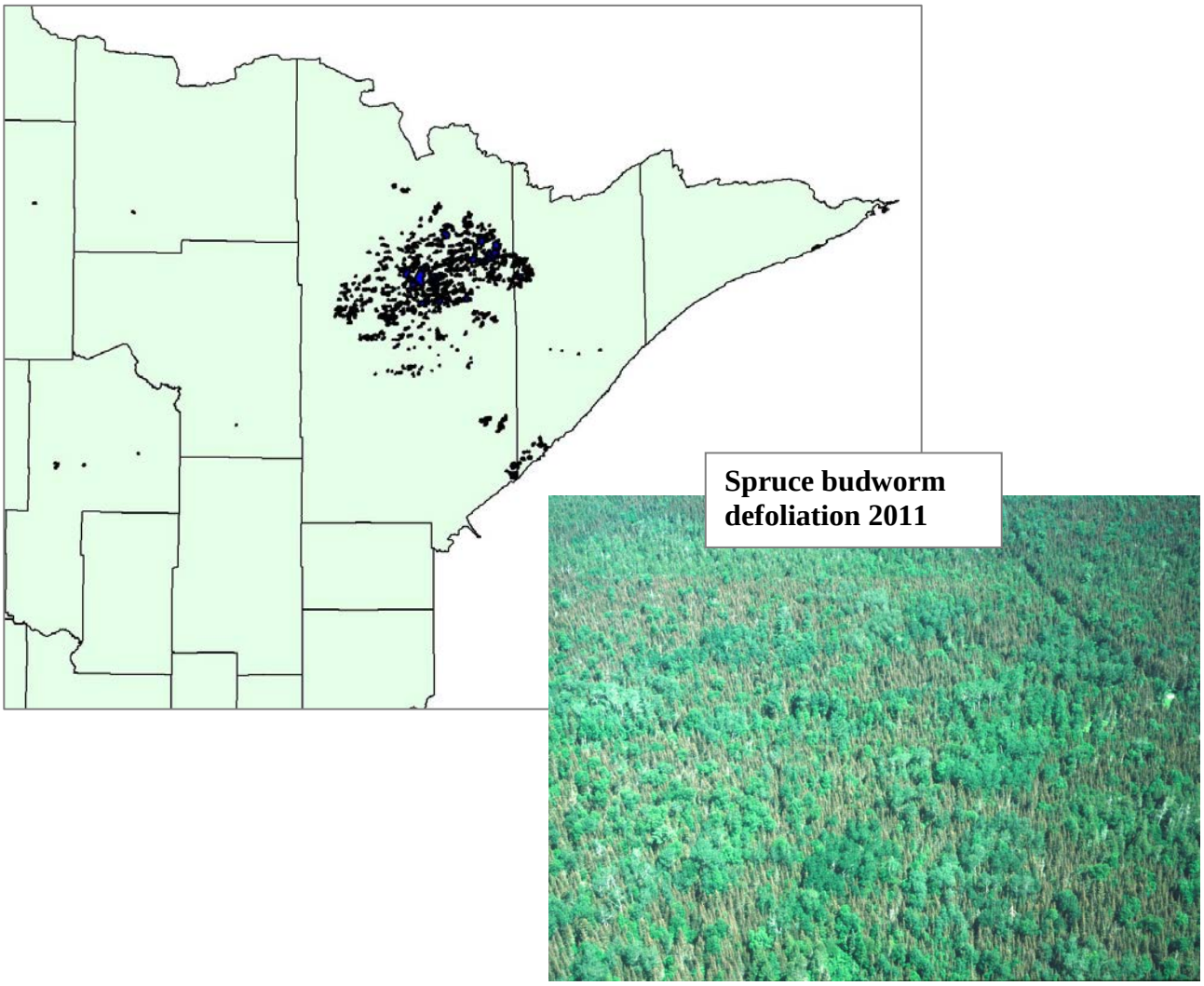
Hosts	Balsam fir and white spruce
Setting	Rural forests
Counties	Koochiching, St Louis, Lake, Beltrami, Clearwater, Hubbard, Cass, Mahnomen and Becker
Survey methods	Aerial survey
Acres affected	136,066 ac of defoliation 92,528 ac of mortality

Narrative

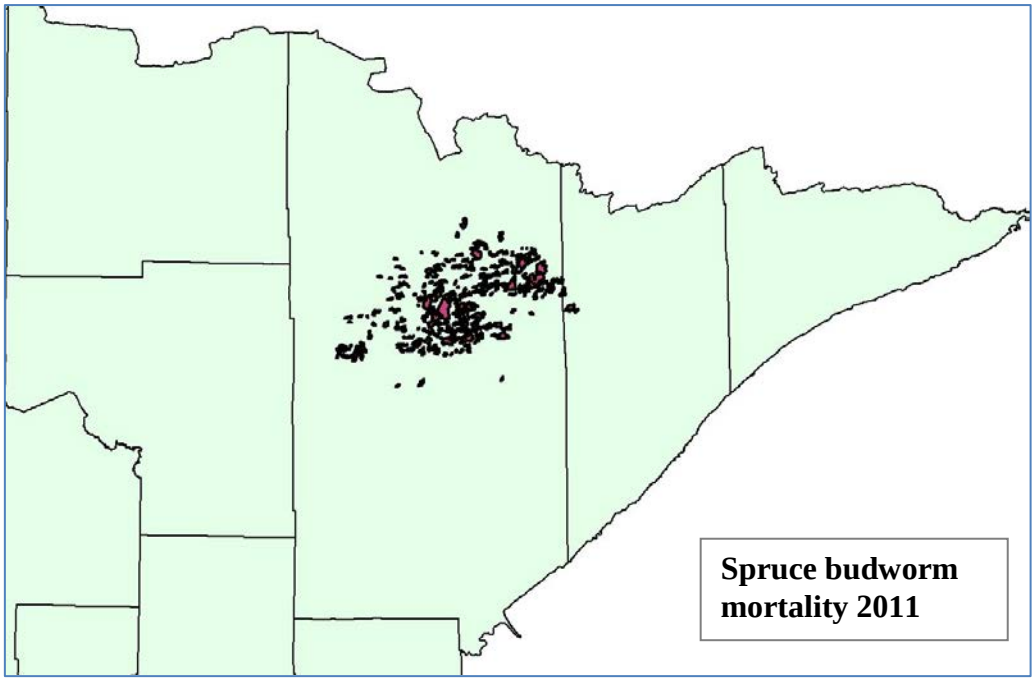
Spruce budworm is a native insect in North America. Massive outbreaks periodically occur in spruce-fir forests of eastern Canada and the United States. Since 1954, when annual aerial sketch-mapping began, spruce budworm has caused defoliation of balsam firs and white spruces every year in Minnesota. This year, 136,066 acres of defoliation were observed in northeastern counties. See map. For the last couple of years, spruce budworm populations have been found causing defoliation in southern Lake and St. Louis Counties. The last time budworm was in this area was the 1970's.

The USFS mapped 92,528 acres of spruce budworm mortality in St. Louis Conty during the general detection survey on 233 polygons. See map. This likely represents the cumulative impact of the last 3 to 4 years of defoliation in northern St. Louis County.





Spruce budworm defoliation 2011



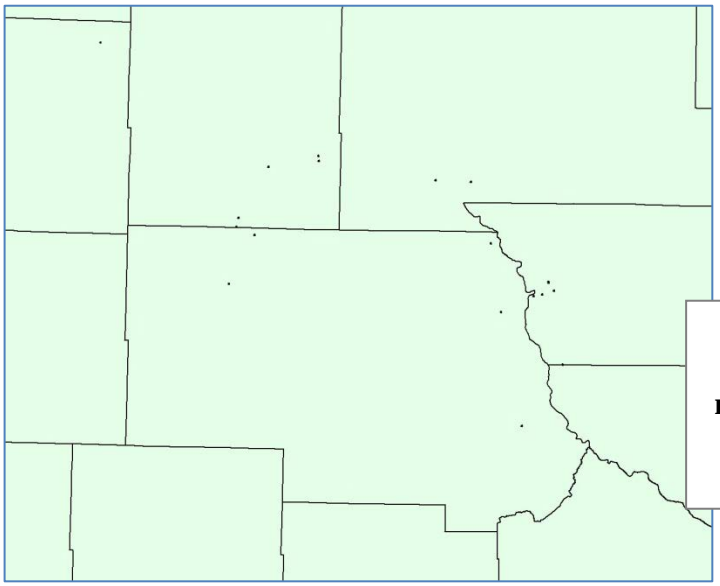
Spruce budworm mortality 2011

Two-lined chestnut borer

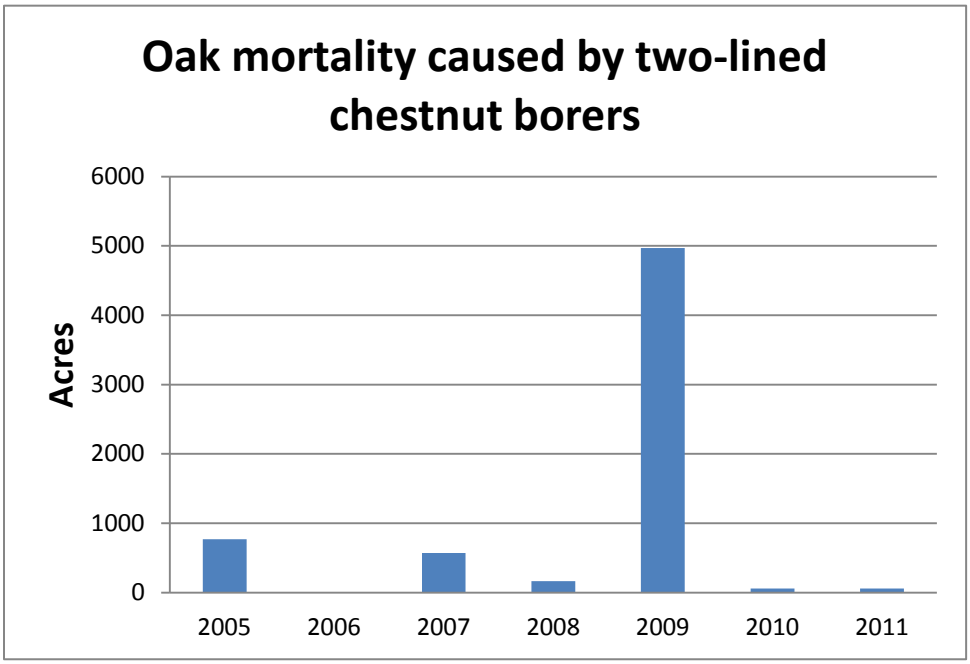
Agrilus bilineatus

Hosts	Oaks
Setting	Rural and urban forests
Counties	See map
Survey methods	Aerial survey
Acres affected	59 ac
Narrative	

This insect has had a fairly constant presence over the last decade, the weather of which has been warmer and drier than most. A huge build-up and oak mortality occurred in 2009. For the past two seasons, new damage caused by two-lined chestnut borers was detected on less than 60 acres each year as soil moisture increased. See chart.



Two-lined chestnut borer caused oak mortality. 2011. Close-up of area around Stearns County.



Wooly alder aphid

Prociphilus tessellates

Hosts	Silver maple and alder
Setting	Forest and shade trees
Counties	
Survey methods	Ground
Acres affected	Not determined
Narrative	

Alder infestations by wooly alder aphid occur sporadically, but are always noticeable especially in July on maples and in August on alders.

DISEASES

Bur oak blight

An unnamed species of *Tubakia*

Hosts	Bur oak
Setting	Rural and urban forests
Counties	14 NEW counties, see table below
Survey methods	Ground sampling
Acres affected	Unknown
Narrative	

The first bonafide case of bur oak blight, confirmed by Dr. Tom Harrington of Iowa State University, was been identified in Minnesota in 2010. Previously, symptoms of BOB were reported to occur in portions of southern Minnesota, however, the disease was then called Tubakia leafspot and was cited to be caused by the fungus, *Tubakia dryina*. Since then, Dr. Harrington, Professor at Iowa State University, has completed DNA and pathogencity testing that confirms this disease is caused by a new, and yet unnamed, species of *Tubakia*, and he has named the disease bur oak blight (BOB).

In 2011, bur oak blight was found in 14 new MN counties and confirmed by microscopic exam and we are awating DNA testing by D.r Harrington, Univ. of Iowa. See table.

2010 ***Verified by DNA testing***	**2011** ***Awaiting DNA testing results***	
Anoka	Beltrami	Mower
Hennepin	Carver	Ottertail
Mille Lacs	Dakota	Pennington
Ramsey	Lac Qui Parle	Polk
Sherburne	Marshall	Pope
Washington	McLeod	Stearns
	Morrison	Wright

Maple anthracnose

Likely *Discula* spp.

Hosts	Sugar maple
Setting	All forests
Counties	Northeast and North central
Survey methods	Ground detection
Acres affected	Not determined
Narrative	

Normally overlooked on sugar maple, this fungal disease was quite common and noticeable this summer. Where maple anthracnose infections were heavy, crowns looked sparse and anthracnose blotches were visible throughout crown on the remaining leaves. Anthracnose infections occur during the spring as buds are breaking and leaves are expanding. A “good” year for anthracnose is when spring is protracted, cool and moist. Drier springs generate much less anthracnose. By the time symptoms are observed it’s too late to do anything but rake and burn (or bag) the leaves in the fall to prevent next year’s infections.

Oak wilt

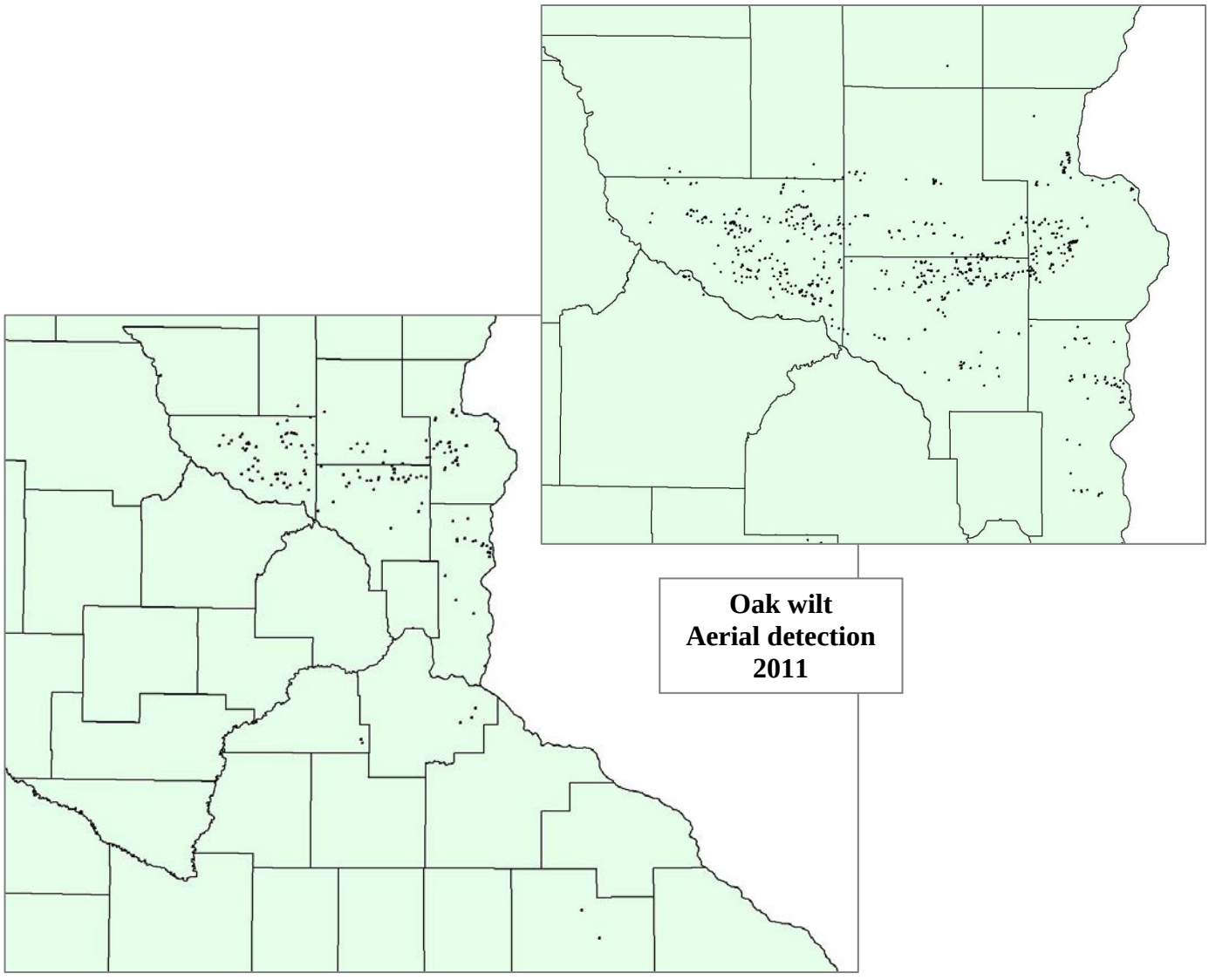
Ceratocystis fagacearum

Hosts	Primarily red oaks, white oaks occasionally
Setting	Rural and urban forests
Counties	See map and attached list.
Survey methods	Aerial survey
Acres affected	1,522 acres

Narrative

Oak wilt is an invasive fungal disease. During the federally funded oak wilt control program in the Metro area, new infestations "spread" north at about 7 miles per decade and west at 10 to 14 miles per decade. Since the program's end was so recent, we do not have a recalculation of the rates of spread. Control actions are now land-owner initiated and funded, so we expect oak wilt in the currently infested areas to increase in size and abundance.

This year's acreage was about half of last year's likely due to the lateness of the aerial detection survey. The survey was flown a month later than normal due to the MN government shutdown and missed the signature crown discoloration of dead and dying leaves that occurs in early July. Still, 1785 infection centers were mapped. See map and inset.



Spruce needle rust

Chrysomyxa ledi and *Chrysomyxa ledicola*

Hosts	Colorado blue, white and black spruces
Setting	Natural and planted
Counties	Northwide
Survey methods	Ground detection
Acres affected	Not determined

Narrative

This year many, many acres of upland and lowland spruces were highly discolored due to needle rust infection. We did not map them during aerial detection survey because the needles turned color after the last detection flight. Homeowners in northern Minnesota also noticed their spruce trees turning tan, pink, orange or yellow during the late summer. The needles were infected with a spruce needle rust fungus. It is more of an aesthetic problem and seldom a tree health problem. Infections by the spruce needle rust fungi, *Chrysomyxa ledi* and *Chrysomyxa ledicola*, look bad but aren't serious for most trees. However they can be tough on newly planted trees and Christmas trees. The rust is generally most common on blue spruce but it seemed to equally infect white and black spruce this year.

EXOTIC INSECTS AND DISEASES

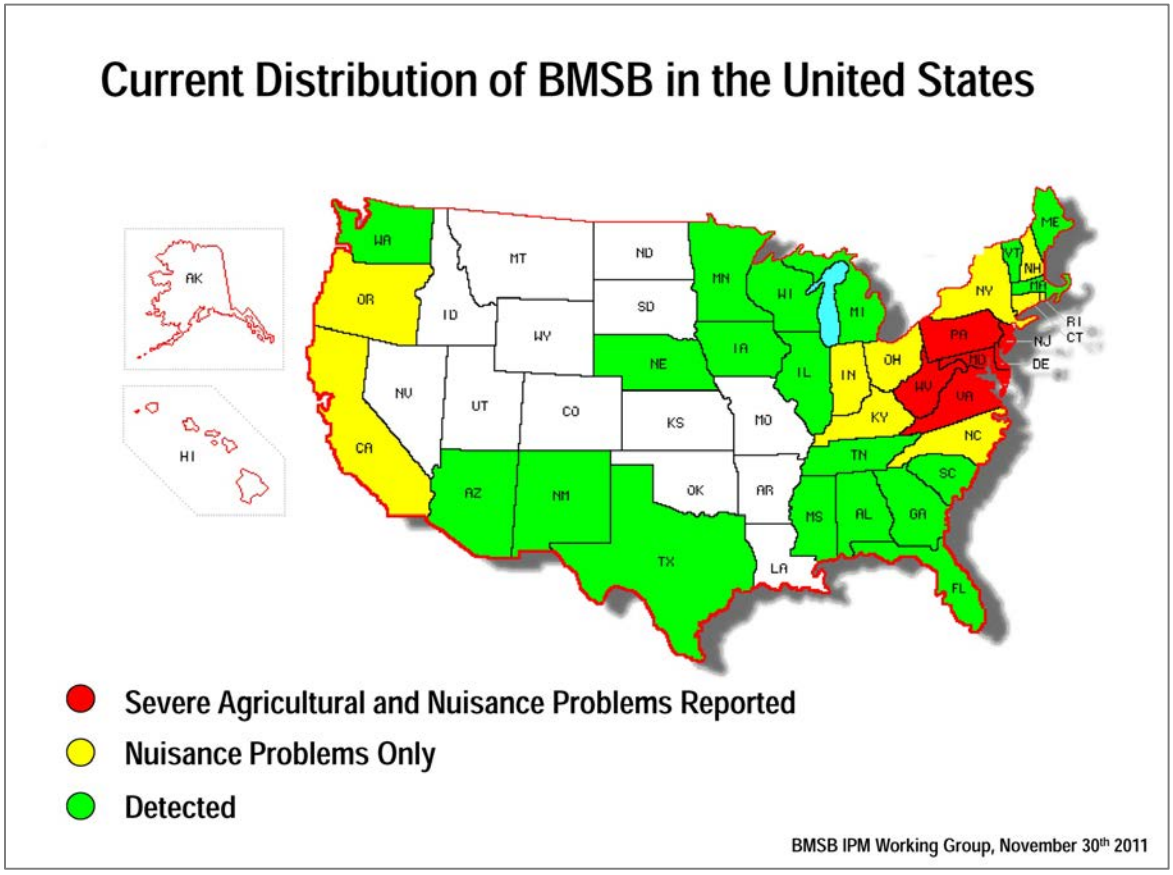
Brown marmorated stink bug

Halyomorpha halys

Hosts	Many herbaceous plants and trees
Setting	Rural and urban
Counties	Ramsey, Anoka, Washington and Winona Counties
Survey methods	Ground detection
Acres affected	Not determined
Narrative	

BMSB were introduced from Asia and was first found in the U.S. in Pennsylvania in 2001. It is now known in most mid-Atlantic states as well as in Oregon. They were first identified in Minnesota in November 2010 in Ramsey County. During the winter of 2010-2011, they were also identified in Anoka, Washington and Winona Counties (as reported by MN Dept. of Agriculture).

BMSB are pests because they feed on fruit, like apples and peaches and vegetables, such as corn, tomatoes, and soybeans. They are also found on many hardwood trees and shrubs and some herbaceous plants, although it is not clear how injurious they are to these plants. This year has seen an explosion in the numbers of this stink bug in many areas where they are already known to occur, causing severe losses in some tree fruit crops, including acorns.



Emerald ash borer

Agrilus planipennis

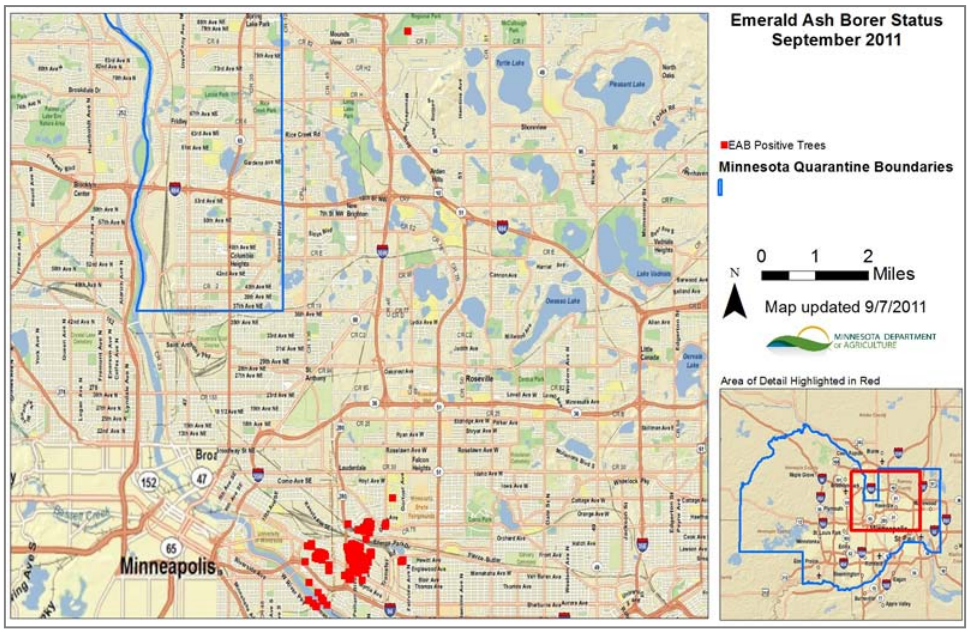
Hosts	Black, green and white ash
Setting	Forests and shade trees
Counties	Hennepin, Ramsey, Houston, Winona
Survey methods	Ground and some aerial detection
Acres affected	Not determined

Summary:

Three positive trap captures led to a new county quarantine in SE Minnesota, making a total of four quarantined counties. And three new infestations were discovered which expanded the area under management. One infested tree was found in Shoreview near the edge of Ramsey County. While visual inspection identified no other infested trees, symptoms of woodpecker activity this fall suggests another 3 to 4 trees are infested. Five to six infested trees were found in a residential neighborhood of St Paul considerable distance from the original infestation discovered in 2009. And in Winona County, nearly 400 trees were found to be infested along I90 on MNDOT and MNDNR administered lands. In all three cases, state or city officials are planning to remove the infested trees this winter. Most will be chipped, with chips in the metro area going to District Energy as biofuel and those in Winona County to be used to enhance state park trails (after having met 1x1" federal standards). But some trees will be taken to the UMN quarantine facility to support state funded research to explore the spread rates and cold tolerance of the three biocontrol agents. The egg parasite was released at all of the previously identified infestations. Both larval parasites were again released at those same sites, as well as the three newly discovered infestations.

Metro Area History of EAB discoveries

- May '09 found in a residential area of St Paul. Likely source is solid wood packing material associated with the adjacent rail yard. Likely began around 2005.
- February '10 found in Prospect Park in Minneapolis, likely due to natural spread.
- Oct '10 found along East River Rd in Minneapolis, likely due to natural spread.
- March '11 found along West River Rd in Minneapolis, likely due to natural spread.
- July '11 found in a residential area of Shoreview on the Anoka/Ramsey County border. Source is unknown (too far away to be natural spread). Likely began around 2008.
- Sept '11 found in St Paul, near the intersection of Summit & Dale. Possibly due to natural spread or the movement of firewood for home use. Likely began around 2007.

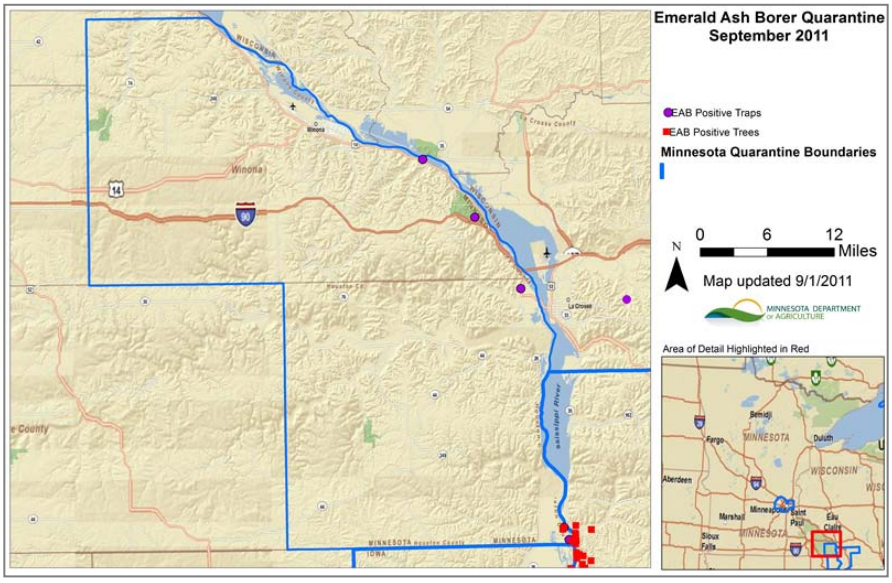


Pest Management in Metro:

- Hennepin and Ramsey Counties were quarantined in 2009. Quarantines monitor and regulate movement of ash and ash products (including mulch), and hardwood firewood out of the quarantined boundaries.
- MDA has contacted all businesses related to the movement or disposal of wood within those counties. Many have established compliance agreements so their products can be safely shipped out of the area.
- The cities of Minneapolis and St Paul are actively looking for and removing publicly owned ash trees known to be infested, except along MS River bluff where steep terrain hinders sanitation.
- St Paul and Shoreview are requiring the removal of privately owned ash trees known to be infested. To date, Minneapolis has been reluctant to enforce their nuisance ordinance on private lands due to a lack of confidence in their ability to correctly identify infested trees.
- Federal funds have supported much of the sanitation work accomplished to date.
- Minneapolis and St Paul have been pre-emptively removing and replacing some ash trees along their boulevards to increase the diversity of their urban forests.
- A number of other communities have adjusted their maintenance schedules and are removing and replacing ash at a faster rate than before the discovery of EAB.
- State funds have supported much of these urban forest diversification efforts.

Southeast counties history of EAB discoveries:

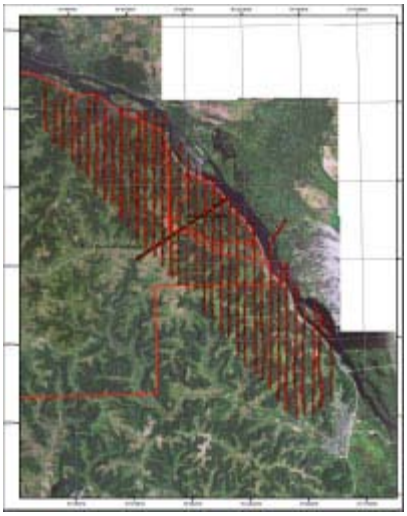
- April '10 found on US Fish &Wildlife Service (F&WS) island in Houston County, likely due to natural spread across the river. Likely began around 2007.
- Sept 11 found in Winona County near intersection of I-90 & CR12, and in Great River Bluffs SP. Likely began around 2005.



Pest Management in SE counties:

- Houston County quarantine was quarantined in 2010 and Winona County was quarantined in 2011.
- Again, MDA has contacted all businesses related to the movement or disposal of wood within those counties. A few compliance agreements were developed as a result of those contacts.
- MNDOT and DNR Parks are actively removing ash trees known to be infested. Some of the smaller infested trees are being taken to the quarantine facility at the UMN to support research into the cold tolerance of EAB and the biocontrol agents. The rest are being chipped and utilized on-site.
- MNDOT is also removing uninfested ash in several plantings near the I90 infestation to make use of available labor (utilizing plow drivers currently idle).
- The F&WS is not removing infested trees on the island near Victory because of difficult access.
- WI is not enforcing sanitation of trees known to be infested in Victory, WI (mostly private lands).

EAB Survey and Monitoring



- Every year, MDA and USDA APHIS put up green or purple prism survey traps on a grid basis in the highest risk areas of the state and other locations as warranted. These are checked once during the season and again when they are taken down in the fall.
- Winter surveys consist of visual inspections of ash trees in and around known infestations. Indication of wood pecker feeding is the most easily recognized sign of infestation. Winter surveys are carried out by a combination of state and city staff.
- The DNR took and is now interpreting aerial photography over the Winona County infestations & positive trap sites. Purpose is to detect new infestations that may better explain the pattern of positive trap captures in the area.
- Reports of suspect EAB are monitored through the MDA Arrest-A-Pest Hotline and the network of volunteer First Detectors.

EAB Biocontrol

- Two larval parasites & one egg parasite (all non-stinging wasps) have been released at all currently known infestations. All three species are specific to EAB, and not likely to attach native wood borers.
- 300 trees not known to be infested within 2 miles of the core infestation in MPLS & St Paul have been characterized. Two branches from each tree will be removed each yr for 3 yrs to monitor the rate of spread for EAB & biocontrol agents.
- This branch sampling method was recently developed in Canada to survey for EAB. The advantage is that its 75% effective in detecting EAB in trees that have no other sign of infestation. This is the first time the methods have been used in MN, but are already showing promise – the 1st branches cut and peeled this fall were found to be infested – a new find for that area. This may be an effective way for Park mgrs to monitor EAB in their campgrounds.

EAB Implications

- On its own EAB moves very slowly. So sanitation is effective at removing portions of the population and slowing its rate of spread.
- EAB is very difficult to detect. So infestations may be present long before being discovered.
- Federal funding is drying up because eradication efforts have failed elsewhere in the country and survey methods are currently inadequate to effectively monitor EAB populations.
- Research has indicated that EAB will kill 99% of all ash within the state. Natural ash regeneration is unlikely. Where ash is the primary regulator of site hydrology, stands may convert to shrub or peat lands.
- Research has shown that removing healthy trees within an infestation may speed the rate of spread, because adult beetles are forced to fly further in search of food.
- On the other hand, stand thinning (to reduce the proportion of ash) where feasible to increase stand diversity **is** advised **before** the stand becomes infested, as a means of sustaining forest cover.
- Once dead, ash trees become very brittle. Michigan has seen significant costs associated with fallen trees knocking down power lines.

PROGRAM OVERVIEW & BACKGROUND

The gypsy moth detection program is a cooperative effort between state and federal agencies including the Minnesota Departments of Agriculture (MDA) and Natural Resources (DNR), the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (APHIS), the U.S. Forest Service (USFS), and the University of Minnesota. The Gypsy Moth Program Advisory Committee (GMPAC) was formed in 1998, consisting of representatives from these cooperating agencies and the University of Minnesota. On a biannual basis, GMPAC meets to discuss issues related to gypsy moth management. It is this cooperative effort that has built a strong gypsy moth program in the state of Minnesota. A strategic plan was prepared by GMPAC members to describe the objectives and administrative structures necessary to manage the gypsy moth in Minnesota. The plan contains a mission statement, a framework for decision making, and outlines the strategies and mechanisms to implement the plan.

Since 2004, Minnesota has been a formal member of the Gypsy Moth Slow the Spread (STS) Foundation. The STS Action Area is moved annually based on trap catch data and to cover areas where moth populations are building. Houston, Winona, Lake, Cook and portions of Fillmore, Carton, Olmstead, St. Louis and Wabasha Counties were included in the 2011 STS Action Area.

The gypsy moth program relies on Minnesota state general funds as a matching cost share to federal grants. The STS Foundation is the major contributor of funding as they support both trapping and treatment within the STS Action Area. They also finance a portion of the regulatory program in Minnesota. In addition to STS sources, funding was provided by APHIS to conduct delimit and detection surveys as well as trapping on federal lands including national forests and Native American reservations.

TRAPPING SURVEY PROGRAM

The MDA has been the lead agency undertaking the annual gypsy moth detection survey since 1973. The trapping survey is the data source for determining where gypsy moth management strategies should be implemented. Gypsy moth survey data from all participating agencies in Minnesota is routed through MDA for inclusion in annual reports.

Program Area

In 2011, MDA filled positions for 26 trapping routes in 4 lead worker areas to oversee field operations. Trappers were responsible for setting, checking, and removing gypsy moth traps (all delta traps in 2011) during the field season. All trap data in Minnesota is collected and recorded using STS protocols. To gather comparable data and achieve similar results, trapped areas beyond the STS Action Area do not follow the APHIS-recommended trap density but rather use the equivalent metric grids used in the STS Action Area.

Minnesota's entire eastern border was trapped this season. The northern trapping grid extended west to the eastern border of Koochiching County, and south to central Kanabec Co. The southern trapping grid covered the southeastern corner of the state, the metro, and the St. Cloud area. In the extreme south, the western trapping border extended to central Mower Co. From there, the southern region extended north to Goodhue Co., west to Sibley Co., north to southern Morrison Co., then back east to the Wisconsin border.

The entire state is not surveyed every year. Gypsy moth is moving into the state from the east, so trapping in the western portion of the state is typically only done on a rotating basis from year to year. The western rotation for 2011 was to include the southwestern corner of the state, but unfortunately this area was not trapped due to budget cuts.

The 2011 survey was designed using prioritized trapping suggestions for each route. New analyses done by our GIS staff identified which traps were inaccessible to set year after year. These traps were pre-omitted so that the trappers had fair access to all traps assigned to them. This system worked well and gave each trapper a realistic and obtainable work load.

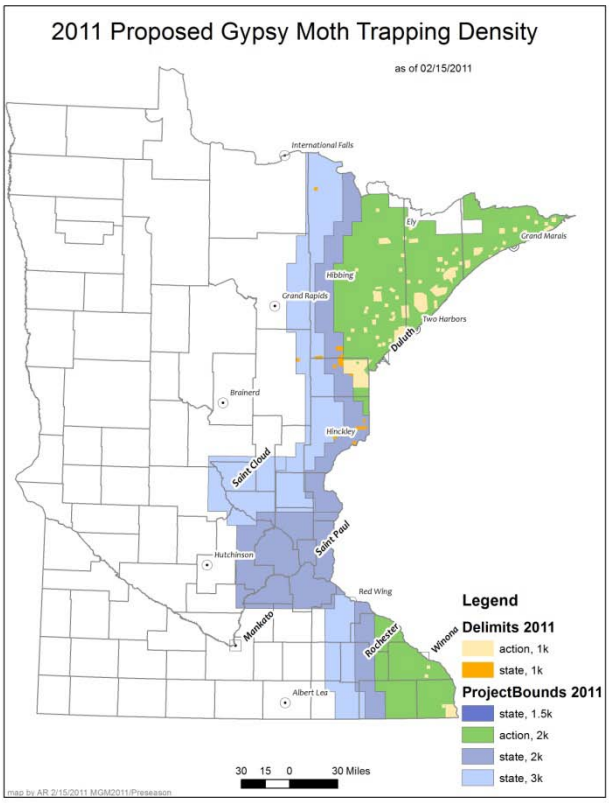
High-risk sites

A determination of risk for the introduction and establishment of gypsy moth is based on human activity levels, preferred habitat for gypsy moth, and the advancing gypsy moth front heading west from the northeastern states. Wholesale nursery dealers and nursery growers that report stock sources from gypsy moth quarantined areas or have a history of pest problems are considered high risk. Sawmills and pulp mills are regarded as high risk if known or likely to have out-of-state sources and if they are within 100 miles of counties that trap fifty or more gypsy moths. State Parks, campgrounds, and other sites associated with the movement or sale of firewood or items from infested areas for tourism/recreation are also deemed high risk.

Compliance Agreement (CA) sites are high risk by nature and are trapped at a higher density. Compliance Agreements for five mills in Minnesota were issued or renewed jointly by state and federal officials this year.

Trapping Grid

Grid densities differ within the trapping area according to the risk of introduction: smaller grid sizes yield higher trap densities which result in higher resolution of actual moth populations. Isolated traps with high moth numbers in 2010 were surveyed intensively in 2011 through site delimitation. This survey technique involves narrowing down a large area to find out if gypsy moth populations are persisting and if treatments should be administered.



The map to the right indicates density differentials throughout Minnesota's 2011 survey area. Within the STS Action Area, standard grid densities ranged from 1 to 2 kilometers (km). Outside the STS area, standard grid densities ranged from 1to 3 km. Urban areas (Twin Cities metro area, St. Cloud and Rochester) outside of the STS Action Area are considered high-risk for gypsy moth introductions due to human movement and were subsequently trapped on a tighter grid. Densities in these urban areas are usually trapped at 1.5 km, but were decreased (inversely meaning that the inter-trap distance increased) to 2.0 km in 2010 and again in 2011 to make up for a loss in program budgets. Despite these cuts, MDA has been able to maintain a similar trapping area as in the past but with fewer overall traps. There were six STS and 28 non-STS delimit sites designated in 2011. Delimit sites were trapped at a grid density varying between 250 and 750 meters.

Much of the northern region of Minnesota remains a challenge to survey because of the lack of access roads or road maintenance. As moth numbers rose in the northeast, trapping routes were designed to be hiked rather than driven. Although hiking field staff can only set about 40% of the traps that driving staff can, the extra attention to trapping on a pre-determined grid has enabled the program to gather more complete data on the existence of moth populations across the landscape. Tourism is a large part of the local economy in the north woods and along the North Shore of Lake Superior, making the area susceptible to artificial introductions of gypsy moth. Popular camping and outdoor recreation sites are still trapped heavily thanks to hike-in trappers.

Asian Gypsy Moth

Trapping for the Asian strain of gypsy moth (AGM) continued in 2011. Over 400 traps placed at potentially high-risk points of introduction including ports of entry, warehouses or sites that receive/store containers**,** and at sites where heterozygous strains were identified previously, were sent to OTIS Laboratories for DNA analysis. This year, 18 AGM traps with 28 moths were sent in for analysis. No AGM have been identified in Minnesota at this time. Before the 2012 trapping season we will be reevaluating the criteria and expanding the areas designated to have moths sent in for testing to ensure a sufficient sample size from Minnesota.

Research

Sharp increases in moth numbers along the North Shore since 2005 along with noticeable variations in moth size and an unusually long adult flight season led MDA to request further research into the biology and behavior of northerly populations.

- Meteorological data are being analyzed to help determine if wind patterns are capable of carrying gypsy moth larvae or adults over Lake Superior from eastern infestations into Minnesota. The actual study was looking at "blow-overs" occurring over Lake Michigan. The current results were presented at the 2011 Annual Gypsy Moth Review. Results suggested that Lake Michigan is not going to be a significant barrier for gypsy moth, and that they are likely blowing over Lake Superior as well. This suggests that weather related influxes (such as what was seen in northeastern MN in 2009) are indeed possible. In addition, and also as was seen in Minnesota in 2010 trap results after the year of the big influx - if the "blow-over" influx occurs during the adult flight period, there is often no establishment because there are no female mates for the males. Only the males are blown over as they fly, and the females do not fly. In turn, more springtime events occurring during the larval stages coincide with increased population spread, as both male and females are being blown over.
- Autotraps were hung along the shoreline to capture and record daily flight patterns as well as seasonal moth activity.
- A sentinel trap grid was established in Minnesota in 2008 on areas of the existing grid along the North Shore to monitor male moth flight patterns. Sentinel traps were set and checked frequently again in 2011. New this year - every other trap along the sentinel grid was given two disparlures instead of just one to see if the resultant moth catches showed a differing pattern
- To address the question of how temperatures over time affect lure release rates from traps, MDA is participating in a regional lure release study to measure these differences. Data gathering for this study ended in 2010.

The above research projects were coordinated through the USFS Field Station in Morgantown, WV.

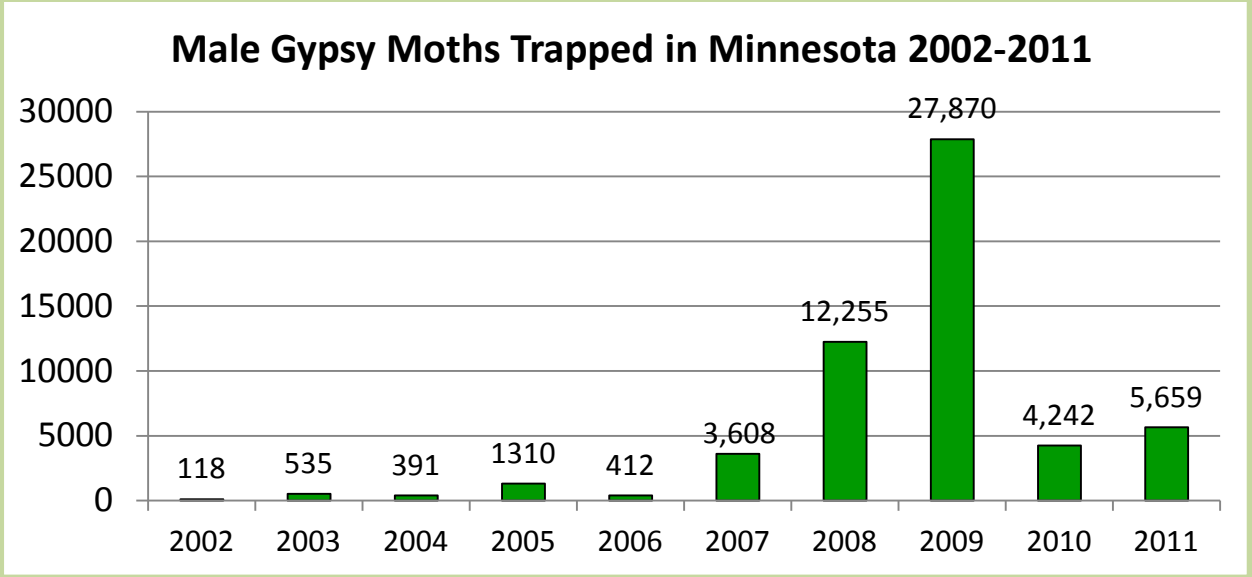
Trapping Schedule

Traps are ideally set just prior to adult moth flight. Trap removal starts once the predicted moth flight is over. A midseason trap check facilitates determinations of moth development and removal timing. It also helps with early detection and regulatory action at regulatory sites. MDA's trapping area was divided into northern and southern regions, as the latitudinal climate range of the state creates a delayed moth emergence in the north and a need for separate trapping schedules. Traps were set between May 23rd and June 28th and removed by September 15th in the south. In the northern region, traps were set between June 16th and July 26th and removed by October 20th.

Survey Results

A total of 15,468 gypsy moth traps were set in Minnesota this season, yielding 5,659 moths. MDA set 14,735 traps, capturing 5,652 gypsy moths in 2,571 traps. APHIS coordinated trap placement for 485 traps on several federal and tribal land sites and areas of high risk interest. These areas included high risk sites or federal lands that fall outside of the boundaries of MDA's program area. Some areas trapped include Pipestone National Monument, Leech Lake Band of Ojibwe, Red Lake and Bois Forte Band of Chippewa Reservation lands, and the U.S. Army Corps of Engineer lands. Minnesota County Agricultural Inspectors (CAI's) volunteered to set 225 traps outside the MDA trapping area in Clearwater, Freeborn, western Koochiching, Murray, Nobles, Rice, Steele, Todd and

Lake of the Woods counties. Three Rivers Park District, located in the Twin Cities metro area, set 23 traps. All positive traps will be followed up in 2012 according to GMPAC-approved delimitation protocols.



There were 502 traps placed on tribal lands by all cooperators, capturing a total of 158 moths. APHIS funds were used to trap all national forest and tribal lands within MDA's standard trapping grid with the exception of the Grand Portage Reservation, which was trapped using STS funds. Results for federal and Reservation lands that were trapped are listed in the summary table at the end of this report.

The total number of gypsy moths trapped in Minnesota in 2011 increased by 33% from the 2010 trapping results. By region, a total of 215 moths were trapped in the south and 5,444 were trapped in the north.

In 2009 there was an increased dispersal of male moths in the northern region due to a well-timed meteorological event which carried adults considerably further inland from Lake Superior in numbers greater than ever before in Minnesota. Trapping evidence shows that most of these moths were not able to find a mate to reproduce and build a sustainable population. In fact, most of the persistent populations were found to be within 15 miles of the shoreline where human activity is most prevalent. The northern region experienced an 87% decline in moths in 2010 from the spiked results of 2009, then a rise of 48% between 2010 and 2011. However, northern moths trapped this season still only add up to 20% of moths trapped in 2009. The moths trapped in the northern region of Minnesota account for 96% of the statewide 2011 totals. Lake County alone accounted for 45% of the statewide moth totals.

Between 2009 and 2010, the total number of gypsy moths trapped in the southern region more than doubled as a result of a weak "bulge" of moths pushing in from southwestern Wisconsin. Like in the northeast, it was thought that southeastern Minnesota was experiencing widespread but low counts of moths which theoretically would not develop into established populations. Between 2010 and 2011, the moth count fell by 61%.

MDA will be working closely with the land stewards in areas where there is a need to align management strategies with increased or perpetuating moth populations. Many of the isolated positive traps will be further delimited and treatments will be proposed for these areas in 2012.

Regulatory Sites

MDA staff set 429 traps at 77 nursery sites in 2011, yielding 9 positive traps and a total of 9 moths recovered from 8 different sites. The substantial outreach campaign MDA promotes has made a huge impact as more nurseries are

contacted and informed about proper sanitation of imported stock. MDA continues to work with the industry to minimize their risks of transporting gypsy moth into the state.

Outside of the STS area, there were four nurseries that each yielded a single moth. These sites will all receive outreach education and a delimit of traps surrounding their property in 2012.

MDA staff set 161 traps at 71 mill sites in 2011, yielding 19 positive traps and a total of 34 moths at 7 different sites. Catches at these mills were not investigated for regulatory concerns because the numbers of moths caught there simply reflect the overall high moth population in the larger landscape.

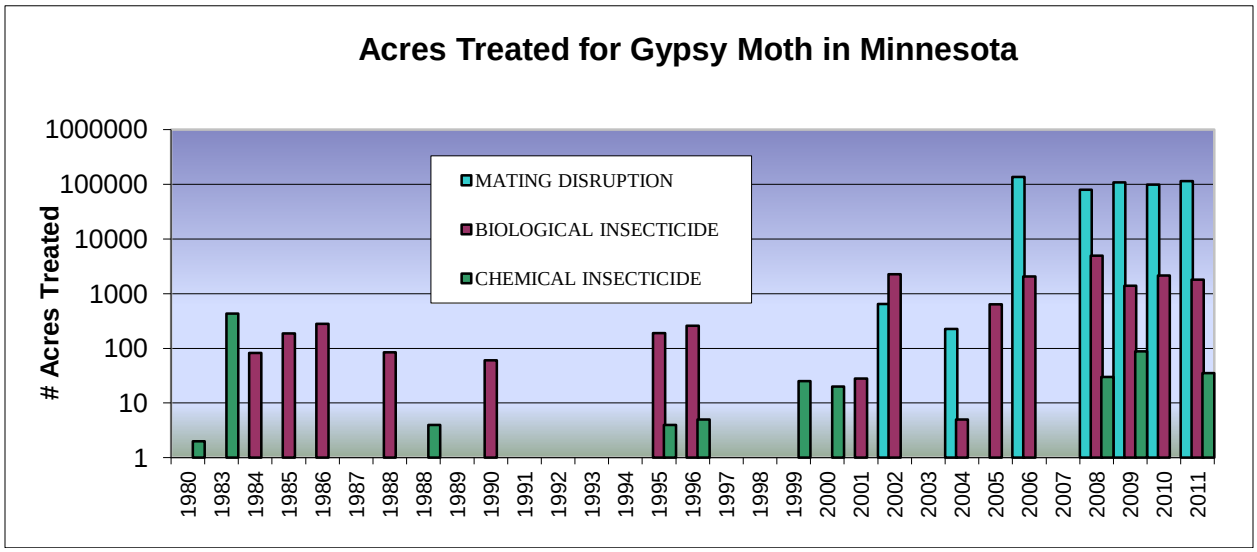
Of Minnesota's 81 State Parks, 31 were covered by the standard trapping grid in 2011 and had an additional 1-2 random traps placed at each. There were 65 traps set at State Parks, yielding 6 positive traps and a total of 12 moths at 5 different sites. Three of the positive State Parks are located in the STS area.

There were 18 other campgrounds and one randomly trapped sites that had positive trap catches. Catches at these sites account for the remaining 58 out of 114 moths that were trapped at all regulatory sites. Regulatory catches in 2011 accounted for 2% of the total moth catches in the state.

This year's survey results reflect the continued success of the Gypsy Moth Program as a whole by identifying start-up populations, tracking population development over time, and monitoring treated areas. The coverage of the overall moth distribution, as well as persistent moth presence in areas that the STS Decision Algorithm still indicates are Potential Problem Areas, is what substantiates the continued need for investment in the detection survey and subsequent eradication and STS treatment efforts. The success comes when the significantly higher costs of management once gypsy moth is established are delayed year after year thanks to fully functioning programs for both trapping and treatments.

GENERAL TREATMENT PROGRAM

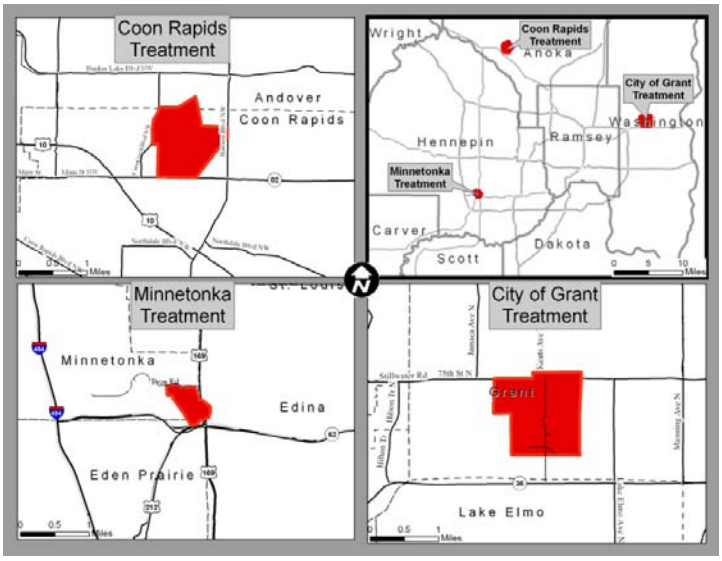
Since 1980 the MDA has coordinated and overseen the treatment of more than 554,000 acres to delay, prevent or mitigate the adverse impacts directly or indirectly associated with gypsy moth infestation on our state's natural resources, citizens and industries.



The Minnesota Department of Agriculture's (MDA) gypsy moth treatment projects this year included both eradication and slow the spread (STS) projects. Planning work on the treatments began in the fall of 2010 when individual blocks were defined, and areas were finalized in February, 2011.

A contract was posted with the Department of Administration on April 15th on the website: http://www.mmd.admin.state.mn.us/process/admin/postings.asp. It was awarded to the lowest qualified bidder, Airborne Custom Spraying (Halstad, MN), on April 21st. Issues with timing once again impacted the contract this year. MDA cannot let a contract without sufficient funds to pay for it and awards for eradication were not secured earlier.

Three eradication sites totaling 1,519 acres in Anoka, Hennepin, and Washington counties in the metro area were treated with the organic formulation of Btk (Foray 48B). An additional 342-acre STS site in Duluth was also treated with Btk. The remaining 114,793 acres were treated with mating disruption. Disrupt II, pheromone flakes, was used on the majority but a 460-acre block on Duluth's Park Point was treated with ground-applied SPLAT. Products were chosen for each site based on management goals and efficacy.

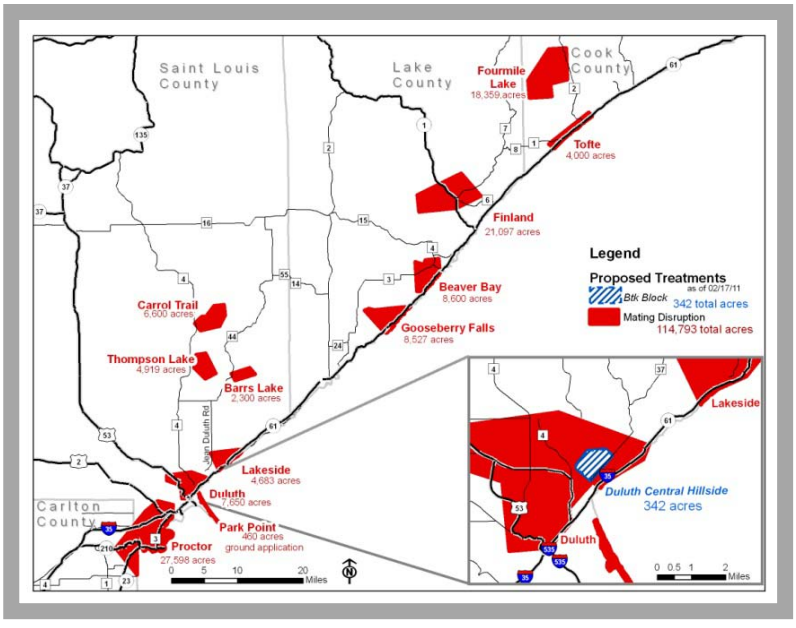


An in-house Incident Command System was used to manage the spray projects, drawing on departmental expertise in planning, public information, operations, and more. Personnel from state, federal, and local organizations were involved throughout the planning process which led to a successful spray program with minimal turbulence.

Environmental Assessment

The environmental assessment component of the projects was completed by our cooperating federal agencies. The St. Paul office of State and Private Forestry's Forest Entomologist along with the Superior National Forest staff did most of the analysis and writing of the STS EA.

Again this year we used the expertise of a colleague in the Department of Health at open houses to answer questions related human health issues. Our website was linked to one of their web pages that described the Btk product from a public health perspective. The FONSI was signed after no objections were made to the application.



Operations

Eradication: Three eradication blocks in the Twin Cities metro area began on May 24th, 2011. Weather conditions were ideal and the treatments were completed the same day. The second application was called off after only two blocks were finished due to high winds and storms. The final block was completed on June 2nd but a strong weather system moved through shortly after applications were made. ADAM kits tests on foliage collected after the storm were positive for Btk proteins.

A Safety Assurance Review was hosted by Minnesota in response to a request from the Aerial Application Safety Council. Team members observed, reviewed, and offered suggestions for improvement to the MDA's program. Overall we earned high marks for emphasizing safety, using social media platforms for outreach, and including multiple agencies in the delivery of the treatments. Constructive criticisms included preparing block monitors better, making air to ground communications improvements, and being more familiar with spray aircraft specifications.

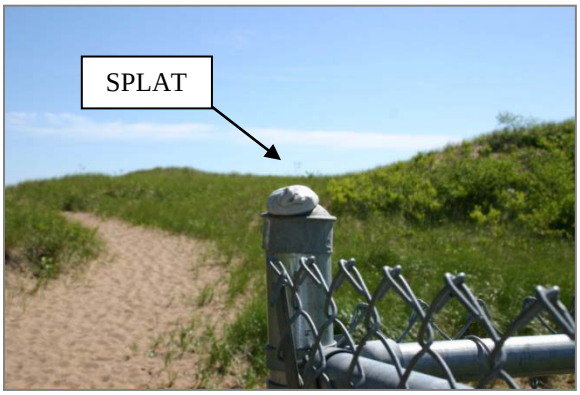
No major incidents were reported during the applications, although a Temporary Flight Restriction was placed over a tornado touchdown site in Minneapolis and an unrelated mosquito control helicopter was downed during the second application, making for very busy control towers.

A nursery in Monticello, MN violated the terms of a Compliance Agreement in 2010, resulting in the cancellation of the established CA and issuance of an order to treat in the spring of 2011. Alternate life stages were found on stock that was brought in from a quarantined area of Wisconsin. The stock was supposed to have been inspected and free of gypsy moth prior to bringing it into Minnesota. Insecticide treatment was ordered to include the stock holding area and all other areas identified by the Minnesota Department of Agriculture (MDA) and the United States Department of Agriculture (PPQ) representatives.

Slow the Spread: The Btk block in St. Louis County was right in central Duluth. Treatments began on June 12th during an open weather window and were completely blocked by fog and rain until June 24th when the second application was completed without incident. The first application fell within "normal" date ranges despite the cool, wet spring.

The Park Point neighborhood of Duluth, situated on one of the world's longest freshwater spits, is too narrow to fly with spray aircraft so a ground application of the mating disruption product SPLAT(R) was planned for the 460-acre site. Sixteen MDA employees and one federal worker helped to apply the product with caulking guns along the length of the spit, including the southern third which is forested and boasts a healthy poison ivy crop.

The flakes applications began on Friday, July 15 when the caravan moved in to the Superior airport. We were unsure how a weekend treatment would go over with residents and businesses but treated the state lands (during the government shutdown they were supposedly empty) and encountered few problems associated with the timing. Thanks to relatively large blocks and long flight lines, pilots were able to make up for late starts each day due to heavy haze, fog, rainstorms, and low ceilings. Excessive heat warnings coupled with air pollution from Canadian forest fires the entire week meant extreme conditions for all personnel involved in the project. Aerial treatments wrapped up on the evening of July 20th.



COST

Treatment Type	*Product*	*Acres*	*$ Per Acre*
Eradication	**Foray 48B**	**1,861**	**$35.50**
Eradication	**Dimilin 25W**	**35**	**$0***
Slow the Spread	**Foray 48B**	**342**	**$35.50**
Slow the Spread	**SPLAT GM**	**460**	**$10.68****
Slow the Spread	**Disrupt II**	**114,186**	**$7.57**

* Cost incurred by the private nursery operation.
**Includes only the product and shipping costs, not the personnel used and expenses to carry out the work.

ALTERNATE LIFE STAGE SURVEYS

No alternate life stages were found during the surveys this season. In the southern region, trap catches were extremely low, along with the likeliness of finding egg masses in the only areas where traps caught more than three

moths. In the north, even multiple high trap catches in two concentrated areas of Lake County didn't result in finding any alternate life stages.

Three areas in the southern region were surveyed by MDA and APHIS-PPQ staff. One site was a delimited area that yielded a total of nine moths in five traps this season. This site is located in Eyota, just east of Rochester, at an Olmstead County park and campground. Another delimited area in a residential neighborhood of St. Louis Park (Hennepin Co.) was surveyed due to a single trap yielding 6 moths. In Randall (Morrison Co.) a motel/RV park and the surrounding residential neighborhood were searched after finding three moths in a trap. This site was of particular importance with how far west it is located from the invasion front.

In the northern region, there were many "Critical Finds". These are traps categorized as having the highest trap catches, having met a threshold moth count. The threshold differs depending on whether the traps are in the STS Action Area or not. These traps are considered to be of high importance when it comes to prioritizing where to conduct alternate life stage surveys. Critical Finds were scattered around the northeast this year, from Carlton to Cook County. There were two areas where clusters of multiple Critical Finds occurred in southern Lake County where larger organized group surveys took place. The approach for surveying the scattered, single Critical Finds was to send individual trappers to assigned sites to survey the area immediately surrounding the trap location for 20 minutes.

OUTREACH

Recent legislation in Minnesota makes the now-fee-based Tree Care Registry a source of income for the division. The Registry is now housed with the Gypsy Moth Program so program managers will have access to contact information for all registered tree care companies to give updates on invasive species quarantine issues.

Treatment proposals offer many opportunities for outreach and MDA coordinated several events for media, elected officials, and the general public to learn about the program. Visits to businesses with compliance agreements are an annual occasion for employees to reacquaint themselves with the gypsy moth regulatory program.

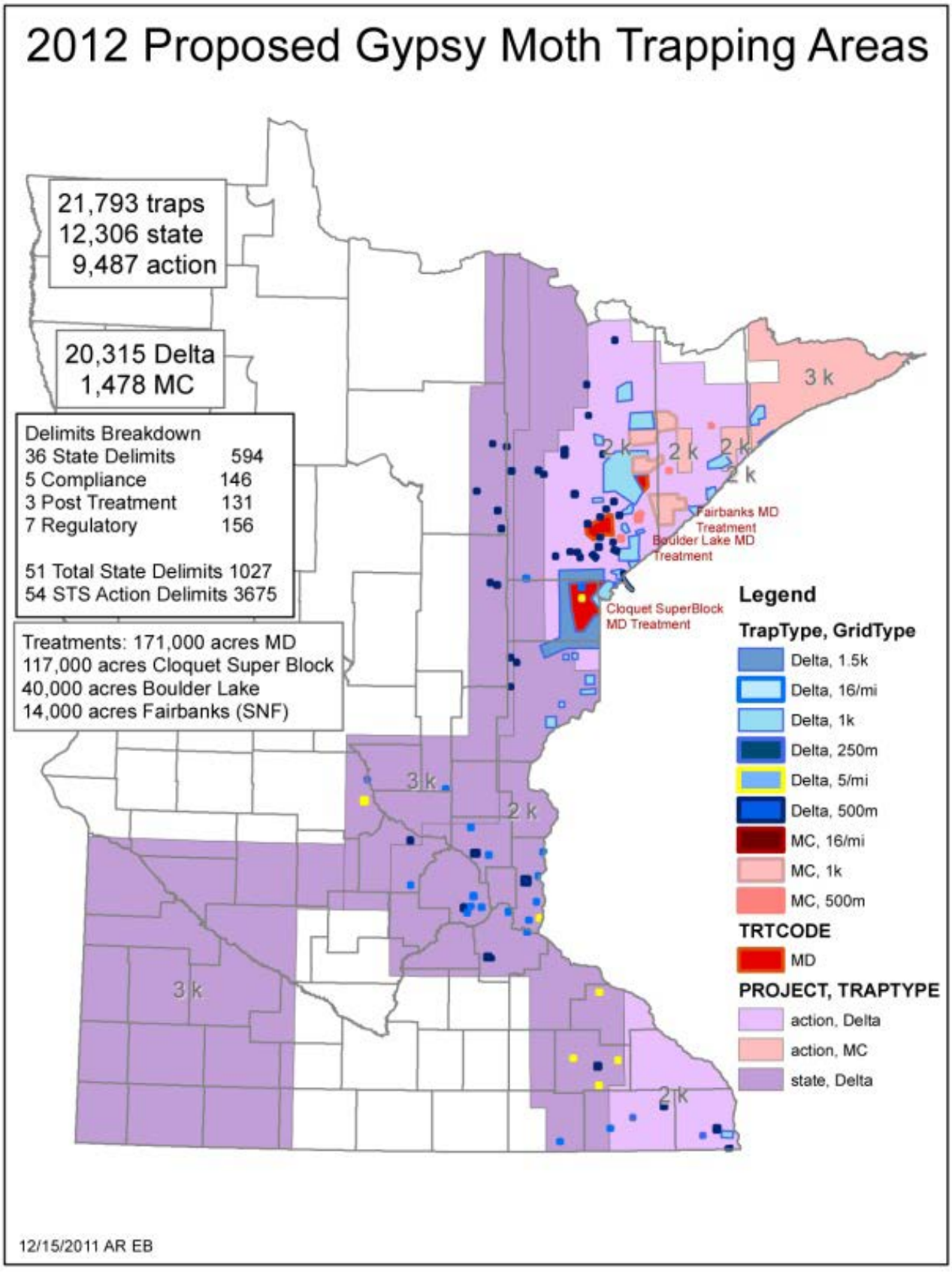
A gypsy moth session was offered at the Minnesota/Wisconsin Invasive Species Conference and a program was given on the Invasive Species Tour hosted by the Minnesota Soil and Water Conservation Districts. Since 2009, gypsy moth information has been included in Minnesota's award-winning Forest Pest First Detectors program offered jointly through the University of Minnesota Extension, the DNR, and the MDA to train people statewide to identify gypsy moth life stages.

PROGRAM PLANS FOR 2012

The annual survey will continue to focus on the eastern border of Minnesota, with special attention paid to both STS areas and high-risk areas such as the Twin Cities metropolitan. The western rotation in 2012 will include the SW corner of the state. Trapping densities are shown on the map below. It is projected that ~21,000 traps will be set. Milk carton traps will be necessary in Cook County and other select areas of the northeastern trapping grid due to high numbers of moths found in those areas in 2011. All other deployed traps will be of the delta variety.

The enormous state budget deficit impacts all programs that rely on general revenue funds to operate, including the gypsy moth program. Newly elected lawmakers and leaders will alter the political climate needed to maintain invasive species management work in Minnesota. The gypsy moth program is integrated with MDA's mission and we are confident that it has proven itself over the past three decades as a successful, economical, and popular service.

MINNESOTA DEPARTMENT OF AGRICULTURE
PLANT PROTECTION



2011 County Catch Summaries

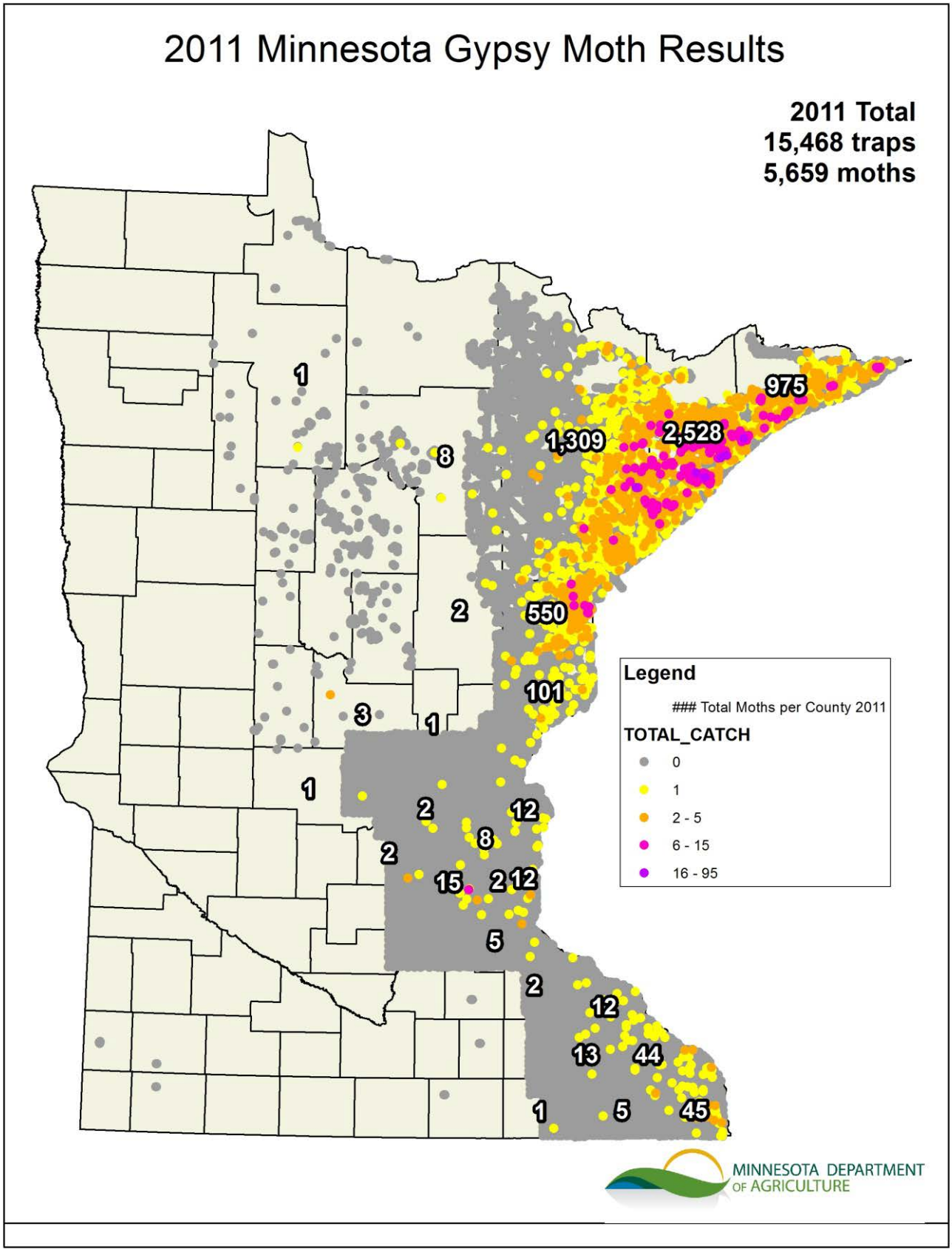
Positive Counties	# Traps	# Moths	% of Total Moths
Aitkin	119	2	0%
Anoka	397	8	0%
Beltrami	40	1	0%
Carlton	**1,022**	**550**	**10%**
Chisago	293	12	0%
Cook	**996**	**975**	**17%**
Dakota	453	5	0%
Fillmore	585	5	0%
Goodhue	245	2	0%
Hennepin	551	15	0%
Houston	**474**	**45**	**1%**
Itasca	278	8	0%
Lake	**1,412**	**2,528**	**45%**
Mille Lacs	83	1	0%
Morrison	40	3	0%
Mower	142	1	0%
Olmsted	435	13	0%
Pine	**757**	**101**	**2%**
Ramsey	121	2	0%
Saint Louis	**3,455**	**1,309**	**23%**
Sherburne	175	2	0%
Stearns	138	1	0%
Wabasha	370	12	0%
Washington	442	12	0%
Winona	**472**	**44**	**1%**
Wright	274	2	0%
# Positive Counties: 26			

Negative Counties	# Traps
Benton	166
Carver	275
Cass	122
Clearwater	35
Cottonwood	1
Crow Wing	88
Dodge	65
Freeborn	25
Hubbard	35
Isanti	155
Kanabec	74
Koochiching	77
Lake of the Woods	43
Le Sueur	45
Murray	25
Nobles	25
Pipestone	8
Rice	52
Scott	255
Sibley	61
Steele	25
Todd	36
Wadena	6

2011 GM Survey Summary Tables:

Management Zones	Total Traps	% of Total Traps	Total Moths	% of Total Moths
Eradication Area	8,496	55%	357	6%
STS Action Area	6,972	45%	5,302	94%
TOTAL	**15,468**	**100%**	**5,659**	**100%**
Traps set by agency	**Traps Set**	**Positive Traps**	**Moth Count**	
MDA	14,735	2,571	5,652	
APHIS	485	5	7	
County. Ag. Inspector Volunteers	225	0	0	
Three Rivers Park District	23	0	0	
TOTAL	**15,468**	**2,576**	**5,659**	
Trap Type				
Standard	10,569	1,400	2,628	
Delimit	3,295	1,102	2,910	
High Risk Sites	871	69	114	
Cooperator Traps	733	5	7	
TOTAL	**15,468**	**2,576**	**5,659**	
High Risk Sites	*Note that these figures are spatial and may duplicate trap and moth counts. These numbers are not to be incorporated into totals.*			
Nursery	429	9	9	
Mill	161	19	34	
State Park	65	6	12	
Campground	146	24	35	
Firewood Dealer	7	1	1	
Reactive	0	0	0	
Random	63	15	23	
TOTAL	**871**	**74**	**114**	
Urban Areas	*Not all urban areas listed; figures include all types of traps set within the urban boundaries.*			
Duluth	111	14	23	
Twin Cities Metro Area *	2,488	33	42	
Rochester	32	0	0	
St. Cloud	16	0	0	
Winona	17	0	0	
Mankato	0	0	0	
Reservations				
Fond Du Lac	245	59	71	
Grand Portage	87	27	85	
Boise Forte (Vermillion, Nett Lake)	41	1	1	
Leech Lake	122	1	1	
Mille Lacs	3	0	0	
Prairie Island	4	0	0	
TOTAL	**502**	**88**	**158**	
Federal Lands				
Superior National Forest	2,644	265	2,863	
Chippewa National Forest	179	2	2	
TOTAL	**2,823**	**267**	**2,865**	

** Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington Counties*


2011 Minnesota Gypsy Moth Results
2011 Total
15,468 traps
5,659 moths
1
8
2
3
1
1
2
8
2
15
2
12
12
5
2
12
13
44
1
5
45
1,309
2,528
975
550
101
Legend
Total Moths per County 2011
TOTAL_CATCH
0
1
2 - 5
6 - 15
16 - 95
MINNESOTA DEPARTMENT
OF AGRICULTURE

Japanese beetle

Popillia japonica

Hosts	Grasses, roses, shrubs, birch, basswood
Setting	Urban forest
Counties	Ramsey, Washington, Hennepin
Survey methods	Ground detection
Acres affected	Not determined

Narrative

It seems like only yesterday that the Japanese beetle was a pretty curiosity in the Twin Cities Metro Area. The Minnesota Department of Agriculture was trapping adult beetles, inspecting nursery stock root balls and containers for grubs and ordering treatment when necessary; that all changed in 2002. That year the MDA recognized that the Japanese beetle population, despite concerted eradication efforts, had grown too large in the Metro area for any hope of keeping this non-native, invasive pest at bay—it was declared a 'general pest' to be added to the lengthy list of insects that will eat our ornamental plants.

Severe defoliation of ornamentals and trees has been reported across the Metro area this year. In past years there have been a few 'hot spots' often near golf courses or other large expanses of turf, but this year damage is widespread as grubs infest more and more lawns and grassy areas as the adult population increases. In many neighborhoods, birch and linden trees sustained 50 to 90 percent defoliation and along many roadways the leaves of Virginia creeper and wild grape growing on fences are completely skeletonized. A large adult population and ample moisture in turf this year are ideal conditions for a bumper crop of larvae – next year may be a very good year for Japanese beetle!

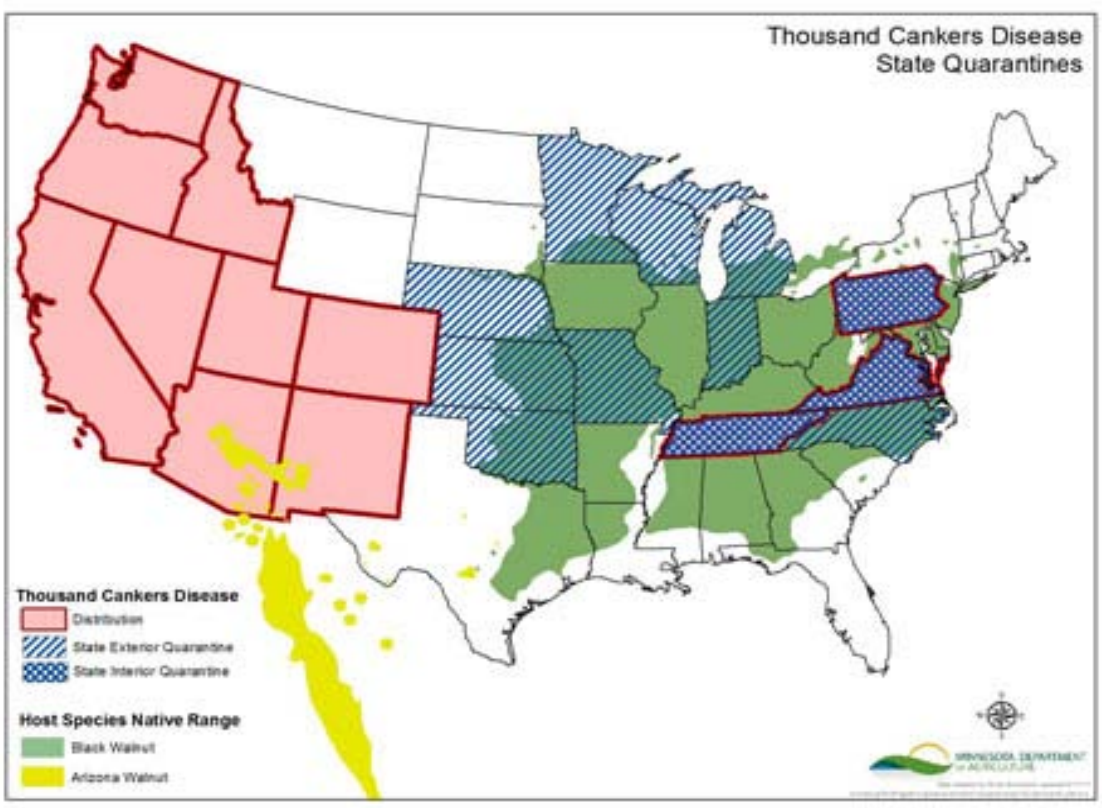
EXOTICS NOT KNOWN TO BE IN MINNESOTA

List of exotics not known to be in Minnesota in 2011

Annosum root disease
Asian long-horned beetle
Beech bark disease
Dogwood anthracnose
Fusiform rust
Hemlock wooly adelgid
Laurel wilt disease
Sirex woodwasp
Sudden oak death
Thousand cankers disease

Thousand cankers disease of black walnut: Exterior quarantine

Minnesota's exterior quarantine was issued in February 2011 by the Minnesota Dept. of Agriculture to protect black walnut trees in Minnesota from thousand cankers disease (TCD). TCD is killing walnut trees in the western United States and Tennessee, Virginia and Pennsylvannia. TCD can be spread by moving infested wood and trees. An exterior quarantine is to prevent the movement of walnut that may have TCD into Minnesota. Several states in the native range of eastern black walnut have issued exterior quarantines similar to Minnesota's to prevent the introduction of TCD. See states with blue stripes on map.

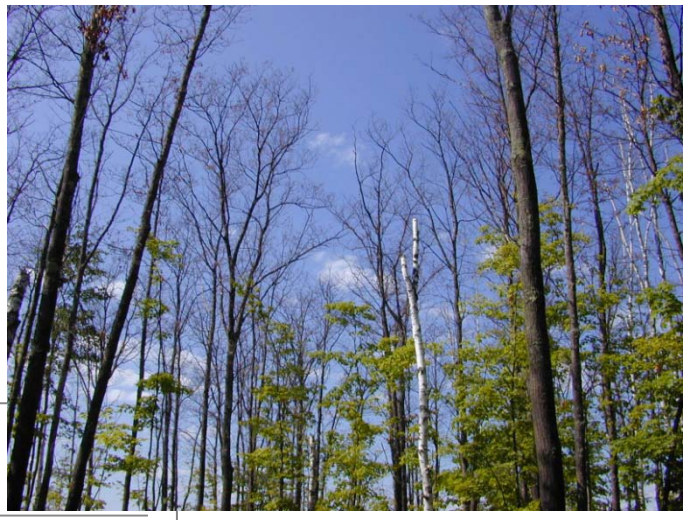


The quarantine was issued as a preventative measure to help stop thousand cankers disease (TCD) from coming to Minnesota. Products covered by the quarantine include live walnut trees, walnut logs, walnut lumber, walnut nursery stock, wood chips and mulch made from walnut wood, walnut branches and roots, packaging materials made from walnut wood, and all hardwood firewood.

The quarantine does not apply to walnut nuts, nutmeat, walnut hulls, finished products made from walnut wood without bark, or processed lumber that is 100 percent bark-free, and kiln-dried with square edges. Several other states within the native range of eastern black walnut have similar exterior quarantines in place. Announcement of the quarantine comes within a month of the detection of TCD in the state of Virginia, the second state within the native range of eastern black walnut to report the disease.

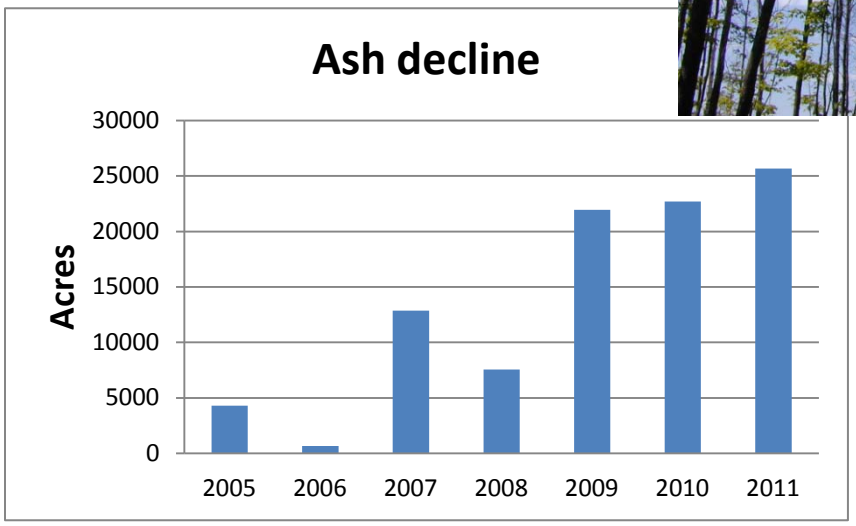
ABIOTIC AGENTS AND DECLINES

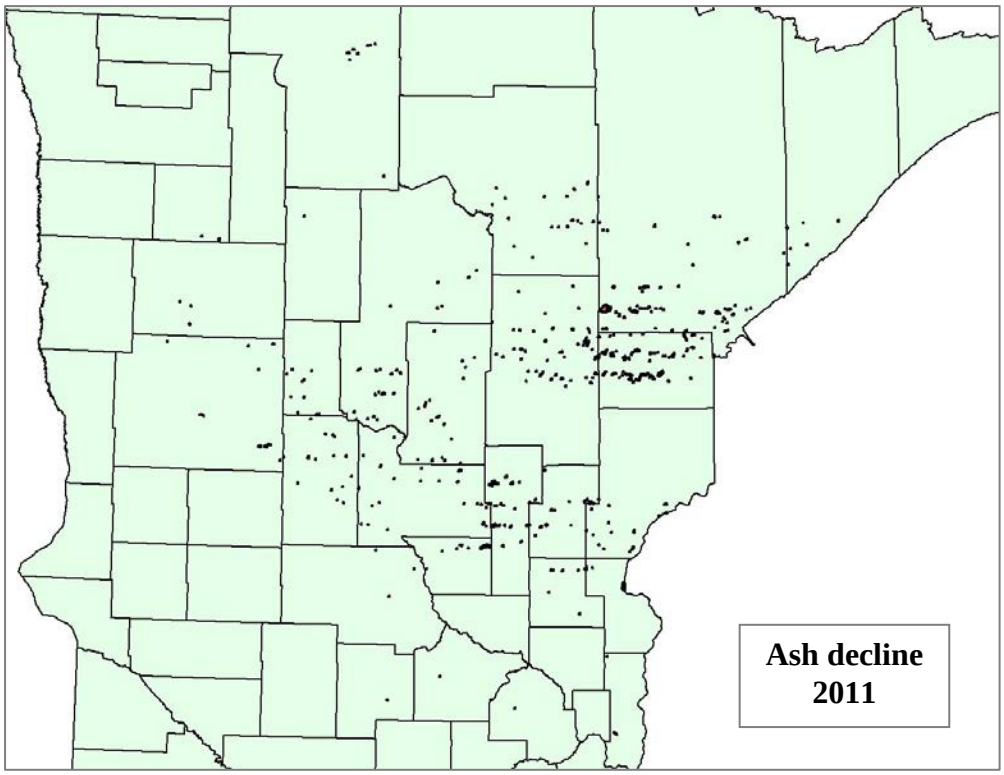
Ash decline



Hosts	Black ash
Setting	Forests
Counties	See map
Survey methods	Aerial detection
Acres affected	25,672 ac
Narrative	

Ash decline occurred in 519 stands and was detected on 25,672 acres in 2011. Acres of ash decline were similar to last two year's tallies. See map and chart.





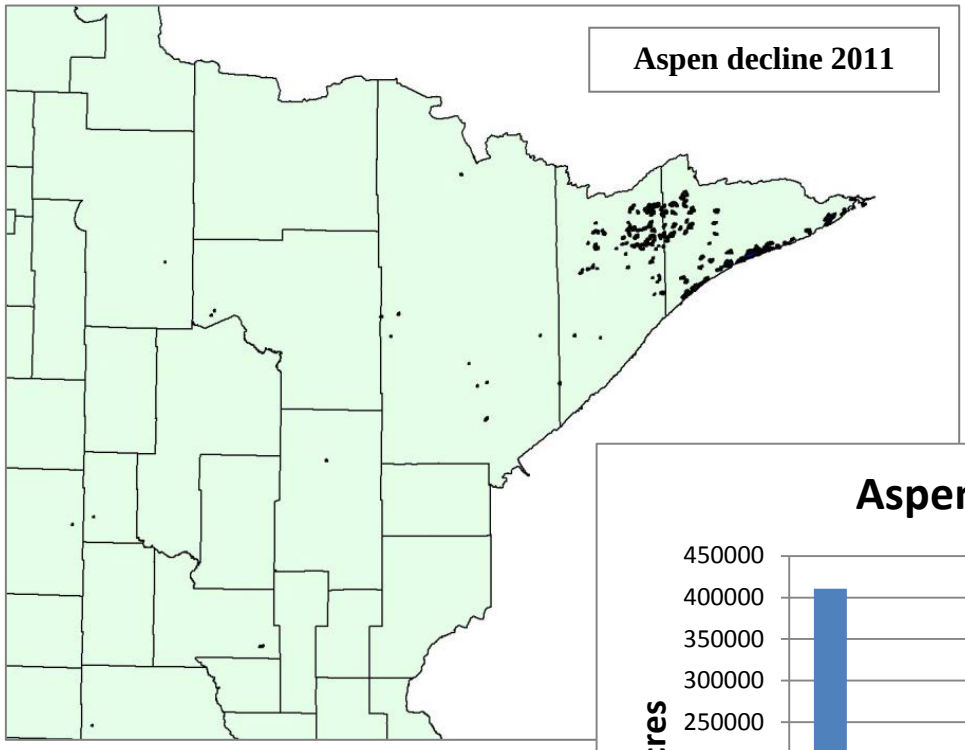
Aspen decline

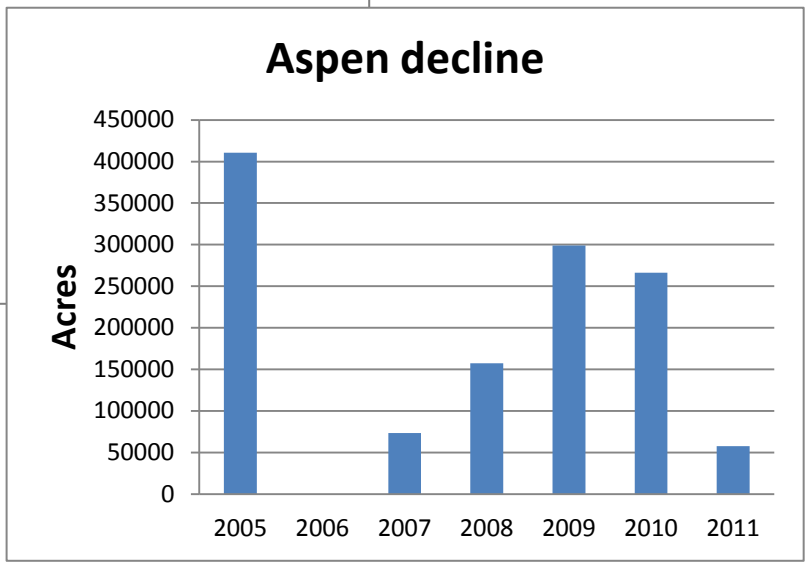
Hosts	Quaking aspen, some paper birch
Setting	Forests
Counties	See map, primarily Cook Co
Survey methods	Aerial surveys
Acres affected	57,702 acres
Narrative	

Since 2004, aspen with symptoms of decline has been mapped by aerial survey sketch mappers. See chart. Symptoms have included combinations of defoliation, discoloration, dieback and/or mortality. The map shows 164 polygons of aspen with current symptoms of aspen decline. This year's decline in acreage may be an artifact of the lateness of the aerial detection survey due to the government shutdown in July.

Dieback is the most common symptom but tree mortality has also occurred. Mortality can vary from scattered trees throughout a stand to patches of 30 to 40 dead trees scattered through stands. Trees with dieback often also exhibit small off-color foliage in the live parts of the crown. Ground surveys have found serpentine galleries of bronze poplar borer on dead trees as well as in trees with extensive dieback.

Most of the dieback has been mapped in the northern tier of counties especially in St Louis, Lake and Cook Counties. It is thought that severe summer droughts, as well as, three to four years of heavy forest tent caterpillar defoliation early in the decade stressed the aspen resulting in attack by bronze aspen borers.

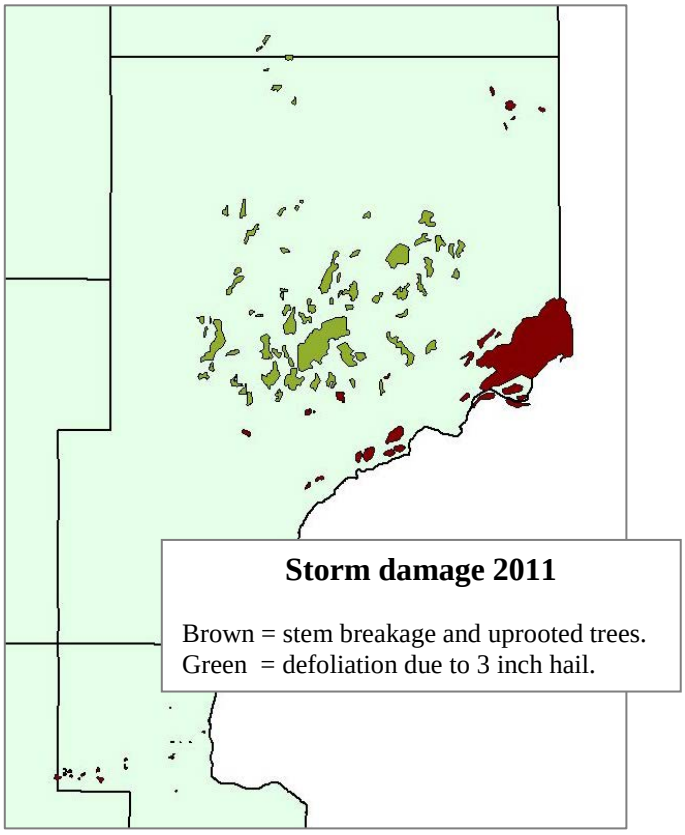




Blowdown

Hosts	Conifers and hardwoods
Setting	Forests
Counties	Pine and Chisago
Survey methods	Aerial survey
Acres affected	52,794 ac
Narrative	

On July 1st and 19th, Pine County suffered tremendous damage from straight-line winds. There were 27,397 ac of defoliation due to 3 inch hailstones. There were 25,397 ac of uprooted trees and stem breakage. The July 1st storm took 32 minutes to traverse an area starting in Pine Co, MN and ending in Bayfield Co, WI. Straight line winds were clocked at 100 mph. The storm did most of its serious damage in St. Croix State Park. Luckily, the storm occurred during the government shutdown so no people were there to be injured. Most of the buildings and other facilities were lost.

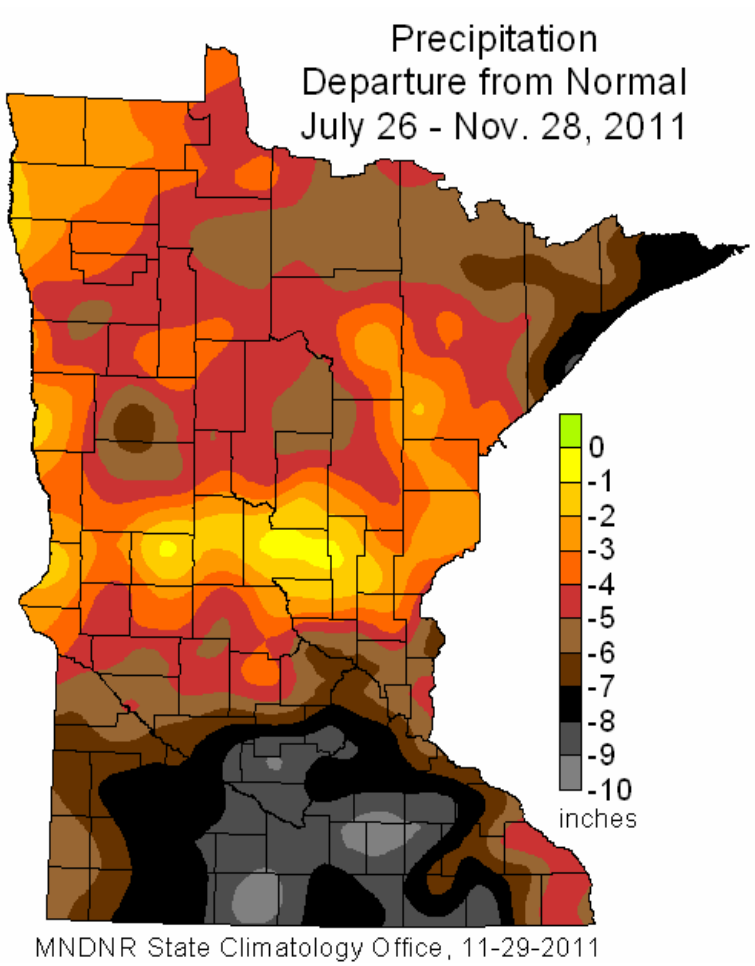


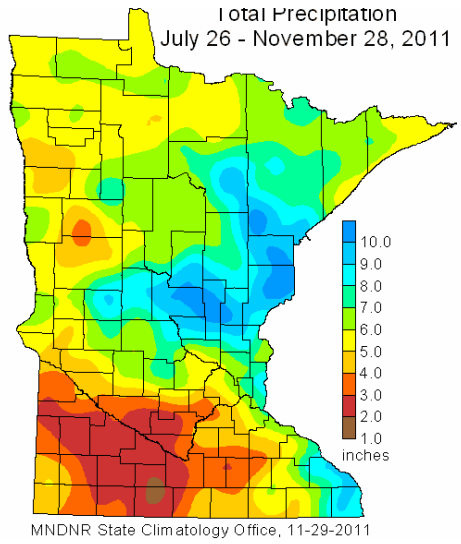
Forested counties designated as ‘Abnormally Dry’ to under ‘Severe Drought’

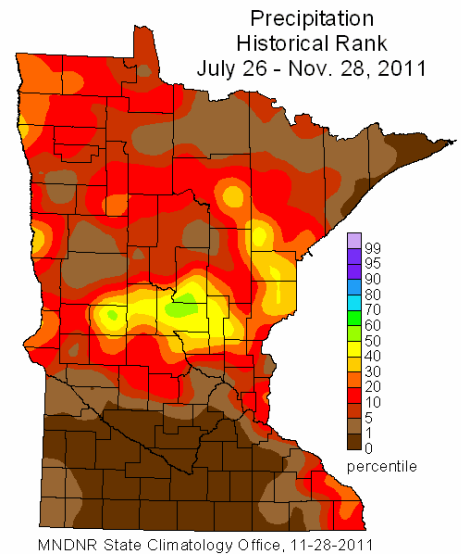
Hosts	All species
Setting	All forests
Counties	Statewide
Survey methods	Ground detection
Acres affected	Not determined
Narrative	

Adapted from the Climatology Work Group
See http://climate.umn.edu/doc/journal/drought_2011.htm

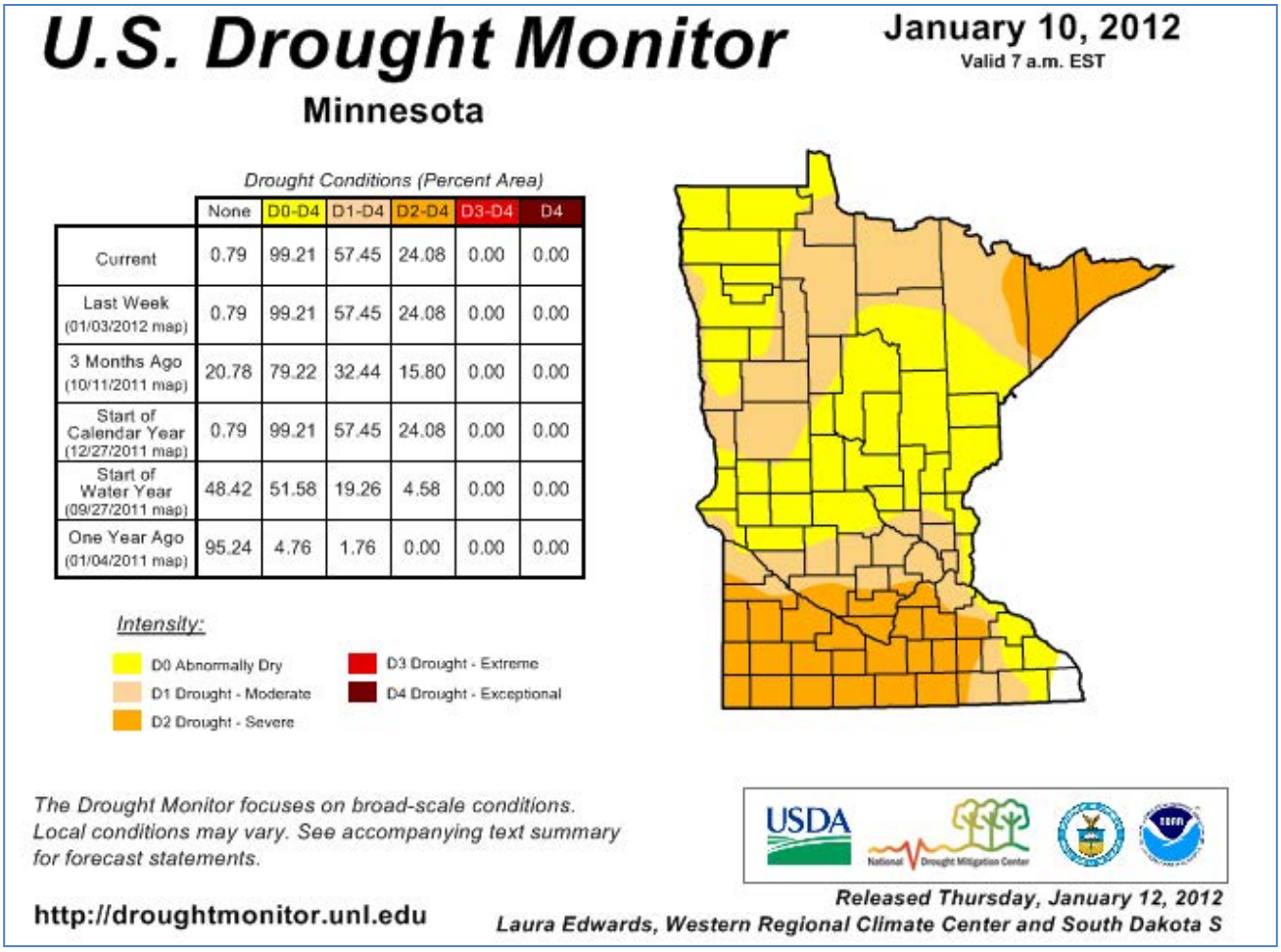
Significant precipitation shortfalls were reported across Minnesota over the period from late-July through the end of November. See maps below. Large sections of north central and northeast Minnesota are said to be undergoing ‘Moderate’ to ‘Severe Drought’ by the U.S. Drought Monitor. See maps next page. Stream flow and lake levels are very low due to the ongoing impact of precipitation deficits accrued during the 2010 growing season and spotty rainfall that fell during this growing season. In southern and western counties, large areas are also depicted in the ‘Moderate and Severe Drought’ categories. Much of this region reported significant late-summer and autumn precipitation shortfalls. Precipitation totals for the past eighteen weeks are less than three inches in many areas, a negative departure from the long-term eighteen-week average of five to nine inches. When compared with the same eighteen-week period in the historical database, the 2011 precipitation totals rank among the lowest on record.



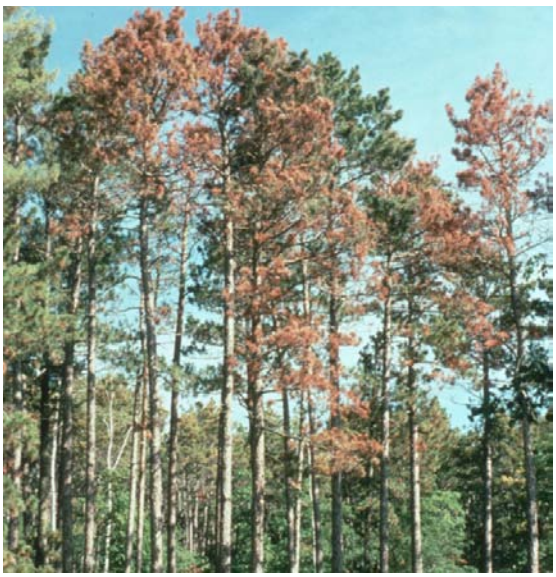




In addition to that, the fall months were warmer than usual. October of 2011 is ranked in the top ten warmest months on record and November is ranked the warmest November to date. Temperatures were 4 to 6 degrees above normal across the state. In biological terms, it is likely that these warmer temperatures facilitated root growth in all species. Warmer temperatures increased transpiration in conifers and combining that with soil water deficits, the effect was to create physiological stress.



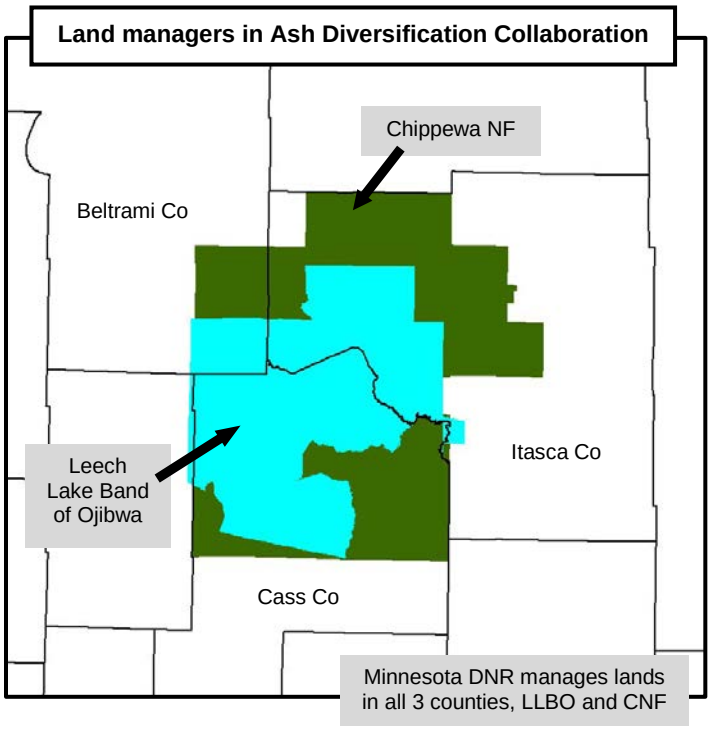
Going into the winter, trees will be drought-stressed all across Minnesota. That will mean that they are more vulnerable to opportunistic insects such as bark beetles in conifers, bronze birch borers, two-lined chestnut borers in oak and bronze aspen borer in trembling aspen. If the spring weather is warm and dry, the opportunists will flourish, build populations and start to cause mortality by the autumn of 2012. If the spring weather is cool and rainy, the trees will have an opportunity to rebuild their water reserves and repel the opportunists. We'll just have to "wait and see".



SPECIAL PROJECTS
FOREST HEALTH PROGRAM

Ash Diversification Collaboration: 2011 accomplishments
Detecting *Diplodia* pathogens from seeds of red and jack pines
Diplodia: Seedling storage experiment
Eastern larch beetle studies initiated at Univ. of Minnesota
EAB: Cross-jurisdictional response and preparedness
EAB: Responding to ICS requests for assistance
First Detectors Program: Accomplishments and awards
FID Newsletter goes on-line
Forest tent caterpillar: Incorporating insect migration into assessments of how climate change will impact forest health
National Insect and Disease Risk Mapping efforts
NAASF-Forest Health Subcommittee summary
Operational Order 113: Invasive Species Guidelines
White spruce thinning study – 5 year results paper published

Ash Diversification Collaboration



The Chippewa National Forest and Minnesota Forest Resources Partnership (MFRP) initiated the Ash Diversification Collaboration project the fall of 2010 that focuses on a collective response to managing black ash stands across ownerships within the boundary of the Chippewa National Forest. It was generally agreed at the Black Ash Symposium 2010, that to maintain sites occupied by black ash in forest cover following invasion by the emerald ash borer (EAB), silvicultural treatments that diversified these stands would be necessary. This could be accomplished as individual agencies, organizations and private landowners. However, with the impacts of our ash demise affecting not only ash covertypes, but also the hydrology of these lands, it is obvious the effects of EAB will cross ownership boundaries. A collective response to the management of black ash stands would be more effective and potentially more efficient. It is also felt that this project could serve as a model for others dealing with the same threat or new future threats that know no political or geographic boundaries. A coordinated effort would also aid in testing the effectiveness of various prescriptions and methodologies.

All the agency land managers inside the boundary of the Chippewa NF, Beltrami County, Cass County, Itasca County, Leech Lake Band of Ojibwa and the MN-DNR along with the MFRP, agreed to collaborate on this pilot project and created project goals and objectives early in 2011. The overarching goalsare to diversify tree species on a few ash-dominated stands in lowland habitats and retain current site hydrology so that we can prevent inundation of the sites expected from EAB-caused mortality. That way, we can keep future options open for long-term stand management. We hope to accomplish this by using selection harvest to meet silvicultural requirements of seeded/planted species on suitable microsites, while retainng high levels of transpiration in residual ash trees. Some species will also be provided protection from deer. Other objectives are to:

- Collaborate on processes for stand selection, creation of stand prescriptions and implementation of the prescriptions,
- Collaborate on the creation of stand prescriptions and implementation of the prescriptions,
- Use the DNR-DOF “Ash management Guidelines” to guide prescription development,
- Independently contract for silvicultural and timber activities on our own lands, but time contracts so work is done simultaneously in order to facilitate contract marketing and lower costs of that work,
- Adapt these plans and prescriptions as research results become available from Dr. D’Amato’s research plots on the Chippewa NF,
- Incorporate private lands on a parcel-by-parcel basis as future grant funding allows, and,
- Share project goals, methods and outcomes with other foresters and landowners in Minnesota.

After data compatibility problems were worked out, the stand selection process began. DNR stands came from the pool created by the SFRMP process. Each agency brought a list of candidate ash stands and together they totaled 99 stands. Further filters were applied to computer/ GIS searches. Criteria were: stand is predominately black ash, in lowland habitat, has DBH. >10 inches and is accessible. Thirty-one stands fit our criteria and needed to be field checked to verify inventory, operability, habitat classification and accessibility. After field checking sixteen parcels, eight stands met our final criteria. See table. In 2012, we will collaborate on the development of individual stand prescriptions for each of the eight stands and begin the paperwork needed in each of our agencies. Potential impediments to success include: collaborative development of individual stand prescriptions, simultaneous marketing of silviculture/ timber contracts, adequate funding for seeding/ planting and gap creation, long-term follow-through, and inclusion of private forest land parcels into the project.

Acres and number of parcels by agency for the 8 ash-dominated stands selected for the ADC pilot project

	LLBO	*Cass Co*	*DNR*	*Chippewa NF*
Acres	7.6	44.6	65.4	160.8
Stands	1	3	3	9

Cultural detection of Diplodia shoot blight pathogens from red pine and jack pine seeds

Denise R. Smith and Glen R. Stanosz, Department of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706, USA; Jana Albers, Division of Forestry, Minnesota Department of Natural Resources, Grand Rapids, MN 55744, USA

The pine shoot blight and canker pathogens *Diplodia pinea* and *D. scrobiculata* are among the many fungi associated with seed cones of conifers. Each of these species has been found to commonly and abundantly sporulate on cones of red pine (*Pinus resinosa*) and jack pine (*P. banksiana*) collected in Wisconsin forests. Cultural methods were used to investigate the incidence of these fungi on or in seeds obtained from government nurseries in Minnesota (three red pine seedlots) and Wisconsin (five red pine seedlots and five jack pine seedlots). Seeds were extracted, cleaned, and stored using standard methods at each nursery. In each of three replicate trials, seeds of each lot were assigned to four treatments: 1) not surface disinfested, 100 seeds; 2) surface disinfested, 50 seeds; 3) surface disinfested and then inoculated with *D. pinea* conidia, 50 seeds; or 4) not surface disinfested but then inoculated with *D. pinea* conidia, 50 seeds. Each seed was placed in a slant containing tannic acid agar and autoclaved pine needles, and incubated for up to 6 weeks. Development of pycnidia with conidia consistent with those of *Diplodia* species indicated presence of either pathogen. For red pine seeds, the mean percentage positive was 2.7% for treatment 1 and 1.3% for treatment 2. Jack pine seeds were less frequently positive for both treatments. Using species-specific PCR primers, the *Diplodia* species cultured was identified as *D. pinea* in almost every case, with identification of *D. scrobiculata* only rarely. *D. pinea* was much less frequently detected from seeds that were not surface disinfested but then inoculated (treatment 4) compared to seeds that were inoculated with *D. pinea* after surface disinfestation (treatment 3). This indicated that presence of seed-surface microflora led to underestimation of the actual presence of the pathogen in treatment 1. Results confirm the potential for dissemination of *D. pinea* on red pine and jack pine seeds. And although the frequency of positive seeds was low, the large numbers of seeds planted in nurseries suggest that seeds may be a potentially important route of entry of *D. pinea* into nursery beds.

Final report and oral presentation by Dr. Stanoz at the IUFRO mtg. in Spain, 2011.

Storage conditions influence cultural detection of the shoot blight pathogen *Diplodia pinea* on or in asymptomatic red pine nursery seedlings

Denise R. Smith and Glen R. Stanosz, Department of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706, USA; Jana Albers, Division of Forestry, Minnesota Department of Natural Resources, Grand Rapids, MN 55744, USA

The pine shoot blight and canker pathogen *Diplodia pinea* has been shown to persist on or in asymptomatic red pine nursery seedlings, with later potential to rapidly proliferate after outplanting to cause disease, including seedling mortality. After lifting from nursery beds, seedlings are routinely kept in cold storage at nurseries, but during and after shipment to containers may be maintained without refrigeration for several days prior to planting. The potential for both the duration and temperature of storage to influence the frequency of cultural detection of *D. pinea* from asymptomatic red pine seedlings was investigated. In the first two experiments, surface-disinfested stem segments from seedlings were culturally assayed for *D. pinea*: shortly after lifting in spring; after 3 weeks of cold storage (approximately 4 degrees C in experiment 1) or 4 weeks of cold storage (approximately 8 degrees C in experiment 2); or after 3 weeks of cold storage followed by 1 week of storage at approximately 24 degrees C in both experiments). Probably due to implementation of a program of scrupulous sanitation and application of preventative fungicidal sprays at the nursery, *D. pinea* was infrequently detected, and no effects of storage were apparent. In two additional experiments, seedlings were inoculated with a suspension of *D. pinea* conidia and then similarly assayed: after 3 weeks of cold storage (approximately 4 degrees C in experiment 3) or 4 weeks cold storage (approximately 8 degrees C in experiment 4); or after 3 weeks of cold storage followed by 1 week of storage at approximately 24 degrees C in both experiments. In experiments 3 and 4, in which the pathogen was initially present due to inoculation, frequency of detection of the pathogen was greater after longer storage and after storage at a warmer temperature. This indicates that the association of the pathogen with seedlings may be affected by storage conditions. Thus, when inoculum is present, minimization of the duration of storage and maintenance of cold temperatures during storage may inhibit persistence of *D. pinea* on or in seedlings, and help to reduce later seedling mortality.

Final report and oral presentation by Dr. Stanoz at the IUFRO mtg. in Spain, 2011.

Eastern larch beetle studies initiated at the University of Minnesota

Fraser McKee, a PhD candidate at the University of Minnesota, working with Dr. Brian Aukema started a research project in the spring of 2011, studying eastern larch beetle with the following initial goals:

1) Track larch beetle flight periods (via pheromone-baited funnel traps) throughout the year, and correlate these flight patterns with over-wintering adult emergence, adult re-emergence from successfully colonized hosts, and emergence of secondary/tertiary broods (via emergence cages attached to colonized hosts)
2) Create a life-table analysis of mortality factors for developing brood.
3) Examine host selection by over-wintering and re-emergent adults as a function of host health/vigor, and relate this to intractions between the insect and plant via host defensive responses, and ultimate brood production as related to host vigor. This study will look at host selection as beetle populations are increasing.
4) Look at interactions between larch beetle and other herbivores (eg. larch case bearer) and how defoliation affects rates of beetle entrance into hosts, reproductive output etc.
5) Use dendrochronology to examine patterns of larch beetle host selection across time from incipient-epidemic to post-epidemic population phases.
6) Side-project: look at seed tree survivorship in clear-cut stands following salvage harvest

Emerald ash borer: Cross-jurisdictional response and preparedness

USDA Animal Plant Health Inspection Service (APHIS) – Plant Protection and Quarantine (PPQ) sponsored two workshops in conjunction with other Minnesota agencies, levels of government and landowners. The focus of the workshops was to begin a discussion around emerald ash borer (EAB) response concepts in order to develop one general response plan among Tribal governments, National Forest Service, counties and other state and federal agencies in Minnesota.

The initial meeting in February was held to collect current EAB response plans from the various agencies and to learn agency roles, responsibilities, and authorities. At the second meeting, held in May, attendees participated in an exercise to improve understanding of response concepts within the Incident Command System and other control structures. Presentations on response roles were given by APHIS-PPQ, the Minnesota Department of Agriculture, and the Minnesota DNR. Exercises planned for 2012 include a table-top exercise, a drill to practice communications and actions from the discovery of an unknown pest through identification, confirmation, and notification to effected groups, and a functional exercise to respond to an actionable forest pest.

Emerald ash borer: Responding to ICS requests for assistance

The Division of Forestry developed an emerald ash borer (EAB) response plan this year to be applied when EAB is discovered in greater Minnesota, away from the seven-county metro area and the existing quarantined counties. In this situation, the Minnesota Department of Agriculture will evaluate local conditions and resources, and if required, notifies other state authorities of a local need. The plan is based on the Incident Command System, and describes the local step-by-step process of reporting EAB, communicating information to authorities, and conducting plan implementation.
This is still a draft document until it has been accepted by the EAB Unified Command.

INITIAL DNR EAB RESPONSE PLAN	Responding to Requests for Assistance with Outlier EAB Infestations

Approved By	Initiation Date	Revision Date
EAB Unified Command	DRAFT	DRAFT

PURPOSE	To support the Minnesota Department of Agriculture (MDA) and when needed respond to new EAB infestations in a consistent and efficient manner; To minimize the spread of EAB and subsequent damage.
SCOPE	These procedures pertain to "outlier" infestations in situations where the MDA has identified a need for local resources. "Outlier" infestations are new EAB infestations occurring outside the seven-county metro area and existing quarantined counties.

STATE-LEVEL PROCEDURES	
Detection & Verification	All new EAB detections, regardless of the detection source, are reported to MDA. MDA consults with USDA Animal and Plant Health Inspection Service (APHIS) for positive identification and verification of EAB.
Notification	MDA notifies State Unified Command of the positive find.
Request	If warranted upon evaluation of local conditions and available resources, MDA notifies State Unified Command of a local need.
Response	State Unified Command authorizes response at the local level. The DNR IC in the Unified Command notifies the DNR Regional Forest Health Specialist (RFHS).

INITIAL RESPONSE TEAM - RESPONSIBILITIES	
State Ops Chief and RFHS	▪ State Unified Command Ops Chief (or their representative) serves as the primary technical advisor to initial and local responders. ▪ RFHS serves as a local technical advisor to initial responders. ▪ State Unified Command Ops Chief (or their representative) notifies affected tribes, and state and federal land owners. ▪ RFHS notifies DNR Area Forest Supervisor, Regional Information Specialist, Regional Forest Manager and Regional Director. ▪ All initial notification occurs within 48hrs of confirming EAB.
Initial IC and PIO	▪ Area Forest Supervisor serves as the initial response incident commander (Initial IC). ▪ Regional Information Specialist serves as the initial public information officer (Initial PIO). ▪ Initial IC and Initial PIO identify local representatives from all land management organizations and local units of government that may be involved in the infestation. ▪ Initial IC schedules and organizes a local briefing meeting to be held within one week of confirming EAB. ▪ Initial PIO notifies all potential local partners. ▪ At briefing meeting, Initial IC, State Ops Chief (or their representative) & RFHS brief attendees on the following: • Current understanding of the new infestation and what additional information is needed. • Regulatory issues. MDA and APHIS representatives will provide regulatory (quarantine) information. • Potential implications of the current find on local environmental and economic resources (to the extent known).
Initial Response Team	▪ Meeting attendees identify the structure and delegation of authority needed for a local response team (Type III). • The Initial IC may or may not be identified as the local IC (or as a member of the local unified command) depending on where the find is located and the local partners involved. • The Initial PIO may or may not be identified as the local PIO depending on

	where the find is located and the local partners involved. ▪ The Initial IC and PIO communicate Initial Response Team recommendations to the State Unified Command, who then issues the Delegation of Authority.
Initial Response Outcomes	▪ Within one week of confirming EAB, Local Incident Team has been identified and given the authority to respond as needed. ▪ At a minimum, the local incident team consists of the IC (or local unified command), PIO and technical advisor(s). The team can expand and include other positions as needs dictate. ▪ Upon Delegation of Authority, initial responders not identified as members of the Local Response Ream stand down.

LOCAL RESPONSE TEAM – RESPONSIBILITIES	
Local Response Team (Type III)	▪ The local IC (or local unified command) is responsible for coordinating actions with the State Unified Command Ops Chief. ▪ The local PIO is responsible for coordinating communications with State Unified Command PIO. ▪ The local incident team is responsible for work planning and implementation in four broad areas: • Initial survey and destructive sampling to describe the infestation. • Further delimitation and destructive sampling to define the boundaries, age, density and distribution of the infestation. • Mitigation (and wood management) to contain the infestation and to limit future impacts to rural and community forest resources. • Utilization opportunities within the context of state and federal regulations. • Monitoring to determine mitigation results and to determine the need for further action.
Local Response Team OPERATIONS	SURVEY ▪ Develop local operation plan for initial survey and destructive sampling. ▪ Identify resources, equipment, and supplies needed. ▪ Develop appropriate maps. ▪ Gather and train participants. ▪ Collect and summarize survey and sampling results. ▪ Review survey results to determine mitigation actions and/or the need for additional delimitation and destructive sampling.
OPERATIONS CONT.	MITIGATION ▪ Develop mitigation plan. ▪ Identify key partners and landowners. ▪ Identify resources, equipment and supplies needed. ▪ Identify disposal needs and utilization opportunities. ▪ Develop appropriate maps. ▪ Seek plan approval from State Unified Command PIO ▪ Once approved, implement plan. MONITORING ▪ Develop and implement monitoring plan to evaluate mitigation efforts and determine the need for ongoing mitigation.
Local Response Team COMMUNICATIONS	▪ If needed, develop a local communications team. ▪ Develop local communications plan. ▪ Seek plan approval from State Unified Command PIO. ▪ Once approved, implement plan.
Local Response Team Outcomes	▪ Mitigation and communication actions are carried out as planned. ▪ Status of the infestation is monitored and effectively communicated to landowners and decision makers. ▪ State Unified Command is kept informed of local operations, communications, and resource needs. ▪ State Unified Command determines if and when the local incident team stands down.

First Detector Program: Accomplishments and awards

2011 marked the fourth year of Forest Pest First Detector workshops taught by the award-winning Minnesota Forest Pest First Detector training team, comprised of representatives from University of Minnesota Extension (UMnExt), the Minnesota Department of Agriculture (MDA), and the Minnesota Department of Natural Resources (DNR). Minnesota is the first state to use the National Plant Diagnostic Network (NPDN) to focus on detecting forest pests. Using a step-by-step process to identify signs and symptoms of invasive forest pests, the first year of workshops focused on identifying and reporting infestations of emerald ash borer (EAB). While continuing to emphasize EAB, training in subsequent years expanded its focus to other forest pests such as gypsy moth, bur oak blight, Asian long-horned beetle, thousand cankers disease, and mountain pine beetle. UMnExt houses the database of Minnesota's First Detectors and directs calls from concerned citizens who think they've spotted a pest to a trained Minnesota First Detector. The First Detector can then determine if the call warrants a site visit. In addition, Minnesota First Detectors can contact the MDA themselves using the MDA's Arrest-the-Pest hotline at the first sign or symptom of EAB or other forest pests.

In the past three years, UMnExt referred 463 out of 1,229 calls regarding potential forest pests to First Detectors. In 2010, First Detectors volunteered 1,316 hours and traveled 7,733 miles, which resulted in a total public value of nearly $29,000. The discovery of EAB by a tree care worker in St. Paul in May, 2009 was a result of First Detector training, demonstrating the value of the Forest Pest First Detector program.

These popular workshops attracted 203 participants in 2011. Since 2008, 411 volunteers from 66 out of 87 Minnesota counties have committed to becoming First Detectors. Volunteers from Wisconsin, Iowa, North Dakota, and South Dakota have also attended the workshops.

In recognition of their efforts, in 2010 the First Detector team won five awards:
1. Dean's Distinguished Team Award, University of Minnesota Extension Dean's Office
2. Silver Award, Innovative Program, Association of Natural Resources Extension Professionals (ANREP)
3. Silver Award, Outstanding Team, ANREP
4. Innovation Award, Minnesota Association of Extension Professionals
5. Excellence in Natural Resources Programming, Minnesota Association of Natural Resource Extension Professionals

In 2011, the team was honored with the NPDN Outstanding First Detector Educational Training Award.

Forest Insect and Disease Newsletter goes on-line in 2011

For several months over the winter of 2010-2011, we worked to move our Newsletter from paper copies (1400 copies per issue) to an electronic-only version. Starting with the May issue, all subscribers were informed by postcard of the changes and given two means of obtaining the Newsletter:

1) Find it on our DNR-Forestry-Forest Health webpage at http://www.dnr.state.mn.us/treecare/forest_health/index.html, or,
2) Receive an automatic email which alerts the subscriber to the presence of a new issue. The subscriber needed to sign-up for a free online subscription by going to the DNR Forest Health web page and clicking on the subscribe button.

We hoped to capture all of our readers, those who have email and those who must go to a public library to access our webpage.

Forest tent caterpillar: Incorporating insect migration into assessments of how climate change will impact forest health

LOCATION: North Central Region; Minnesota, Wisconsin

DATE: Yr 1 of 2-yr Project: Jan 1-Dec 31, 2012

PROJECT LEADER: Kenneth Raffa, Dept. Entomology, Univ. Wisconsin-Madison; 608-262-1125;
raffa@entomology.wisc.edu

COOPERATORS: Richard Lindroth, Dept. Entomology, Univ. Wisconsin-Madison
Ezra Schwartzberg, Dept. Entomology, Univ. Wisconsin-Madison
Johnny Uelmen, Dept. Entomology, Univ. Wisconsin-Madison
Michael Albers, MN DNR
Jana Albers, MN DNR
Mark Guthmiller, WI DNR

PROJECT OBJECTIVES: Our overall objective is to evaluate how climate change will influence phenological synchrony, and hence susceptibility, between trees and defoliating insects, accounting for the higher ability of insects to migrate with gradually changing conditions.

Our specific objectives are to:

1. Determine the onset, incidence and duration of larval feeding in outdoor temperature-controlled rings by Forest Tent Caterpillars (FTC) that are obtained from multiple populations collected along a latitudinal gradient.
2. Evaluate phenological synchrony between plant development (bud-break in aspen & birch) and larval feeding among the above temperature regimes and population sources.

DESCRIPTION:

a. Background: The extent to which defoliating insects remain at low-density levels or undergo large-scale outbreaks is largely determined by the synchrony of larval feeding with vulnerable plant stages. Larvae that hatch too soon have no food and are exposed to environmental extreme. Those that emerge too late are confronted with foliage that is tougher, more lignified, lower in nitrogen, and higher in defense chemicals (Parry et al. 1998, Nealis & Nault 2005, Jones & Despland 2006, Van Asch & Visser 2007, Gray 2008, Thomas 2009). The Forest Tent Caterpillar is one of the most important defoliators affecting North American forests (Hicke et al. In press). At high populations, they kill trees directly, reduce their growth, and increase susceptibility to other biotic and abiotic stress agents. Population dynamics of FTC are strongly tied to weather conditions that influence their phenological synchrony with budbreak (Parry et al. 1998, Gray 2008, Thompson 2009, Van Asch & Visser 2007. Females are very strong fliers, so these species have high potential to rapidly migrate as climatic conditions change.

b. Methods: Collect overwintering FTC egg masses along a latitudinal gradient (collection sites on right). Bring them to a common environment at the **B4Warmed** site, and suspend them in mesh cages from host trees.

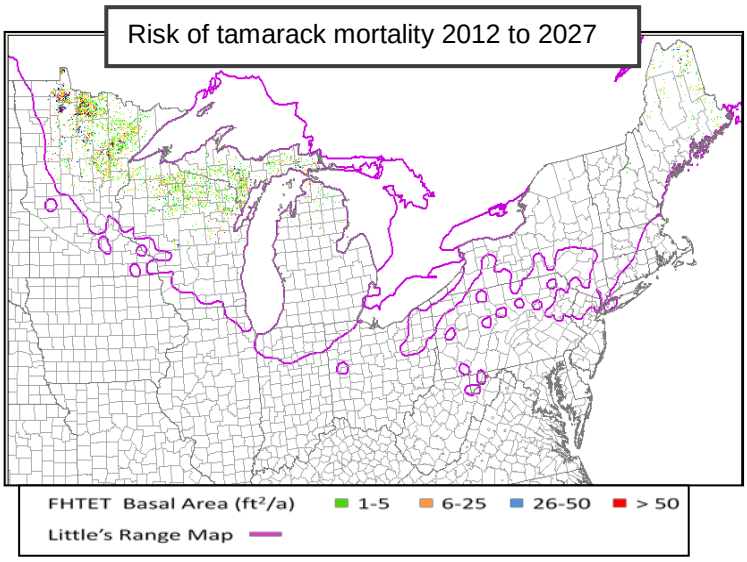
1. Expose the above insects to ambient, +1.8'C, +3.6'C conditions, beginning in mid-March, to provide variable regimes of degree-day accumulation that simulate anticipated climate change.
2. Record onset, incidence, and duration of egg hatch and larval feeding, along with onset incidence, and duration of various phenological stages in aspen and birch. Model these responses using temperature recording devices.

c. Products: This information can be incorporated into population models of forest tent caterpillar to better integrate two potential consequences of climate change, altered phenological relations, and disparate rates of movement, between insects and host trees. We will publish our results in scientific journals and present them at scientific meetings, including FHM review.

ACCOMPLISHMENTS IN 2011: In mid-October, several FTC egg mass surveys were made in Regions 1, 2 and 3 to locate possible sources of egg masses needed for the study. Two locations were selected: near Isle, MN on the southeast shore of Mille Lacs Lake, and, near Elbow Lake, MN in northern Becker County. More than 300 egg masses were collected at each location with the help of Ezra Schwartburg and Johnny Uelmen from October 23rd -25th.

National insect and disease risk mapping efforts

In April, Val Cervenka and Jana Albers represented MN-DNR at an NIDRM workshop in Colorado where state and federal forest health staffs worked on both the national and USFS Area models. The map shows the preliminary results for tamarack mortality in the Northeast Area. The following article explains the goals, process and expected national products from our efforts and is uses work being done in the Southern Area as an example.



The Large and Difficult Task of Estimating Risk of Mortality from Multiple Agents is Made Easier with Modern Technology

By Dale Starkey, Frank Krist and Jim Ellenwood, USFS

In 2006, the USDA Forest Service, State & Private Forestry, Forest Health Protection (FHP) unit published the second National Insect and Disease Risk Map (NIDRM). The publication, individual maps and much background information can be viewed at: http://www.fs.fed.us/foresthealth/technology/nidrm.shtml. Built using a GIS framework, 1-kilometer resolution host tree species maps and ancillary data such as climate, topography, soils, pest occurrence, etc., were used to model the risk of mortality for individual pest agents. The resulting maps were combined to display composite risk of mortality of 25 percent or more of forest basal area over a 15-year period.

Technology advances and forests change; and a new revision of NIDRM is underway with a projected completion date of 2012. GIS data layers are being completely updated at a finer resolution of 240-meters with many of the layers being re-sampled from 30-meter host and climate data. FHP's Forest Health Technology Enterprise Team (FHTET) is leading the effort with assistance from USDA Forest Service regions and staff of many State Foresters. Tapping a large and diverse team of experts is essential in making technology represent biology in a realistic way. The 240-meter host species layers form the foundation of individual risk models. FHTET constructed representative layers for host tree species using three seasons of satellite imagery, Forest Inventory & Analysis (FIA) field data and other data layers such as climate and topography. Final host layers will contain species attributes such as basal area per acre, quadratic mean diameter, percent host, and a stand density index. Initial versions of host layers are currently under review by federal and state personnel. The federal and state review will initially identify large areas that may be poorly predicted. In addition, the review will include the collection of field data from various areas that will help to verify predicted parameters such as basal area and quadratic mean diameter. Feedback from field visits will be used to adjust models and improve host layers.

Technology is also making risk modeling easier, quicker and more intuitive. FHTET has produced a software program, the Risk Map Application (RMAP), which allows regional teams of Federal and state insect and disease specialists to readily produce and modify risk models for individual pest/host combinations. Modelers can almost immediately see the resulting output and add, subtract, and modify factors contributing to risk, thus adjusting models based on known science and professional knowledge.

Modeling is done by ecoregion and can be applied to one or many ecoregions as is biologically appropriate. Important pests that will be addressed by the Southern modeling team include *Heterobasidion* root disease, beech bark disease, butternut canker, Dutch elm disease, emerald ash borer, fusiform rust, gypsy moth, hemlock wooly adelgid, laurel wilt, oak wilt, red oak decline, *Sirex* wood wasp, southern pine beetle and white pine blister rust. Others may be added as necessary. There may be insufficient data to create good models of some pests. In those cases, maps illustrating a special concern will be created using whatever data is available to best display the risk or threat to southern forests. Many southern pests are east wide in their distribution and whenever appropriate, southern and northeastern specialists will collaborate to build models that seamlessly display risk across large geographic areas.

Once individual models are complete and reviewed, a composite map will be constructed by summing the mortality risk of the various agents. Acres at risk to mortality can then be tallied and displayed. Further periodic revisions to the risk analysis are a

certainty given the rapidly-changing nature of forests and pest threats, especially the threats from introduced and invasive pests which often have rapid and devastating effects.

Northeastern Area Association of State Foresters Forest Health Committee Update

In March, 2011 the first stand-alone meeting of the NAASF Forest Health Committee was held in St. Paul. The purpose of the committee is to provide technical input, advice and recommendations to the state foresters on forest and tree pest issues, to promote greater emphasis and support for forest health and invasive pest issues in the 20 states of the Northeastern Area (NA), and to strengthen communication between the forest health community, NAASF, and partners. Val Cervenka is in her final term as vice-chair of the committee, and will begin her two-year term as chair in February, 2012.

Fifteen of the 20 states sent representatives, a great turnout for this first meeting. The Forest Service, state foresters, and the NAASF Urban and Community Forestry Committee were also represented. Discussion topics included clarification of the committee's roles, individual insect and disease pests and their threat levels and best course of action for 2012, invasive plants, implementation of State Assessment objectives, and the Competitive Allocation Request for Proposals process.

In November, Val attended the NAASF fall meeting in Pennsylvania to provide the Forest Health Committee work plan update. The committee's FY2012 work plan included development and delivery of a pest matrix, identifying the major insect and disease threats to the forest resource in the NA and recommendations regarding the best course of action. Val presented the matrix to the state foresters and included recommendations for Asian Long-horned Beetle funding from the Durham Field Office.

This matrix was developed by the NA Forest Health Committee in 2011 through discussion among Forest Health Program Leaders from the 20 States and Washington D.C. The purpose of the matrix is to outline, in a concise fashion, the primary pests across the NA considered to pose the greatest threat to NA forests. The matrix provides key background information, research needs, and Committee recommendations to NAASF, and will be updated regularly as needed.

Pest headers have been color-coded to indicate relative threat to the resource across the NA:

Considered high-priority, immediate concerns across all or most of the NA

Major concern in some but not all States, or potential impact not yet determined

Pests that could pose a serious threat and require attention, but are not currently causing widespread mortality

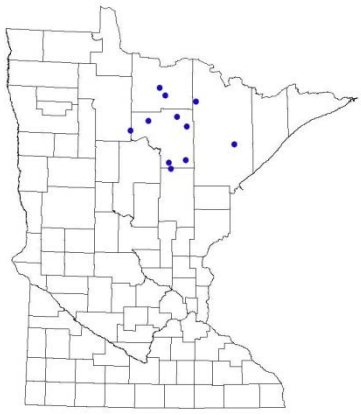
Pest	***Notes***	***Research & Technology Development Needs***	***Recommendations to State Foresters***
Asian Longhorned Beetle	Too early to tell whether eradication in Worcester will work. USFS funding last 2 years for risk-based surveys and lure development A big deal for everyone since all States have maple. New find in OH will require resources for years to come.	Lure development	Continue to fund eradication efforts. Don't give up on eradication - it may not be too late! Continue to support ALB outreach and detection efforts Surveys need to happen 5-10 miles outside quarantine area, e.g. Worcester. Encourage APHIS to continue funding.
Emerald Ash Borer	Could management teams be created in an IC model to handle new finds? First detector program $13 million in President's budget for biocontrol production	Silviculture studies Better decision models than FIA e.g. WI work on black ash How to manage EAB in the aftermath area? Resistance studies	Perhaps S&PF could compile EAB management models. Support APHIS biocontrol work Support predator releases
Gypsy Moth	Continues to be a significant forest pest in the east and will repeat itself. Staff and $ are required for adequate control. 2009 Pennsylvania 221,000 acre suppression project Funding issues - no money for suppression, and lack of staff. Timing of $ allocations for GM control (present system doesn't work)		Consider emergency response fund for outbreaks. Continue to fund slow-the-spread (STS) as highest priority GM activity Second-highest priority is eradication of outlying infestations Third-highest priority (still important) is suppression
Hemlock Woolly Adelgid	HWA Initiative Group Develop guidance on how to review grants based on what is research.	Entomopathic fungi	HWA suppression should be removed from RFP. Continued $ for outreach, surveys, tech transfer. Slow-the-Spread approach (using GM model) may be best Assure $ available for biocontrol efforts
Thousand Cankers Disease	APHIS - no federal quarantine on TCD 11 states have TCD quarantines At least 9 NA States surveyed in 2011.	Better detection tools inc. pheromone under development. Available treatments Interaction of beetle & disease complex Value of Walnut in each State. USFS should help with the valuation. Resistance research	Encourage delineation of boundaries as a priority for 2012 Support research
Southern Pine Beetle	South of New Jersey - existing SPB problems Existing science sufficient but red tape hinders NJ response		Endorse recommendations from southern SPB reseachers Need vigilant & timely treatments of NJ infestations ("rapid response")
Winter Moth	Significant threat to northeast area forests "The fly" (biocontrol) is doing well Also need suppression	Fly for biocontrol (now established in east)	Support biocontrol Encourage States to consider requesting suppression $ if needed
Oak Decline	Now recognized as a major issue region-wide	Total impact on the oak resource from all causes? Investigate cause(s) of this widespread phenomenon Identify areas of oak decline that cannot be attributed to another cause	Need for labs that can diagnose forest diseases Support FO development of diagnostic capabilities
Beech Bark Disease	Genetic conservation of species that are targeted by multiple stressors What is the plan? Restoration with resistant tree species? Develop a plan before species are severally impacted.	Resistance studies Surveys to delineate extent of BBD occurrence	
Invasive Plants	Sources of funding? They are out there. Training of staff e.g. Parks Focus on bio-control opportunities (mile-a-minute weed) Invest wisely, focusing on eradicating outliers and biocontrol Cooperative weed management areas Engage the different Plant Boards. Establish an invasive plants subcommittee Help provide leadership	Possibilities for biocontrol e.g. the success of the weevil used for MAM weed	Encourage USFS to finalize Invasive Plant Work Plan. (Where did CWMA boundaries come from?) 1-page briefing paper for State Foresters
Forest Tent Caterpillar	In combination with anthracnose --> severe mortality.		States need to monitor to determine if suppression is needed
Sudden Oak Death		We may want to declare victory Committee agreed not a top-tier concern any more Don't forget entirely; survey every 3-5 years	Put SOD on the back burner for now. Respond to potential introductions with watershed-based stream surveys
Sirex Wood Wasp	Funding sources are drying up. APHIS funding is ending. Should the southern states be asking for funds?	Threat level to trees in the field? Pilot program to fund stand thinning	We need some input when APHIS develops host list. Keep surveying in DE-MD-NJ (gateway to southern pine resource) Keep funding bio-control. Encourage $ for research on bio-control nematode.

Operational Order 113: Invasive Species Guidelines

DNR Operational Orders define policies and procedures for internal management of the Department. Operational Order 113 defines DNR policy and procedures to prevent or limit the introduction, establishment and spread of invasive species and to implement site-level management in order to limit the spread and impact of invasive species. Each division within the DNR is responsible for developing guidelines to implement this operational order.

This operational order requires accompanying discipline guidelines. In 2011, the Division of Forestry Guidelines for Invasive Species were revised, and spell out the daily minimum effort toward preventing the spread of invasive species on DNR-managed land. They are meant to provide practical steps for minimizing the risk of moving or favoring invasive species to the extent feasible while carrying out normal duties.

White spruce thinning study: 5 year results paper published



A white spruce plantation thinning study was initiated in 1999 in cooperation with the USFS S&PF and the University of Minnesota with assistance of a Federal Focus Fund Grant. The study was developed to look at thinning of white spruce plantations affected by spruce budworm defoliation to see how the thinning affected growth and survival of the trees. A goal was to see if thinning could be used as an alternative to insecticides to reduce the impact of spruce budworm. Unfortunately while this study was being established, spruce budworm activity declined statewide, so that only two of the stands in the study experienced moderate or heavy levels of defoliation with the others experiencing zero or light defoliation levels.

The study involved 10 plantations on DNR, Blandin and USFS lands. Plantations were thinned between 1999 and 2002. All plots were measured annually for the first 5 years but only measures of pre-thinning and 5 years after thinning were used in the analysis for the current paper. Data on spruce budworm defoliation levels were also collected on all plots in the fall each year.
A paper on the 5 year results of the study was published in 2011 in the Northern Journal of Applied Forestry and can be found on the web at; http://silviculture.forestry.umn.edu/Publications/index.htm. The citation for the paper is:

> D'Amato, A.W., S.J. Troumbly, M.R. Saunders, K.J. Puettmann, and M. Albers. 2011. Five-year response of Picea glauca plantations thinned following spruce budworm outbreaks in Minnesota. ***Northern Journal of Applied Forestry*** 28:72-78. (.pdf)

Stands in the study varied in age from 25 to 49 years at the time of thinning and had a variety of spruce budworm defoliation levels and histories. All stands were fully stocked before thinning and showed 'good health'. A reserve area (unthinned) was maintained for each stand. All stands received a commercial harvest with the level of thinning determined by each land manager. Thinning was through a combination of low and row thinning. BA removed averaged 50%.

Some study results are below:

- Overall, thinning reduced tree mortality, increased live crown ratios and increased individual tree growth compared to unthinned portions of the stands.
- Trees with a live crown ration of 40% or more had the highest post thinning growth response. Trees with LCR less than 40% did not show much benefit from the thinning.
- In stands defoliated by spruce budworm, thinning resulted in increased survival, live crown ratios and higher volume growth rates compared to defoliated trees in unthinned portions of the stands.

SPECIAL PROJECTS
INVASIVE TERRESTRIAL PLANTS PROGRAM

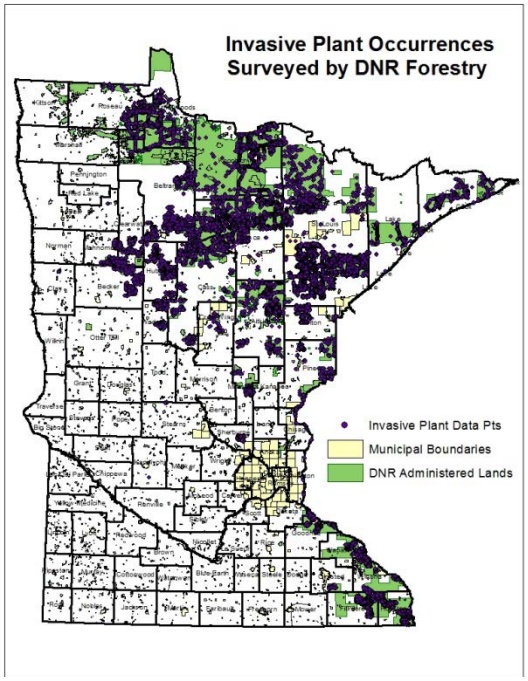
Branding project for DNR educational campaigns
Forestry Inv. Plant Program: The first four years
MN recreationists and Threatened and Endangered Species education

Branding Project for DNR educational campaigns

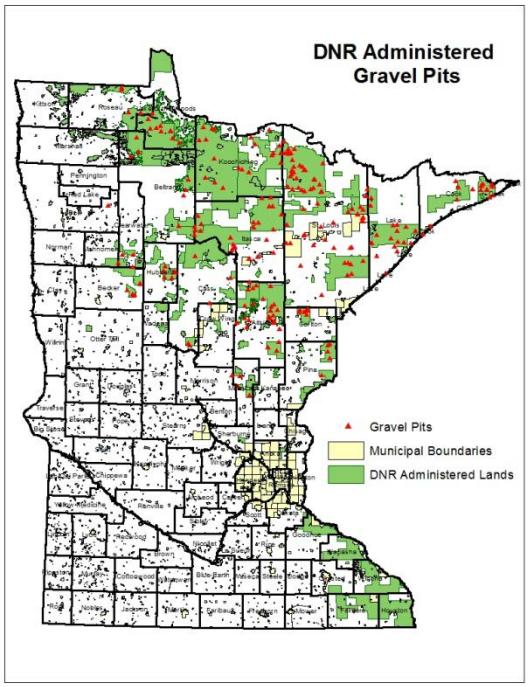
This month, the Division of Forestry is launching a project to develop a brand and marketing plan meant to foster recreation behaviors which will help stop the spread of terrestrial invasive species. Project administrators were thrilled when Ivarson Brand Visions won the bid to do the creative work on the project. Ivarson Brand Visions has extensive experience in brand development and had previously worked for the US Fish and Wildlife Service to produce the Habitatitude and Stop Aquatic Hitchhikers brands. The success of these two projects was clearly demonstrated in the results of the focus groups carried out last year. When asked to name a land-based (terrestrial) invasive species, recreationists were more likely to mention zebra mussel and Eurasian milfoil than any of the more common land-based species such as emerald ash borer or buckthorn.

DNR Forestry's Invasive Plant Program: First Four Years

With funds from the Heritage Enhancement account, a position was created and a program begun in late 2007. The first task was to complete division guidelines for invasive species as directed by operations order 113. From there, the task was a large one – develop a program where there hadn't been one before; fill in the massive gaps in our understanding of where invasive species occurs on state forest land, and the factors that influence their spread; and then begin a prioritized approach to invasive plant management across the state.



Grant funds awarded through the division of Ecological and Water Resources were a great addition to the effort. With those funds, three large projects and a number of smaller projects were begun. The first project was to develop a set of survey and training protocols, and implement a survey of invasive plants found on rights-of-ways along all maintained roads within state forest boundaries. Both public and private roads were included because of the potential for invasive plants on those rights-of-ways to move into adjacent forest lands. Over 87,000 invasive plant occurrences were reported in the first three years of the program (see map). For several plant species it was the first good look at their distribution across the state. For instance, wild parsnip was thought to occur mostly in southeast Minnesota. Our surveys indicated that large pockets also occur in far northern Minnesota.



The next big project was to survey all gravel pits managed by the DNR to determine the risk of spreading invasive plants during road maintenance operations. A total of 258 gravel pits were surveyed from top to bottom (see map). The survey was then followed by a large management project to treat invasive plants found in those gravel pits being actively used. Treatment efforts were completed in FY2010 with post-treatment monitoring to follow for several years.

The third large project was to develop aerial detection protocols for common and glossy buckthorn. There is a narrow window of opportunity in the fall after most hardwood tree species have dropped their leaves and buckthorn is still bright green. During that time, even small individual plants show up well on color photography when interpreted using stereo paired photographs. Photographs at a 1:22,000 scale (taken with two cameras, a 25MB color and a 16 MB color infrared camera) were first used on an experimental basis to survey the Hay Creek unit of the R. J. Dorer state forest and Frontenac state park. Then to test the methods at an operational scale, all state forest lands were flown in Pine County. In both cases, a subset of the data points was ground truthed to determine the accuracy of the data. And then management practices were implemented on the highest priority infestations. Photo interpretations were pushed so as to avoid missing any buckthorn. That meant the likelihood of false positives

increased. Interestingly, we found the false positives varied by region. In southeast Minnesota most false positives were either black locust or honey suckle – both invasive plants that could be controlled during operations to remove the buckthorn. However, in Pine County to the north, the false positives were almost all native alder. Using elevation models in that area, the accuracy of the invasive plant occurrence data could be enhanced by pulling out the sites at lowest elevation where alder was much more likely to occur. In FY2011, the methods were used again to survey state lands in Sherburne and Carlton Counties.

A total of 29 smaller projects were implemented across the state during the first four years of the program. These ranged from noxious weed management projects on DNR managed rights-of-ways, to buckthorn control during regeneration operations, to trials testing the efficacy of goats at controlling woody invasive plants. Combining state funds, a total of $730,770.00 was spent on invasive plant inventory and management over the four years (see chart by year).

In additional to the project work, 32 power washers were purchased to support operations order 113 goals and division objectives. These were purchased and stationed such that all forestry staff had access to wash station. Many of these locations were at multi-discipline sites, so other division staff benefitted as well. Several small backpack sprayers and an extra water bucket to be used in aerial fire suppression when working in areas with infested waters were purchased using state funds.

In addition to the state funds spent in Forestry‘s program, a grant of $100,000.00 was awarded for outreach and education specifically aimed at Minnesota recreationists. The goal was to disrupt the link between recreational activities and the spread of terrestrial invasive species by changing public behavior. Project objectives were to establish a baseline of understanding of recreationists and develop an education plan that built on the science or social marketing. Nine focus groups were held and a phone survey of 1200 participants was completed to describe current recreationists’ knowledge, behaviors and attitudes. Besides informing the education plan, survey results can be used as a baseline to measure the success of future outreach efforts With state FY2012 funds, a brand identity for the education campaign is being developed (plans are to launch it in FY2013) that will parallel the national Stop Aquatic Hitchhikers program.

With all of this work, the biggest accomplishment of the four years is the increased understanding of the issues among our foresters and vendor-partners. The division went from being largely oblivious of the concern beyond county-enforced noxious weed laws, to grasping the potential future impact of invasive species on the long term sustainability of our forest resources. Most field staff now have a working understanding of the species that occur in their area and can identify those most likely to harm people or the forests under their care. They are familiar with management practices that can help prevent the accidental introduction or spread of invasive species. And there are now extensive tools, materials and references available to support them in their management efforts.

So, while the road is long and we’re just beginning, we have a strong foundation on which to build. May the next four years be as productive.

Chart 1, Project Dollars (not including staff labor)

	FY2008	FY2009	FY2010	FY2011	Total by type
Inventory	$ 31,000.00	$ 151,000.00	$ 169,000.00	$ 50,250.00	$ 401,250.00
Management		$ 20,886.00	$ 33,069.00	$ 134,458.00	$ 188,413.00
Equipment	$ 1,000.00	$ 72,200.00	$ 12,757.00	$ 7,656.00	$ 93,613.00
Outreach		$ 14,437.00	$ 83,588.00	$ 49,469.00	$ 147,494.00
Total EWR*	$ 32,000.00	$ 181,086.00	$ 123,967.00	$ 122,077.00	$ 459,130.00
Total FOR*		$ 66,500.00	$ 90,859.00	$ 114,281.00	$ 271,640.00
Total USFS*		$ 10,937.00	$ 83,588.00	$ 5,475.00	$ 100,000.00
Total for Program	$ 32,000.00	$ 258,523.00	298,414.00	$ 241,833.00	$ 830,770.00

*funds provided by EWR = DNR Division of Ecological and Water Resources; FOR = DNR Division of Forestry; USFS = USDA Forest Service.

Minnesota Recreationists and Terrestrial Invasive Species

Slowing the spread of terrestrial invasive species (TIS) needs a multi-pronged approach. As natural resource managers and scientists, focusing on the science of suppression comes easy. However, it's just as important to manage the vectors of TIS: human behavior.

Between July 2009 and July 2010, as part of a USFS-funded project, Forestry staff conducted a series of focus groups and a large phone survey of Minnesota recreationists. The intent was to reveal recreationists' beliefs about TIS and their understanding of how their own actions might influence the spread of forest pests. Both the focus groups and the phone survey were divided among three regions of the state: north, central, and south. Participation included campers, non-motorized trail users, and motorized trail users. We held nine focus groups (one for each user group in each region) with an average of 11 participants each. The phone survey contacted 400 participants in each of the three regions for a total of 1,200 participants.

The project goals were to outline desired recreational behaviors less likely to spread TIS and to identify what Minnesota recreationists must believe to adopt those behaviors. The results will be used to construct a marketing campaign (to be developed in 2011) that will encourage Minnesota recreationists to adopt positive actions.

The "take away" points from our research results include:

1. Most recreationists participate in multiple outdoor activities, so they don't fit neatly into gross categories of user groups. For instance, motorized vehicle users are no less likely to care about the environment than non-motorized users. In fact, motorized users are actually *more* likely to clean their gear on site and at home than non-motorized users.
2. Most recreationists want to do the right thing. Consistently, 80 percent of our respondents chose the more "environmentally friendly" response.
3. The biggest obstacle for recreationists to take TIS-prevention actions is TIME. (For example, recreationists don't want to "waste time" to locate approved firewood, clean mud, dispose of seeds properly, etc.)
4. There were some differences between responses from the general recreation population and those of motorized recreationists and horseback riders. We may want to use customized messages when working with these two sub-groups.

Focus group and survey results

Through interactions with Minnesota recreationists, we identified six desirable beliefs:

- The spread of TIS has undesirable consequences.
- I may be contributing to their spread.
- I can limit the spread of TIS through my actions.
- I am ready and willing to do my part.
- I know what to do.
- I have the resources to do it.

Our survey results indicate that between 60 and 80 percent of our respondents already hold these beliefs! To summarize:

- 79 percent believe TIS are a threat.
- 71 percent believe TIS are likely to impact their recreational experience.
- 78 percent believe Minnesotans should acquire their firewood locally.
- 64 percent believe Minnesotans should clean their outdoor gear.
- 69 percent believe that what they do matters.
- 86 percent know where to find good firewood near their recreation sites.
- 74 percent know how to clean their gear to help limit the spread of TIS.

The rubber meets the road: Do actions match beliefs?

With regard to firewood, the answer is yes. Most (69 percent) of survey respondents acquire their firewood locally. Previous surveys done in 2007 had suggested that 50-60 percent of Minnesota recreationists brought their firewood with them. This implies that the firewood outreach and restrictions on DNR-administered lands successfully changed public behavior. Great news!

With regard to cleaning their gear, yes. Most (91 percent) of survey respondents said they clean their gear. But only 29 percent of them clean their gear on-site before leaving for home. While 29 percent is higher than expected, it means that a lot of folks are carrying mud and weed seeds back home with them and possibly spreading them along the way. We need more outreach.

Time: The main barrier to cleaning gear
Most (59 percent) either agreed with or were neutral when responding to the statement "Cleaning is not how I want to spend my time." As a follow-up, we evaluated which sub-groups were already cleaning their gear and which sub-groups were most likely to agree that time was an issue. We hypothesized that those who already cleaned their gear would be less likely to feel that time was an issue. However, our results indicated otherwise.

The people who are most likely to clean their gear include campers, recreationists with higher incomes, women, and motorized trail users. However among these sub-groups, only women were less likely to agree that time was an issue. The male users felt that time was an issue, even though they are already cleaning their gear.

Those most likely to agree that time was an issue included horseback riders, young (< 45 yrs) respondents, northern Minnesotans, low- and high-income respondents, bicyclists, and men. Among these, northern Minnesotans are more likely to use motorized vehicles AND clean their gear, again refuting our original hypothesis.

Those who were least likely to agree that time was an issue included middle-income respondents, southern Minnesotans, hikers, runners, women, and older (≥45 yrs) respondents. Of these, only women were more likely to clean their gear.

Differences among user groups
It's important to note that most respondents participate in more than one outdoor sport. Therefore, the differences between user groups was extremely small and often was not significant. We can mention trends, but trends are neither obvious nor conclusive in terms of outlining a customized outreach program for specific user groups. However, the trends do suggest values to highlight when working with various user groups.

With that caveat, here are some of the MINOR differences we found.

Horseback riders were among those least familiar with TIS (30 percent compared to 40 percent of other respondents), even though discussions around certified weed-free hay would have likely increased their awareness. They were among those most likely to:

- Agree that time was an issue in cleaning their gear.
- Agree that TIS-prevention behaviors would *not* hinder their outdoor experience.
- Clean their gear at home rather than before leaving their recreation site.
- Take firewood with them to their campsite rather than acquiring it locally.

Outreach to equestrians should:

- Leverage tidiness: most horseback riders already clean their gear! However, we need to encourage more cleaning on-site rather than waiting until arriving home.
- Use media around certified hay to make clear connections between recreationists' behavior and the spread of TIS.
- Communicate the firewood messages in areas that horseback riders use. Most equestrians ride in lands other than DNR parks, and they may not get media messages about the risk of moving firewood, which have only focused on DNR parks.

Motorized vehicle users were slightly less familiar with TIS than the average recreationist, even though riding clubs have been exposed to the Trail Ambassador program – the goal of which is to education and engage motorized recreationists. They were also slightly less likely to acquire their firewood locally, again because they may not be getting firewood media messages that target Park users.

Motorized vehicle users were among those LEAST likely to agree that:

- TIS may hinder their outdoor experience.
- Recreationists should get their firewood locally.
- Recreationists should clean their gear to limit the spread of invasive species – even though they were more likely to be already cleaning their gear than non-motorized recreationists, including horseback riders and mountain bikers.

Recurrent themes:

- Motorized recreationists take more time to clean their gear and are more likely to be thorough about it.
- Motorized recreationists want access to more recreation areas.
- Motorized recreationists perceive that TIS represents a threat of more trail closures. (Some think that TIS is a legitimate threat; others think that TIS as a tool/excuse for land managers to close more trails.)
- Motorized recreationists are much more likely to be male (60 percent versus 52 percent of all survey respondents) and live in northern Minnesota (80 percent versus 46 percent of all survey respondents).

- Like all other recreational sub-groups, motorized vehicle users participate in many other outdoor activities and respond accordingly to most other questions. Therefore, we must avoid singling out motorized vehicle users as the "bad guys."

Outreach to motorized vehicle users should:

- Avoid any threats of closing trails. Doing so may produce a backlash with regard to sustainable behaviors.
- Leverage motorized recreationists' participation in clubs or riding organizations that can help spread the word and encourage favorable social norms.
- Target firewood outreach messages to areas that motorized recreationists use.
- Remember that most recreationists participate in a range of outdoor activities that may spread TIS.

Summary

Most Minnesota recreationists (80 percent) want to do the right thing. But they either don't know what that is and/or perceive time as an issue to getting it done. Two strategies are worth noting:

- Reinforce the desired beliefs that recreationists already have. This may motivate them to spend a little (more) time cleaning up and/or finding local firewood.
- Stress that cleaning (or finding local firewood) can be quick and easy. If that's not the case in your area, it needs to be addressed.
- For the nearly 80 percent who consistently choose the more "environmentally friendly" response, additional outreach is likely to increase sustainable behaviors. For the 20 percent who answered otherwise, establishing the positive social norms of the first 80 percent may be critical to influence the remaining 20 percent.

This article is a follow-up to an article that appeared November-December 2009 issue of Roots*, titled: "What Makes Them Tick? Figuring Out How to Change Citizens' Behavior Around Invasive Species."* By Sue Burks, Exotic Species Program Coordinator