Montana Department of Agriculture Cooperative Agricultural Pest Survey 2006 Report

Contributors:

Montana Department of Agriculture
Commodity Services Bureau

Donna Rise, Bureau Chief

Pest Management Section

Kimberly Merenz
State Survey Coordinator
Michele Mettler
Nursery & Quarantine Specialist
Patricia Denke, PhD
Entomologist
Patrick Dougherty
GIS Specialist
Robert Cochran
Molly Miller
Zachary Hassler
Morgan Rocchio
Pest Survey Interns
Kevin Grzebielski
Survey Technician

Commodity Section

Andy Gray
Commodity Section Supervisor

Bob Bales
Velda Baltrusch
Robyn Cassel
Chris Herron
Sean Mulla
Dan Poff
Lori Vance
Agricultural Specialists

Cooperators

USDA APHIS Plant Protection & Quarantine
USDA Forest Service
Montana Department of Natural Resources & Conservation
Montana State University

2006 Surveys

- European and Asian Gypsy Moth
- Karnal Bunt
- Area-Wide Nematode
- Potato Wart
- Sudden Oak Death
- Cereal Leaf Beetle
- Cereal Leaf Beetle Biological Control
- Wood Boring Beetle

This report was compiled by Patricia Denke, Michele Mettler, and Kimberly Merenz, with contributions from our survey interns and technician.

2006 CAPS Report
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Cereal Leaf Beetle
Oulema melanopus

Cereal leaf beetle (CLB), pictured below, is a quarantine pest of forages and cereal grains. It is commonly found on small grains, particularly oats, barley, and spring wheat. The adults and immatures feed on the developing plants, at times causing extreme defoliation.

Adult cereal leaf beetle.
Approximate length 1/8 to 1/4 inch long.

During 2006, as in the past, routine surveys were conducted for CLB. Up to 5 samples were taken in each of the 36 surveyed counties, with a sample consisting of two sets of 50 sweeps with a 15-inch sweep net. When choosing fields to sample, preference was given to spring planted grains.

Cereal leaf beetles were found in 16 Montana counties during the 2006 sampling season. Counties that had been found positive for CLB in the past were not necessarily sampled during 2006. In total, 45 of Montana's 56 counties have had CLB detections since the discovery of the pest in the 1980's.

There were no noted range expansions for this pest during 2006.

Larval Cereal Leaf Beetles and Light Feeding Damage.

Counties Sampled for Cereal Leaf Beetle During 2006.

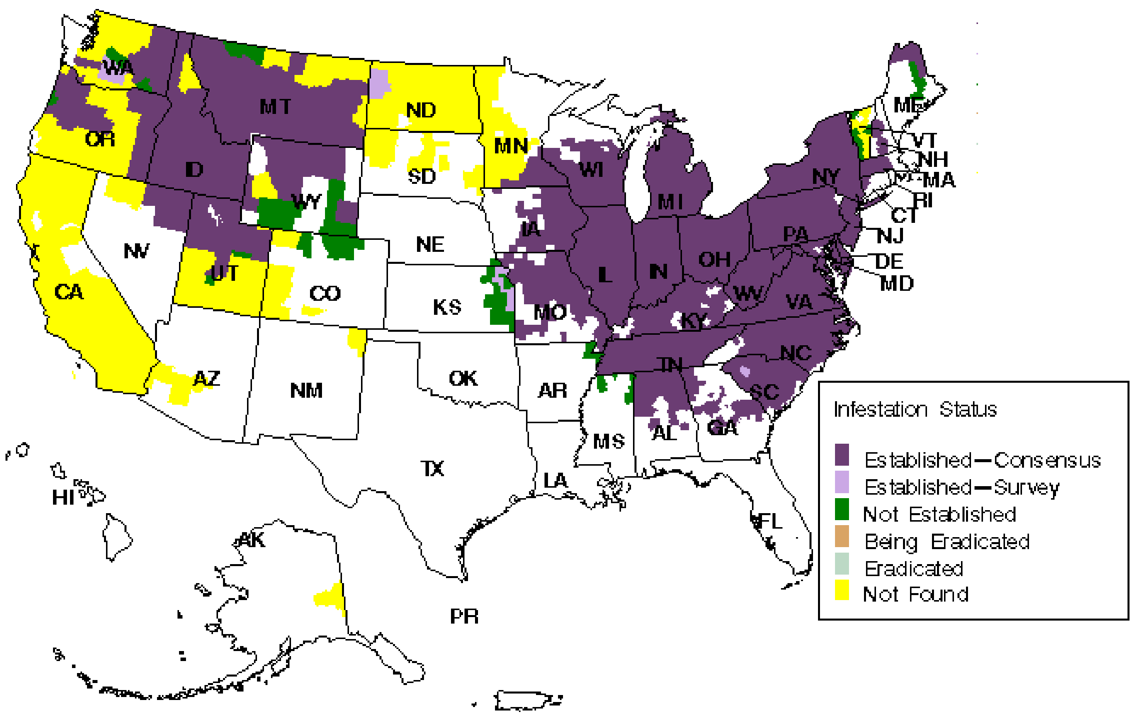
County	No. Pos. Samples/No. Samples	County	No. Pos. Samples/No. Samples
Big Horn	6/6	Madison	0/4
Blaine	0/14	McCone	0/4
Broadwater	2/15	Mineral	2/4
Carbon	7/10	Missoula	1/1
Cascade	3/12	Petroleum	0/1
Choteau	0/18	Phillips	0/8
Daniels	0/5	Pondera	0/20
Fallon	0/3	Richland	0/1
Fergus	1/10	Roosevelt	0/6
Flathead	6/11	Rosebud	0/10
Gallatin	1/11	Sheridan	0/5
Glacier	0/20	Teton	4/9
Hill	0/24	Toole	0/24
Judith Basin	0/1	Treasure	2/4
Jefferson	0/10	Valley	0/7
Lake	3/5	Wheatland	0/10
Lewis & Clark	4/18	Wibaux	1/3
Liberty	0/27	Yellowstone	1/12
		TOTAL	44/353

Reported Status of

CEREAL LEAF BEETLE (CLB) , OULEMA MELANOPUS

in US and Puerto Rico

Data retrieved from National Agricultural Pest Information System on 06/08/2006



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Cereal Leaf Beetle Parasitoids
Tetrastichus julis & *Anaphes flavipes*

The Cereal leaf beetle has spread across much of Montana during the past two decades. While initial movement was accompanied by severe outbreaks and economic damage, in more recent years the outbreaks have not been as severe. This may be, in part, due to the nature of the newly infested areas, which are generally drier and therefore less hospitable for the beetle immatures. It may also be due to the presence of two parasitoids released by the United States Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection & Quarantine (USDA APHIS PPQ) to assist in the management of this pest.

The first of these parasitoids to be released and recovered was *Tetrastichus julis*, an internal parasitoid of the CLB larva. The larvae of *T. julis* are maggot-like and bright orange in color. In some samples over 80 percent of the specimens of CLB have contained parasitoids, although this varies not only from place to place but also from day to day in the same place. Data suggest that this parasitoid is capable of movement as rapidly as CLB.

The second parasitoid, *Anaphes flavipes*, is an egg parasitoid. Although the insect has been released at several Montana locations, the exact status has been more difficult to assess. This is due partially to the small size of the insect, and partially because CLB eggs are prone to desiccation, making it more difficult to determine when mortality was due to the parasitoid.

During the survey, egg and larval samples were taken to gather information on the distribution of these two insects. Egg samples consisted of at least 25 eggs, and larval samples consisted of any larvae found in a sample. Up to 5 samples were taken in each of the 14 surveyed counties, with a sample consisting of two sets of 50 sweeps with a 15-inch sweep net. When choosing fields to sample, preference was given to spring planted grains.

Counties Sampled for Cereal Leaf Beetle Parasitoids During 2006.

County	*T. julis*	*A. flavipes*	County	*T. julis*	*A. flavipes*
Big Horn	Yes	N/A	Missoula	Yes	No
Blaine	Yes	N/A	Richland	No	N/A
Carbon	Yes	N/A	Sanders	No	No
Dawson	No	N/A	Stillwater	Yes	N/A
Hill	No	N/A	Sweet Grass	Yes	N/A
Gallatin	No	N/A	Teton	Yes	N/A
Lake	Yes	No	Yellowstone	Yes	N/A

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Gypsy Moth
Lymantria dispar (L)

Gypsy moth (*Lymantria dispar* (L)) was initially introduced into the eastern U.S. It established rapidly, and became a serious defoliating pest of various deciduous trees. The females oviposit on various surfaces, covering the eggs with hairs or scales. This insect is frequently moved on variety of objects, such as furniture and recreational equipment that have been left outdoors.

In Montana, responsibility for the trapping of gypsy moth is a multi-agency cooperative effort between the USDA APHIS PPQ, The Montana Department of Agriculture (MDA), The Montana Department of Natural Resources & Conservation (DNRC), and the USDA Forest Service (USDA FS). The USDA APHIS PPQ is responsible for trapping in mainly the eastern portion of the state, while the MDA traps mainly in the western part of the state. The DNRC traps in Mineral and Missoula Counties, and the USDA FS traps in a large number of campgrounds, as well as other public areas.

All traps were placed by early June, and checked throughout the summer at two to three week intervals.

There were no detections of gypsy moth in Montana during 2006.

Trapping Summary

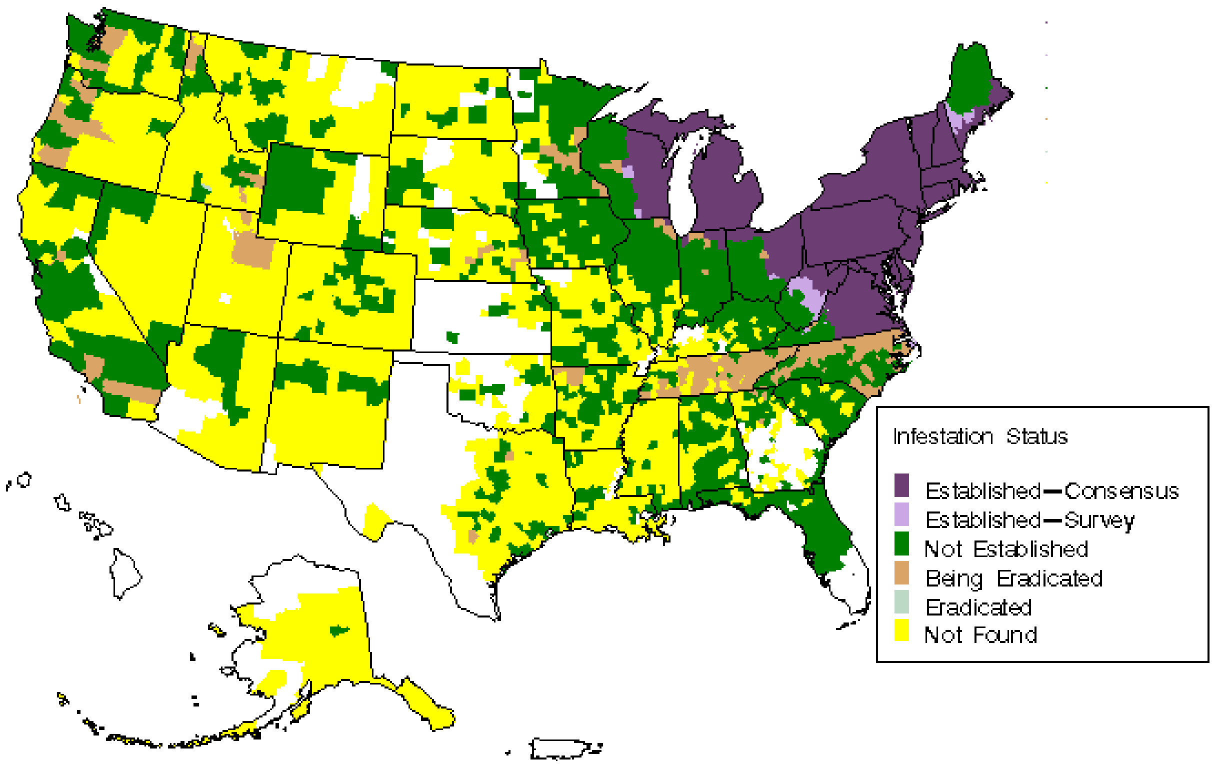
County	FS	MDA	PPQ	DNRC	Total
Beaverhead	12	10			22
Bighorn	2		33		35
Blaine	2				2
Broadwater	2		2		4
Carbon	13		20		33
Carter	2		2		4
Cascade	4		38		42
Choteau	2		12		14
Custer			38		38
Dawson			13		13
Deerlodge	2	7			9
Fallon			1		1
Fergus	6		7		13
Flathead	28	98			126
Gallatin	23		19		42
Glacier	21		1		22
Golden Valley			7		7
Granite	22	14		6	42
Hill	4				4
Jefferson	6		3		9
Judith Basin	4		8		12
Lake	10	78			88
Lewis &Clark	8		51		59
Liberty			4		4
Lincoln	12	49			61
Madison	10				10
Meagher	4		12		16
Mineral	6	30			36
Missoula	21	39		45	105
Musselshell			14		14
Park	19		39		58
Petroleum			6		6
Phillips	8				8
Pondera			4		4
Powder River	2		25		27
Powell	3	12	7		22
Prairie			12		12
Ravalli	6	17			23
Richland			13		13
Rosebud	2		28		30
Sanders	8	39			47
Silver Bow	2		25		27
Stillwater	8		20		28
Sweet Grass	8		16		24
Toole			5		5
Treasure			8		8
Wheatland			12		12
Wibaux			1		1
Yellowstone			54		54
	292	393	560	51	1,296

Reported Status of

GYPSY MOTH (EUROPEAN)(GM) , LYMANTRIA DISPAR

in US and Puerto Rico

Data retrieved from National Agricultural Pest Information System on 12/06/2006



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Exotic Wood Boring Insects

European Wood Wasp – *Sirex noctilio*
Emerald Ash Borer – *Agrilus planipennis*
Asian Longhorned Beetle – *Anoplophora glabripennis*
Oak Splendor Beetle (Metallic Woodborer) – *Agrilus bigutattus*

Constant movement of wood and wood products has created a situation in which wood boring insects from other continents can enter North America with relative ease. During the past decade, several new exotic wood boring insects have been found in North America, and at least three of these have become established. Two exotic wood borers, the Asian longhorned beetle (ALB) and the emerald ash borer (EAB), have become pests of economic concern because of the decimation of tree populations they have caused in affected areas.

During 2006, the Montana Department of Agriculture (MDA) participated in surveys of these exotic wood borers – the ALB, EAB, European wood wasp (EWW), and the oak splendor beetle (OSB). While none of these insects are thought to be present in Montana at the present time, all four have been noted to have an extreme impact on the areas where they have been found. Both EAB and ALB have caused tree die-off in the impacted areas.

Of the four, ALB is the least host specific, infesting several species of hardwood trees, including maple, horse chestnut, buckeye, elm, birch, and willow. ALB was first detected in Brooklyn, New York in 1996, and spread to other portions of New York City. Since then, isolated populations have been detected in other cities in the eastern U.S., including Chicago (1998), where the primary treatment has been removal of infested trees. There are currently populations of ALB in New York, Illinois, and New Jersey, as well as Canada. In addition, two adult beetles were found in California in 2005, but it is not known if the insects represented an established population.

At the present time, detection surveys involve not only trapping, but also visual inspection of individual trees. High value trees may be treated in an attempt to kill larvae, and infested limbs may be removed. However, total tree removal is still the optimal response for an infested tree. The life cycle of this insect takes several years to complete.

EAB was first found in the Detroit, Michigan area in 2002. At that time, many of the ash trees in the area were dying. Although the initial suspicion was a disease, EAB was determined to be the cause of what was ultimately found to be a relatively widespread die-back of trees in the genus *Fraxinus* (ash). The life cycle of EAB takes one year to complete under most circumstances, however, a two year life cycle is possible. The insect, originally from central Asia and Eastern Europe, has spread over several states and caused total tree death in all of them. Although quarantines are in place to reduce the spread of EAB, the current distribution of the insect is unknown.

The EWW was first found in North America in 2002 in a warehouse in Indiana. During 2005, a single specimen of the species was collected from a forested area in Oswego County, New York. Subsequent surveys (2005) found the EWW in adjoining areas (Cayuga and Onondaga Counties). More intensive surveys in 2006 found EWW in a large number of New York counties, as well as in Pennsylvania and some areas of Canada. This insect is a pest of pine trees, although the potential for damage to North American species is unknown. It is particularly insidious because the adult female introduces a fungus to the tree, which is eaten by the larva. At present, the life cycle in North America is under investigation.

The OSB is a native of Europe. The preferred host is particularly larger oak trees. The life cycle is similar to that of EAB. At present, it is not known to occur in North America, although it has been intercepted at various ports of entry in the past. This insect could potentially displace native wood borers in addition to posing a threat to various oaks and other species of trees.

During 2006, MDA personnel and pest management survey interns placed 84 Lindgren funnel traps at 28 locations throughout the state. Traps were provided by the USDA FS. Each location had 3 traps, placed approximately 100 yards apart. One trap was baited with alpha pinene, one with ethanol, and one with exotic *Ips* lure. A mixture of 1 part propylene glycol, 1 part water, and 1 drop dish soap was added to each trap as a preservative. Traps were checked at two week intervals and the collected material was sorted to family. Siricid wasps (horntails) were identified by Nathan Schiff of the USDA FS, Center for Bottomland Hardwoods Research in Stoneville, MS. Buprestid beetles (metallic wood borers, including Agrilus spp.) were examined by Michael Ivie of Montana State University, as were Cerambycid (longhorned) beetles.

There were no suspect species of concern collected during the survey.

In addition to the Lindgren funnel traps, visual surveys for tree damage, specifically "D" shaped exit holes, were done in selected Montana cities. No suspect holes were found in any of the 2,199 trees surveyed, of which 814 were ash.

2006 EAB Visual Survey Results

	Tree Type				
City	**Ash**	**Elm**	**Poplar**	**Other**	**Totals**
Augusta	15	7	33	49	104
Billings	49	7	5	55	116
Boulder	50	0	0	0	50
Glendive	20	37	0	43	100
Great Falls	173	7	0	11	191
Hamilton	34	0	0	66	100
Helena	72	0	0	31	103
Kalispell	30	15	28	140	213
Lewistown	112	8	4	73	197
Miles City	35	20	2	46	103
Missoula	191	10	44	381	626
Polson	0	0	80	15	95
Saint Regis	0	0	66	34	100
Sidney	33	21	0	47	101
Totals	**814**	**132**	**262**	**991**	**2199**

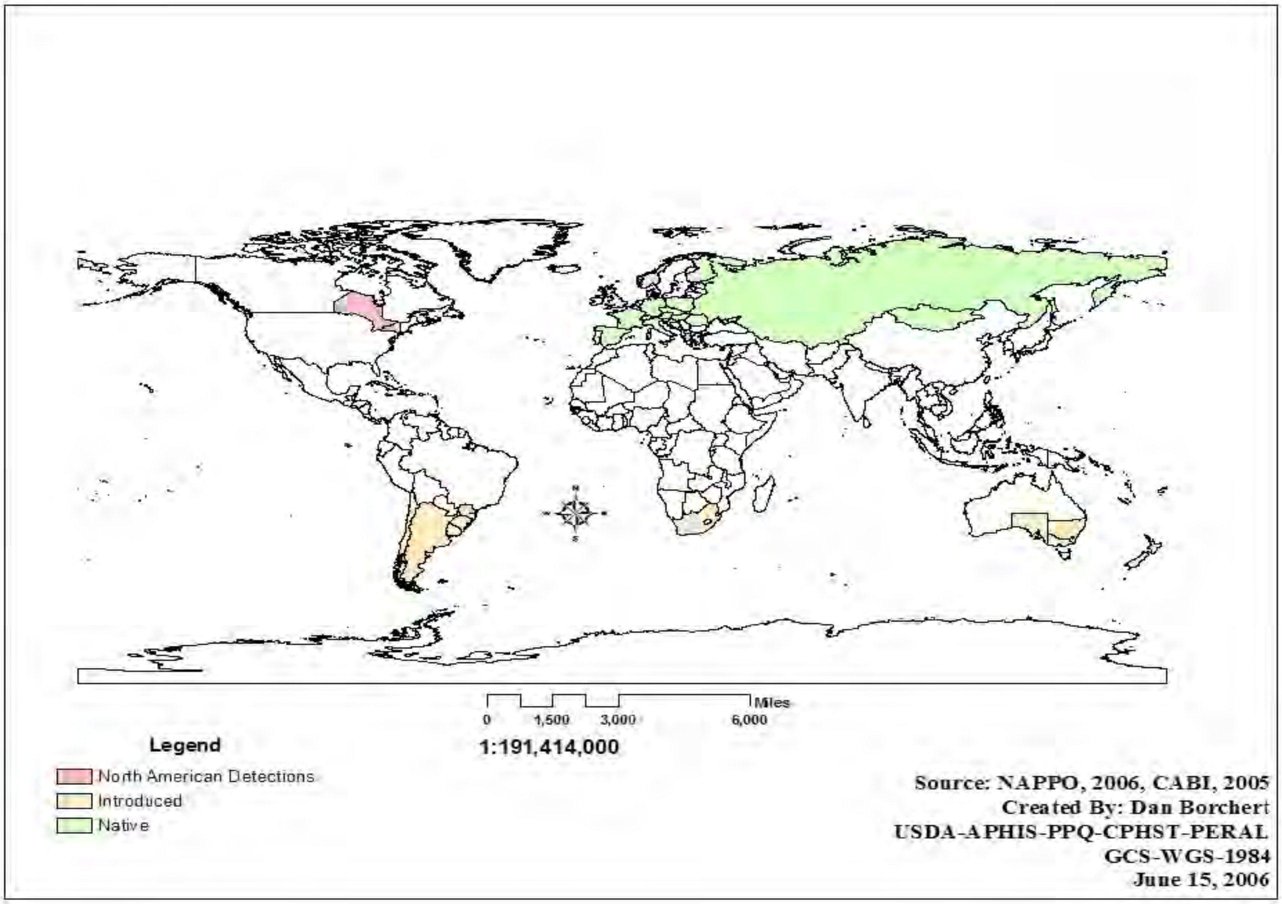
Traps and lure for one site.

Collection container with 10 ounce cup.

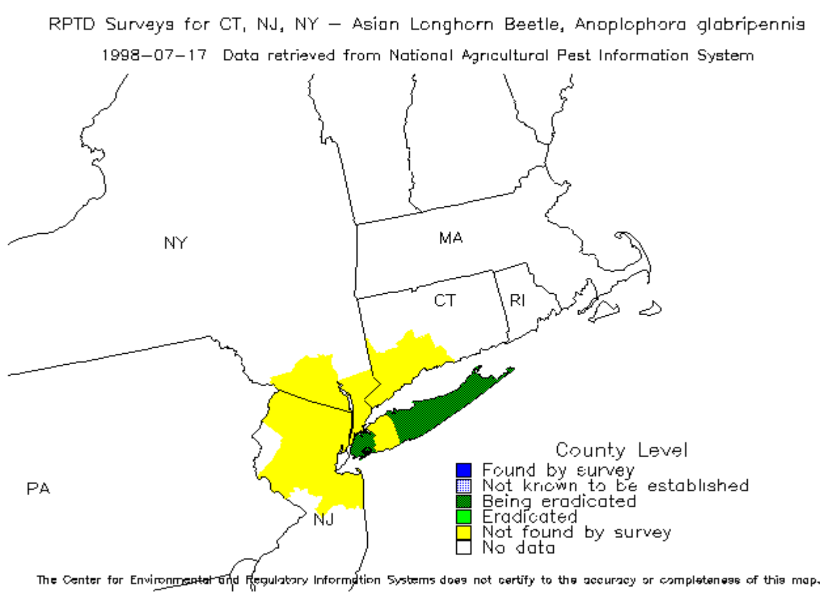
Trap label.

Typical trap location.

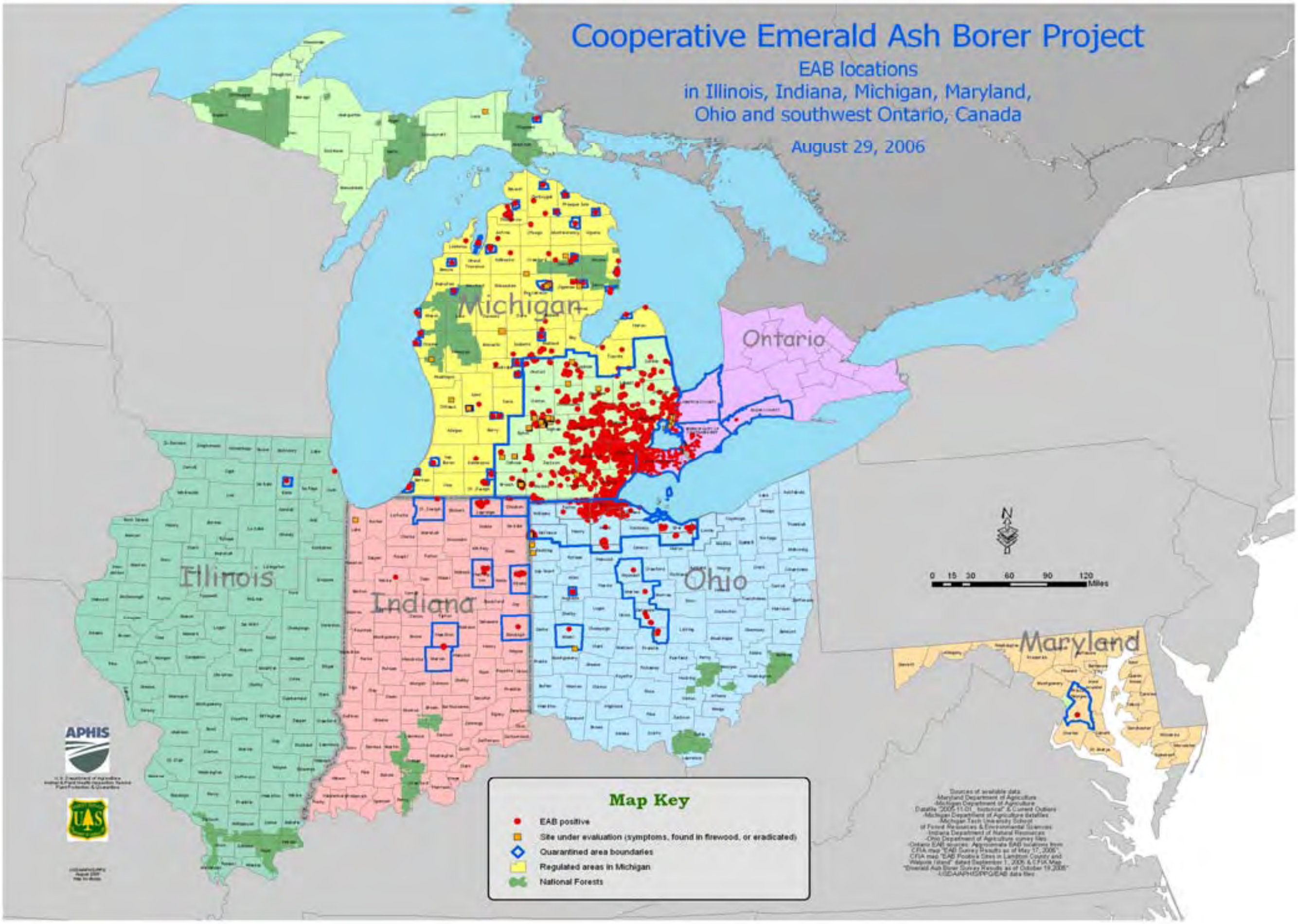
Data collection.



Current range of European wood wasp, *Sirex noctilio*.



Current range of Asian longhorned beetle (*Anoplophora glabripennis*) in the Northeastern U. S.
A small infestation also exists in the Chicago area.



Distribution of Emerald Ash Borer in the Northeastern U. S., late summer, 2006.

2006 Results of Exotic Wood Boring Insects Trapping, at High-Risk Sites throughout Montana.

County (City)	Lure Type	Number of Traps	Total Traps	Positive Suspects
Cascade (Great Falls)	Exotic Ips	3		
	Alpha Pinene	3		
	Ethanol	3	9	0
Custer (Miles City)	Exotic Ips	1		
	Alpha Pinene	1		
	Ethanol	1	3	0
Fergus (Lewistown)	Exotic Ips	2		
	Alpha Pinene	2		
	Ethanol	2	6	0
Flathead (Kalispell)	Exotic Ips	3		
	Alpha Pinene	3		
	Ethanol	3	9	0
Gallatin (Bozeman, W. Yellowstone)	Exotic Ips	4		
	Alpha Pinene	4		
	Ethanol	4	12	0
Lewis & Clark (Helena)	Exotic Ips	1		
	Alpha Pinene	1		
	Ethanol	1	3	0
Missoula (Missoula)	Exotic Ips	3		
	Alpha Pinene	3		
	Ethanol	3	9	0
Ravalli (Bitterroot Valley)	Exotic Ips	1		
	Alpha Pinene	1		
	Ethanol	1	3	0
Richland (Sidney)	Exotic Ips	3		
	Alpha Pinene	3		
	Ethanol	3	9	0
Sanders (Plains)	Exotic Ips	1		
	Alpha Pinene	1		
	Ethanol	1	3	0
Silver Bow (Butte)	Exotic Ips	2		
	Alpha Pinene	2		
	Ethanol	2	6	0
Toole (Sweet Grass)	Exotic Ips	1		
	Alpha Pinene	1		
	Ethanol	1	3	0
Yellowstone (Billings)	Exotic Ips	3		
	Alpha Pinene	3		
	Ethanol	3	9	0
Total	**Exotic Ips**	**28**		
	Alpha Pinene	**28**		
	Ethanol	**28**	**84**	**0**

Species of Siricidae Found during Survey of Selected High-Risk Sites in Montana, 2006.

Species	City	County	Date	Number Specimens
Urocerus albicornis	Missoula	Missoula	6-20 June	1
Urocerus albicornis	Plains	Sanders	27 June - 11 July	1
Urocerus albicornis	Lewistown	Fergus	30 June - 13 July	1
Urocerus albicornis	Kalispell	Flathead	9-25 July	1
Urocerus albicornis	Missoula	Missoula	20 July - 3 August	1
Urocerus californicus	Missoula	Missoula	20 July - 3 August	1
Urocerus californicus	Missoula	Missoula	3-17 August	2
Urocerus gigas flavicornis	Missoula	Missoula	6-20 June	1
Urocerus gigas flavicornis	W. Yellowstone	Gallatin	1 June - 17 July	1
Urocerus gigas flavicornis	Butte	Silver Bow	22 June - 8 July	1
Urocerus gigas flavicornis	Missoula	Missoula	23 June - 6 July	1
Urocerus gigas flavicornis	Bozeman	Gallatin	22 June-10 July	1
Urocerus gigas flavicornis	Missoula	Missoula	23 June - 6 July	1
Urocerus gigas flavicornis	Lewistown	Fergus	31 June - 13 July	1
Urocerus gigas flavicornis	Great Falls	Cascade	5-19 July	1
Urocerus gigas flavicornis	Kalispell	Flathead	9-25 July	1
Urocerus gigas flavicornis	Bozeman	Gallatin	10 - 24 July	1
Urocerus gigas flavicornis	Butte	Silver Bow	17-31 July	1
Urocerus gigas flavicornis	Missoula	Missoula	20 July - 3 August	3
Urocerus gigas flavicornis	Lewistown	Fergus	27 July - 9 August	1
Urocerus gigas flavicornis	Butte	Silver Bow	1-14 August	1
Urocerus gigas flavicornis	Missoula	Missoula	3-17 August	2
Sirex cyaneus	Lewistown	Fergus	30 June - 13 July	1
Sirex cyaneus	Great Falls	Cascade	5-19 July	1
Sirex cyaneus	W. Yellowstone	Gallatin	1-14 August	1
Sirex cyaneus	Great Falls	Cascade	2-10 August	2
Sirex cyaneus	Missoula	Missoula	3-17 August	1 (male)
Tremex columba	Sidney	Richland	27 July - 9 August	1
Total Siricidae				**33**

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Sudden Oak Death
Phytophthora ramorum

Phytophthora ramorum, also known as Sudden Oak Death, is a water mold dispersed through wind, water and soil. As of July 11, 2006, there are 43 proven host plants that carry and transmit *P. ramorum*, and 54 associated plants with the potential to become hosts. The list continues to expand, as more samples are collected and found to be positive for the organism. It is capable of rapidly spreading, as increasing numbers of ornamental plants are shipped both nationally and internationally. The wide range of host plants includes rhododendron, camellia, Douglas fir, viburnum, and lilac, in addition to other hardwood species and herbaceous plants. Pathogenic effects can vary from leaf spots and shoot tip dieback to complete mortality. Often the disease is difficult to detect, therefore an accurate diagnosis requires testing of any suspicious plant material that appears to be infected.

During the 2006 National Survey for Sudden Oak Death, 26 nurseries tested positive in California. Thirteen nurseries tested positive in Oregon, nine in Washington, two in Florida, and one each in the following states: Alabama, Connecticut, Georgia, Indiana, Maine, Pennsylvania, and Michigan.

The Montana Department of Agriculture (MDA) surveyed nurseries and retail outlets throughout ten counties, collecting 600 samples for testing. All results were negative for the detection of the pathogen.

O'Brien, Joseph USDA Forest Service http://www.forestryimages.com

***P. ramorum* positive rhododendron leaf.**
Other signs and symptoms may vary from plant to plant.

Phytophthora ramorum has been detected on these hosts

Coast Live Oak & CA Black Oak

Bay Laurel

Sample leaves

Rhododendron

Sample leaves

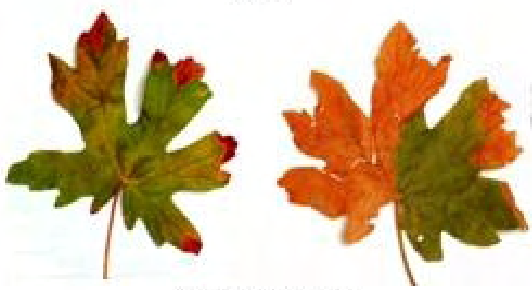
Toyon

Sample leaves

Buckeye

Sample leaves

Maple



Sample leaves

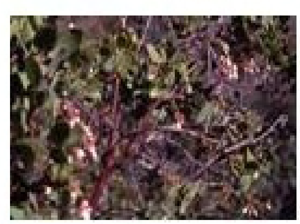
Madrone

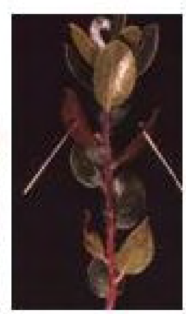
Sample leaves

Tanoak

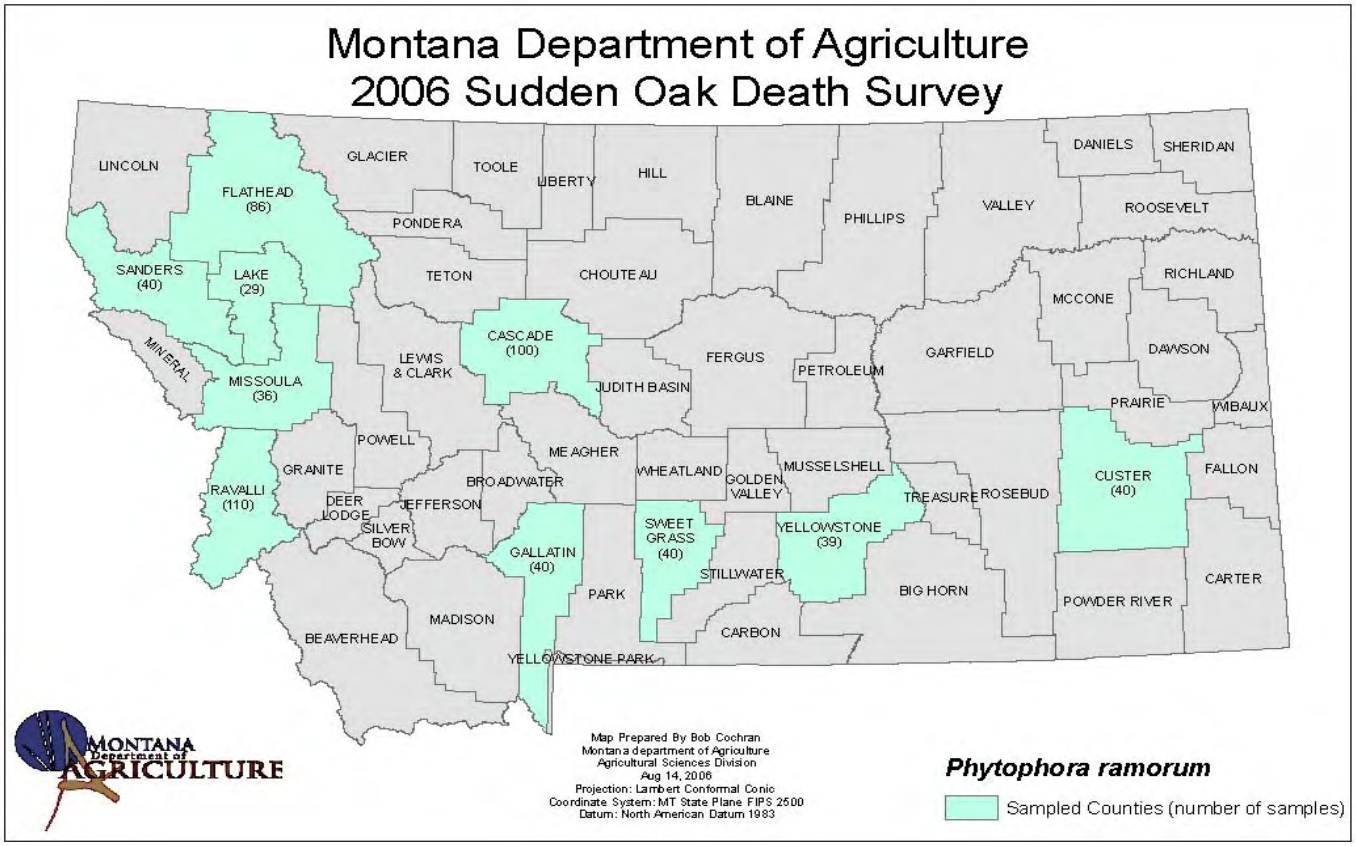
Sample leaves

Manzanita





Sample dead branch- on the border between the dead and the live areas.


Montana Department of Agriculture
2006 Sudden Oak Death Survey
LINCOLN
FLATHEAD (86)
GLACIER
TOOLE
LIBERTY
HILL
DANIELS
SHERIDAN
BLAINE
PHILLIPS
VALLEY
ROOSEVELT
PONDERA
SANDERS (40)
LAKE (29)
TETON
CHOUTEAU
RICHLAND
MCCONE
MINERAL
MISSOULA (36)
CASCADE (100)
LEWIS & CLARK
FERGUS
PETROLEUM
GARFIELD
DAWSON
JUDITH BASIN
PRAIRIE
WIBAUX
POWELL
GRANITE
MEAGHER
WHEATLAND
GOLDEN VALLEY
MUSSELSHELL
CUSTER (40)
FALLON
RAVALLI (110)
DEER LODGE
BROADWATER
JEFFERSON
TREASURE
ROSEBUD
SILVER BOW
SWEET GRASS (40)
YELLOWSTONE (39)
GALLATIN (40)
STILLWATER
BIG HORN
CARTER
PARK
POWDER RIVER
MADISON
CARBON
BEAVERHEAD
YELLOWSTONE PARK
MONTANA Department of AGRICULTURE
Map Prepared By Bob Cochran
Montana department of Agriculture
Agricultural Sciences Division
Aug 14, 2006
Projection: Lambert Conformal Conic
Coordinate System: MT State Plane FIPS 2500
Datum: North American Datum 1983
Phytophora ramorum
Sampled Counties (number of samples)

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Karnal Bunt
Tilletia indica

Karnal bunt (KB) is a fungal disease that affects wheat, durum wheat and triticale. Initially, the disease was discovered near Karnal, India in 1931. It was first detected in the United States in 1996, within the State of Arizona. KB thrives in cool, moist temperatures as the wheat is starting to head out.

Fungal spores are windborne and can be spread easily through the soil. Grain can also become infested after passing through or being transported by contaminated equipment. Spores have the ability to survive within the soil for several years, given favorable conditions. Controlling the transportation of contaminated seed is essential in preventing the spread to major grain production areas.

Credits: R. Duran, Washington State University www.forestryimages.org

Bunted Wheat

Montana ranked third in all wheat production in 2005, accounting for 9.1 percent of U.S. wheat production, up 1.1 percent from 2004. Percent of U.S. total for winter wheat was up 1.8 percent, durum wheat was down 3.8 percent, other spring wheat was up 0.7 percent, and barley was up 1.0 percent from 2004.

Montana's Crop Production for 2005

ITEM	BUSHELS	RANK	% U.S. Total
All Wheat	192,480,000	3	9.1
Winter Wheat	94,500,000	5	6.3
Durum Wheat	16,380,000	2	16.2
Other Spring Wheat	81,600,000	2	16.2
Barley	39,200,000	3	18.5

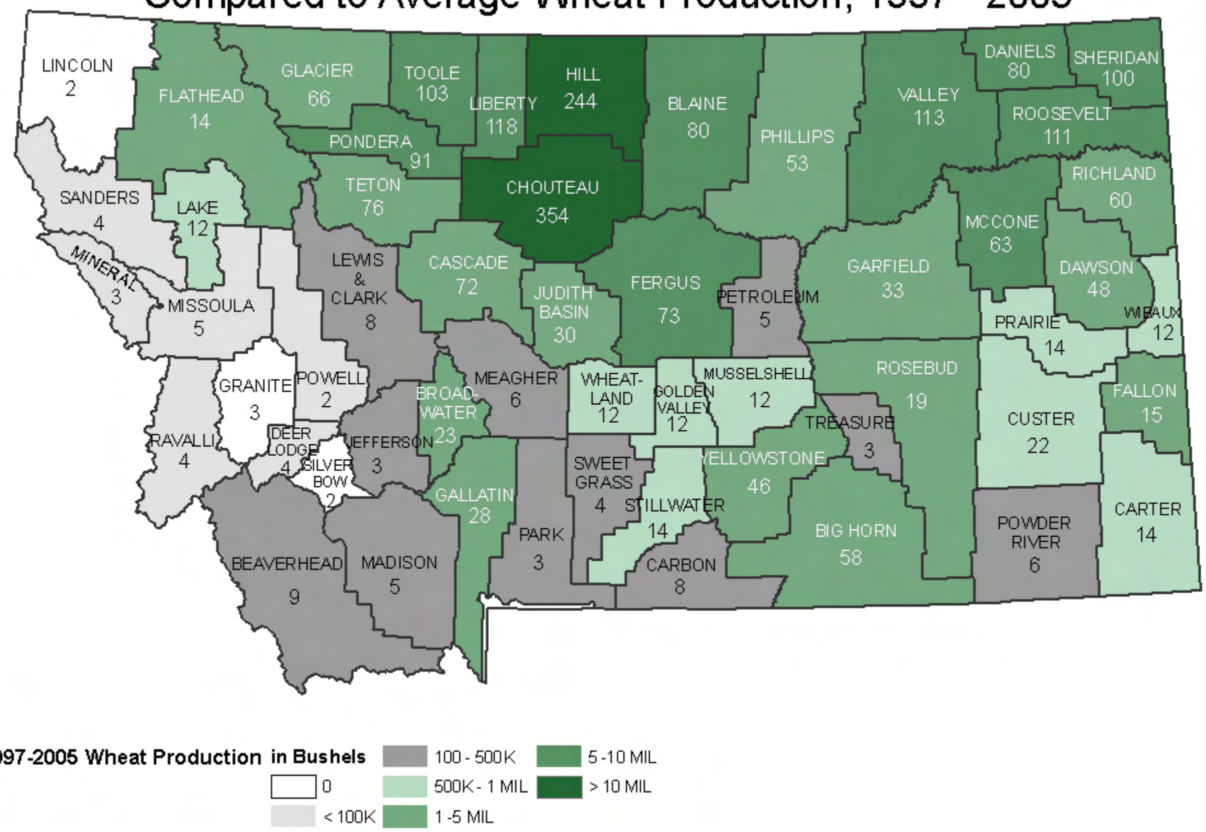
http://usda.mannlib.cornell.edu/usda/current/CropProdSu/CropProdSu-01-12-2006.txt

Montana continued to sample for KB during the 2006 harvest. A total of 119 samples were collected in 28 counties throughout Montana. The USDA Laboratory in Olney, Texas conducted the testing. All samples tested negative for the presence of KB. This sampling is critical for wheat growers in Montana. It confirms our wheat is free from KB, ensuring access to export markets.

Wheat Production in Montana, in bushels (1997-2005)

County	Total	Avg.	Total KB Samples	County	Total	Avg.	Total KB Samples
Choteau	149,102,000	16,566,889	354	Wibaux	8,401,000	933,444	12
Hill	114,327,000	12,703,000	244	Prairie	7,429,000	825,444	14
Roosevelt	82,879,000	9,208,778	111	Musselshell	7,295,000	810,556	12
Sheridan	77,450,000	8,605,556	100	Carter	7,189,000	798,778	14
Valley	72,124,000	8,013,778	113	Stillwater	6,910,000	767,778	14
Daniels	57,081,000	6,342,333	80	Lake	6,554,000	728,222	12
Fergus	54,111,000	6,012,333	73	Golden Valley	5,958,000	662,000	12
McCone	52,418,000	5,824,222	63	Custer	5,529,000	614,333	22
Liberty	50,589,000	5,621,000	118	Madison	4,382,000	486,889	5
Blaine	50,106,000	5,567,333	80	Beaverhead	4,380,000	486,667	9
Pondera	47,868,000	5,318,667	91	Powder River	4,070,000	452,222	6
Toole	47,116,000	5,235,111	103	Petroleum	3,831,000	425,667	5
Teton	41,832,000	4,648,000	76	Lewis & Clark	3,799,000	422,111	8
Richland	41,043,000	4,560,333	60	Park	2,659,000	295,444	3
Cascade	37,961,700	4,217,967	72	Meagher	2,641,000	293,444	6
Big Horn	33,958,000	3,773,111	58	Treasure	2,497,000	277,444	3
Phillips	33,928,000	3,769,778	53	Carbon	2,185,000	242,778	8
Dawson	33,643,400	3,738,156	48	Sweet Grass	1,010,000	112,222	4
Glacier	28,991,000	3,221,222	66	Jefferson	991,000	110,111	3
Gallatin	23,211,000	2,579,000	28	Missoula	862,000	95,778	5
Judith Basin	21,387,000	2,376,333	30	Ravalli	594,000	66,000	4
Garfield	21,190,000	2,354,444	33	Sanders	392,000	43,556	4
Yellowstone	20,768,000	2,307,556	46	Mineral	249,000	27,667	3
Broadwater	13,203,700	1,467,078	23	Powell	149,000	16,556	2
Rosebud	12,166,000	1,351,778	19	Deer Lodge	33,000	3,667	4
Flathead	11,124,000	1,236,000	14	Granite	0	0	3
Fallon	10,210,000	1,134,444	15	Lincoln	0	0	2
Wheatland	8,453,000	939,222	12	Silver Bow	0	0	2
				Totals	1,338,229,800		2,384

Number of Karnal Bunt Samples Per County, 1996 - 2006
Compared to Average Wheat Production, 1997 - 2005



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Potato Wart
Synchytricum endobioticum

The fungal pathogen *Synchytrium endobioticum* causes potato wart disease. The disease was originally discovered in the Andean region of South America during the latter part of the 19th century. It continued to spread into parts of North America and Europe with the movement of seed tubers, infected soil, machinery and implements used in cultivation, footwear, and manure from animals. Other Solanaceous crops may be hosts for the disease. However, it appears that potatoes are mainly affected by the pathogen.

When the conditions are favorable, the disease is highly infectious, appearing mainly on stolons and tubers. Underground development of wart-like growths on the tubers makes it difficult to detect, as signs and symptoms may not be apparent during the growing season. The warts are often knocked off of the tubers during harvest, adding to the difficulty in detection. The fungal spores can live in the soil for decades.

This fungal pathogen is considered a quarantine significant pest internationally due to its destructive nature and longevity within the soil. Montana is a key seed potato growing region within the United States, producing both seed potatoes for interstate trade and table-stock potatoes for international trade. It is essential to ensure that our potato growing areas are free from this pathogen.

Central Science Laboratory, Harpenden Archives, British Crown, www.forestryimages.org

Potato wart infested tubers.

The Montana Department of Agriculture collected 150 soil samples for laboratory analysis to detect the presence of *S. endobioticum* within potato growing fields. The samples were obtained from major geographical regions where seed and commercial potatoes are grown within the State. Potato wart has is not been known to occur in Montana. Monitoring for the pathogen will provide growers with confidence and assure their trading partners that Montana's fields are free from this disease.

2006 Potato Wart Sample Results

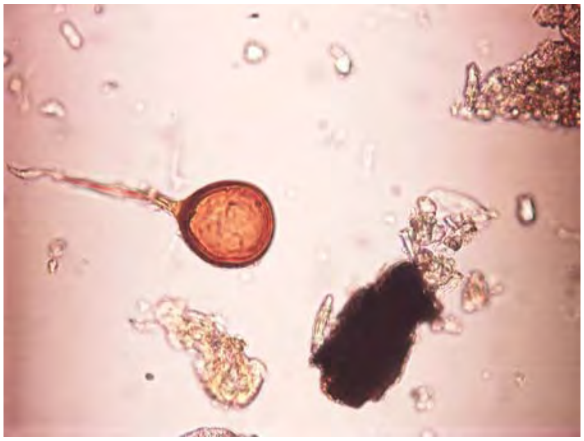
County	Samples Collected	Results
Beaverhead	24	Negative
Broadwater	18	Negative
Flathead	9	Negative
Gallatin	69	Negative
Lake	27	Negative
Madison	3	Negative

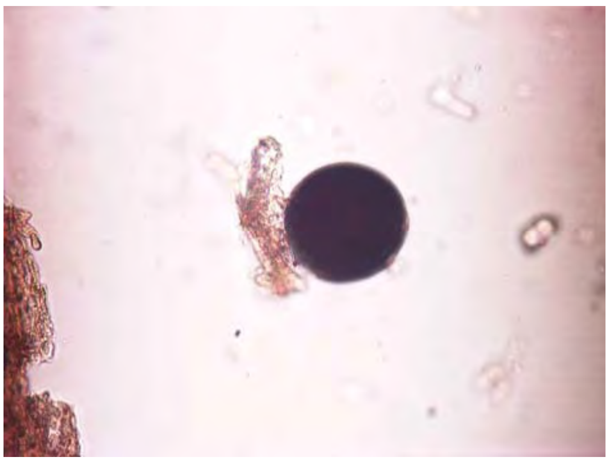
The Schutter Diagnostic Lab processed 150 soil samples and visually assayed all samples for potato wart sporangia. We did not observe *Sychytrium endobioticum* sporangia in any of the samples. Through consultation with MSU mycologist Dr. Cathy Cripps, we developed a list of criteria from which to identify *Synchtrium* sporagia. They are:

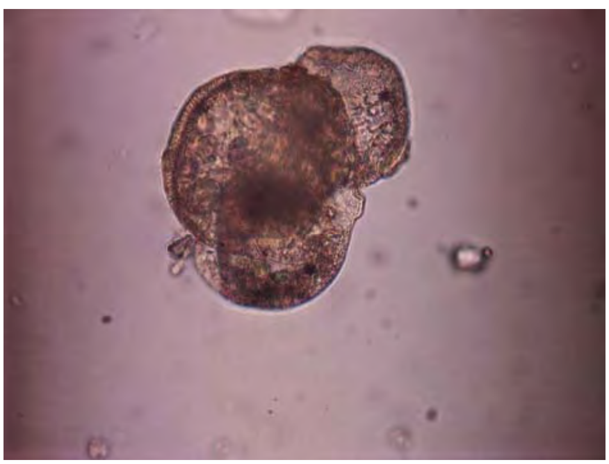
1. Golden color
2. Size 25-75µl (already controlled by sieve size)
3. Round but slightly irregular shape
4. Tri-layered wall
5. Presence of reticulations on cell wall
6. Presence of host tissue surrounding sporangia

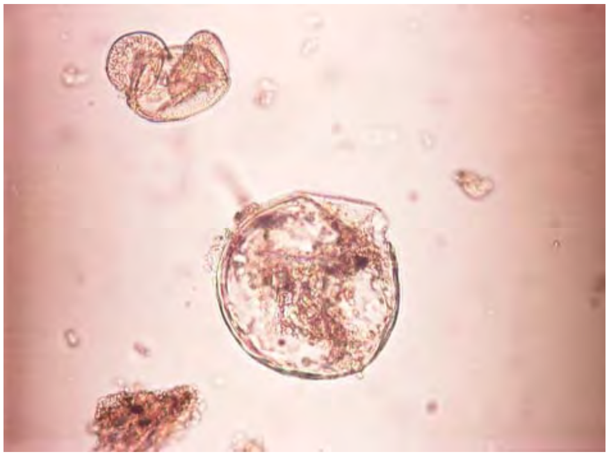
There were a number of sporangia-like organisms in the soil. Using the list of criteria above, and the expert advice of Dr. Cripps, we determined that they were not *Synchytrium endobioticum* sporangia. Some of the structures that we observed at 400X magnification were:

No reticulations, too perfectly round, two cell walls

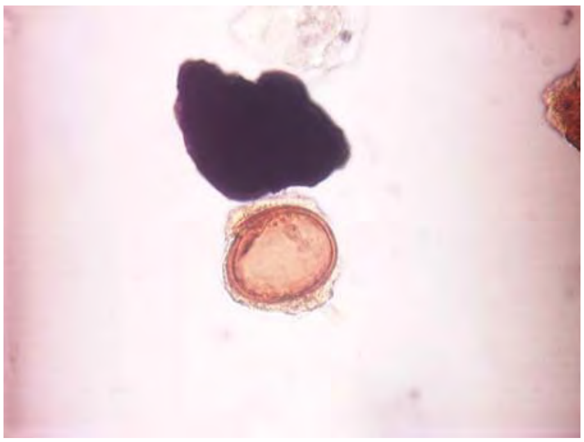

Looks similar to an arbuscular mycorrhizae spore. *Synchytrium* sporangia would not have the subtending hyphae extending out of the structure.


Too dark, and too perfectly round.


Pollen.

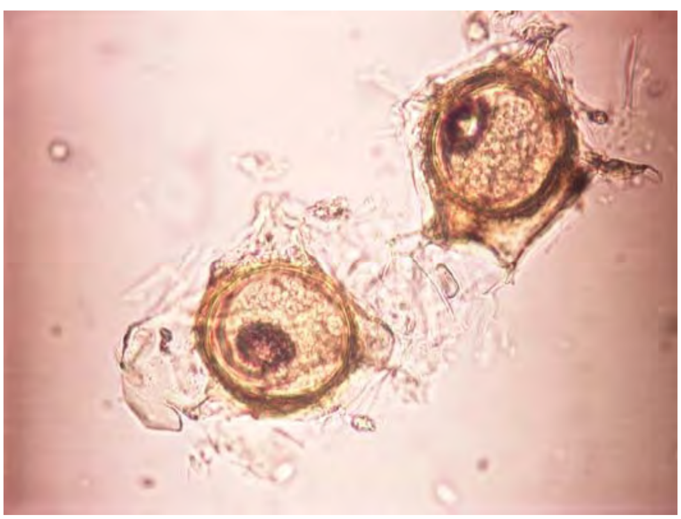


Single, very thin wall



No reticulations, single cell wall

The above structures were compared to slides of de-vitalized sporangia (below) which were obtained from Dr. Mary Palm Senior Mycologist and Lab Director, PPQ Molecular Diagnostic Lab, APHIS PPQ, Beltsville, MD.



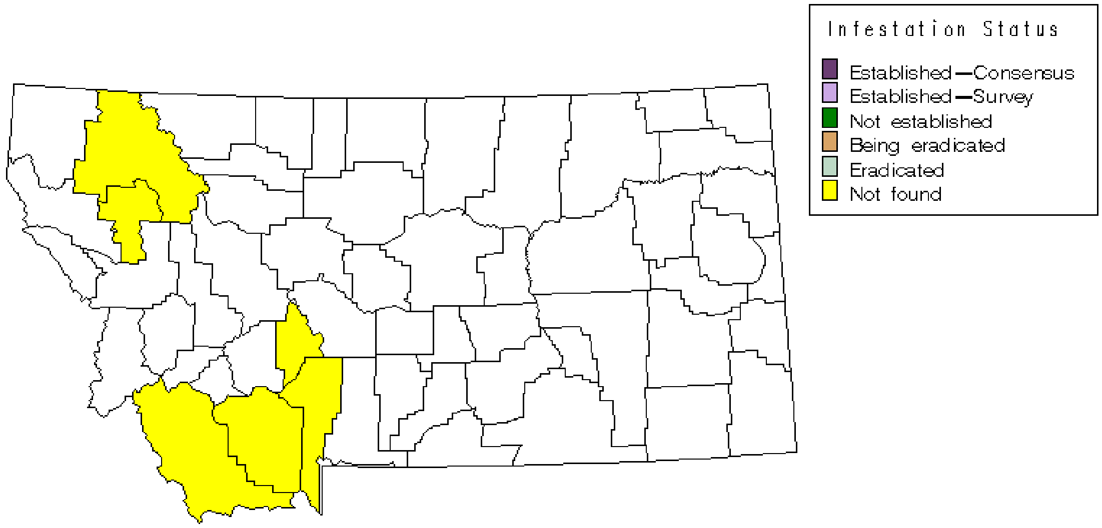
Sporangia of *Synchytrium endobioticum*

Reported Status of

POTATO WART , SYNCHYTRIUM ENDOBIOTICUM

in MONTANA

Data retrieved from National Agricultural Pest Information System on 03/14/2007



The Center for Environmental and Regulatory Information Systems does not certify the accuracy or completeness of the map.
Negative data spans over last 3 years only.

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Area-Wide Nematode Survey

Central Science Laboratory, Harpenden Archives,
British Crown, www.ipmimages.org

Internal damage to tuber caused by Ditylenchus destructor.

Many species of nematodes cause significant reductions in crop yields, impacting the growth of many different crops. The nematodes surveyed for are of regulatory significance and would negatively impact our agricultural export markets, if detected.

The MDA collected 111 soil samples throughout Dawson, Rosebud, Carbon, Beaverhead, Broadwater, Cascade, Lewis and Clark, Big Horn, Daniels, Hill, Judith Basin, Madison, Sanders, Fergus, Flathead, Lake, Gallatin, Pondera, Richland, Treasure and Yellowstone counties. Crops sampled included: alfalfa, barley, beans, garlic, lentils, nursery stock, potatoes, peas, safflower, and wheat.

Soil was screened for thirty five nematodes species, sixteen species of regulatory concern, and nineteen other plant-parasitic genera, including: *Globodera rostochiensis*, *Globodera pallida*, *Ditylenchus destructor*, *Ditylenchus dipsaci*, *Meloidogyne chitwoodii*, *Meloidogyne falax*, *Meloidogyne hapla*, *Meloidogyne javanica*, *Meloidogyne artiellia*, *Nacobbus aberrans*, *Paratrichodorus* species, *Heterodera glycines*, *Xiphinema bakeri*, *X. diversicaudatum*, *X. coxi* (syn *X. europaeum*), and *Rotylenchus reniformis*.

Results from the survey will benefit Montana growers by providing information on the identified species of nematodes that currently reside within their farmlands. The information gleaned from the survey will provide the growers with current nematode population levels, so control methods can be implemented, reducing damage to their crop yields in the future.

Bonsak Hammeraas, Norwegian Institute for Agricultural and Environmental Research, www.ipmimages.org

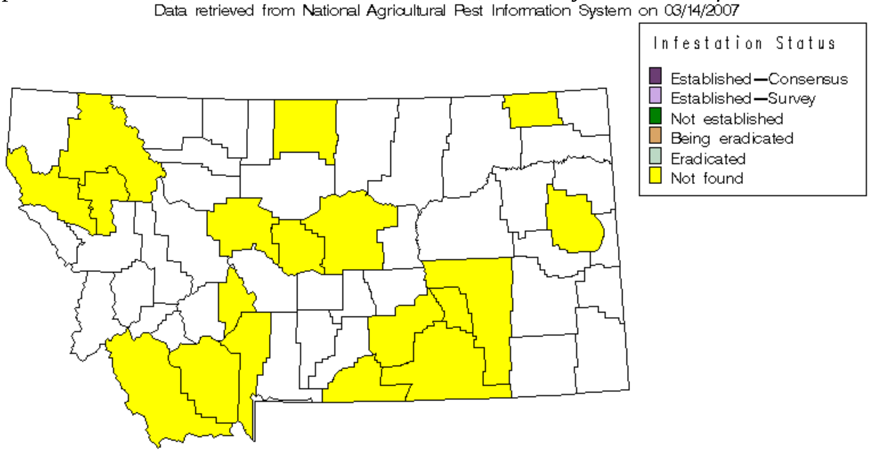
White potato cyst nematode, *Globodera pallida.*

2006 Nematode Survey Results

County	Samples Collected	Results
Beaverhead	8	Negative
Big Horn	7	Negative
Broadwater	6	Negative
Cascade	1	Negative
Carbon	16	Negative
Daniels	10	Negative
Dawson	4	Negative
Fergus	3	Negative
Flathead	3	Negative
Gallatin	23	Negative
Hill	3	Negative
Judith Basin	1	Negative
Lake	9	Negative
Lewis and Clark	1	Negative
Madison	1	Negative
Rosebud	2	Negative
Sanders	2	Negative
Treasure	2	Negative
Yellowstone	8	Negative

Reported status of *Globodera rostochiensis*, *G. pallida*, *Ditylenchus destructor*, *D. dipsaci*, *Meloidogyne chitwoodii*, *M. falax*, *M. hapla*, *M. javanica*, *M. artiellia*, *Nacobbus aberrans*, *Paratrichodorus* species, *Heterodera glycines*, *Xiphinema bakeri*, *X. diversicaudatum*, *X. coxi*, and *Rotylenchus reniformis* for Montana

Data retrieved from National Agricultural Pest Information System on 03/14/2007



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Negative data spans over last 3 years only.

Montana Department of Agriculture 2006 Pest Survey: Final Report

Zac Hassler
Montana Department of Agriculture Intern

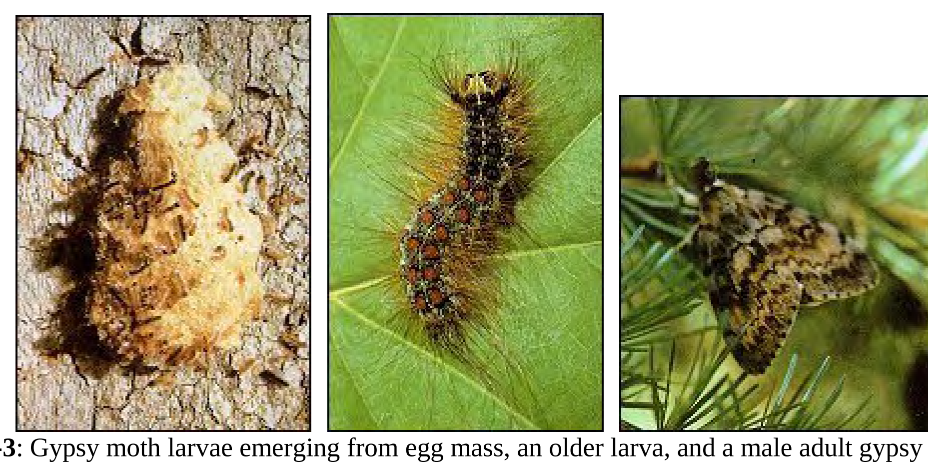
August 23, 2006

Introduction

With the potential to destroy crops, nursery stock, and natural ecosystems, exotic plant pests pose a serious threat to Montana's natural and agricultural resources. Nationally, the U.S. Department of Agriculture (USDA) approximates that pest damage results in a $41 billion dollar annual loss. One way the USDA tries to mitigate annual losses caused by pest damage is through the Cooperative Agricultural Pest Survey (CAPS). The CAPS program seeks to detect and delineate plant pests of concern. The USDA's Animal and Plant Health Inspection Service (APHIS), Plant Protection & Quarantine (PPQ) works in cooperation with state departments of agriculture to carry out this mission.

As an intern with Montana Department of Agriculture's 2006 CAPS campaign, I conducted surveys for four pests: *Rhyacionia buoliana* (European pine shoot moth or EPSM), *Rhagoletis pomonella* (apple maggot fly or AM), *Agrilus planipennis* (emerald ash borer or EAB), and *Lymantria dispar* (gypsy moth or GM). Each pest has a unique history and impact, and thus the goals and methods for monitoring them differed.

The gypsy moth (see Figs. 1-3), a non-native insect introduced in 1869, has acquired a reputation in the eastern United as a devastating pest, defoliating as much as 12.9 million acres in a single year. Outbreaks frequently occur in the northeast and have occurred as far west as Utah and California. In high densities, GM larvae eat continuously, stripping a tree of nearly all foliage. Egg masses and larvae may be transported by cars or recreational vehicles. When these larvae become adults later in the season, they may breed and lead to an infestation the following year, provided the eggs survive the winter. GM prefers hardwood, but during times of dense population they also feed on *Pinus* and *Tsuga* species.



Figs. 1-3: Gypsy moth larvae emerging from egg mass, an older larva, and a male adult gypsy moth. Taken from Forest Insect and Disease Leaflet 161.

European pine shoot moth (see Fig. 4), another non-native whose origins in North America date back to 1914, has much in common with GM . Infestations are most common in the northeastern U.S. and southeastern Canada but have also occurred in Washington State, Oregon, Idaho, and British Columbia. Historically, EPSM has moved through infested ornamental nursery stock. Larval infestations can limit growth of trees or lead to deformations such as trunk forking. Given the abundance of *Pinus ponderosa* and *Pinus contorta* in Montana and the value of these trees for lumber or non-extractive uses, the reasons for trapping EPSM are clear.

Fig. 4: EPSM adult. Taken from http://www.acgov.org/cda/awm/agprograms/images/pineshootlarge.jpg.

Emerald ash borer (see Figs. 5 and 6) is a more recent pest problem. Since its discovery in Michigan in 2002, EAB has spread to Ohio, Indiana, and Ontario, killing 20 million ash trees and causing a regulatory quarantine to prevent EAB movement in the three U.S. states. Highly selective eaters, EAB larvae invade the inner bark of ash trees and inhibit water and nutrient translocation. The goals of Montana's EAB survey were to get a general idea of the quantity of ash trees throughout the state and to search for telltale signs of EAB infestations.

Figs. 5 and 6: Ash borer larva and adult. Taken from http://www.emeraldashborer.info.

Apple maggot (see Fig. 7), unlike the other three pests, is native to the U.S. It is distributed from Oklahoma to North Dakota and eastward. As its name indicates, AM use apple trees as a host, but they also feed on a variety of other fruits, including *Cretaegus*, a shrub native to Montana. Females lay their eggs beneath the skin of fruits. Larvae emerge to feed on the fruit; then, when the fruit drops, larvae transform into pupae and burrow into the soil to overwinter.

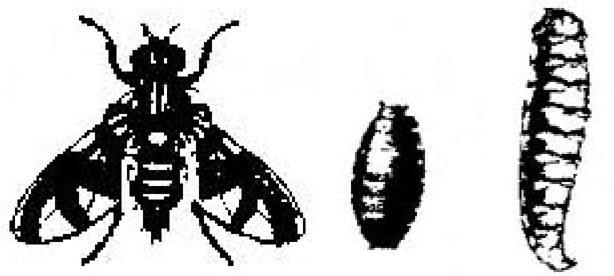


Fig. 7: AM fly, puparium, and larva. Taken from http://ohioline.osu.edu/hyg-fact/2000/2041.html.

Methods

The gypsy moth survey involved placing 250 traps in quadrants lying west of the continental divide (see accompanying map). APHIS conducted GM surveys in quadrants lying east of the divide, and the Montana DNRC conducted surveys in portions of counties in western Montana. Some traps were placed east of the divide, such as those in the Big Hole Valley, because portions of their respective quadrants lie west of the divide.

A pheromone strip that attracts adult male gypsy moths was stapled to each trap. Gypsy moth traps, like the EPSM and AM traps to follow, were lined with tanglefoot.

GM trap placement had two primary goals: 1) to place the traps approximately four miles apart near major highways, and 2) to place the traps in deciduous trees or shrubs, the preferred hosts of gypsy moths. Both of these goals could not be reached at all times, e.g., the Big Hole Valley had lower trap densities than one per four miles because of a lack of potential hosts.

In descending order of frequency, the following deciduous plant genera were selected as trap sites: *Populus*, *Salix*, *Acer*, *Betula*, *Alnus*, *Prunus*, *Rosa*, *Cornus*, and *Physocarpus*. When there were no deciduous trees or shrubs available for placement, *Pinus* and *Tsuga* were selected.

GM traps were checked five times. Trap checking occurred continually June through August. Suspects were sent by overnight delivery to the state offices in Helena for verification. Upon completion of the survey, all traps were re-inspected by the State Entomologist.

The European pine shoot moth survey called for 80 traps in western Montana, the majority of which, at the direction of the State Survey Coordinator and the State Entomologist, were to be placed in Sanders County. In the end, more than 50% of EPSM traps were placed in Sanders County (see accompanying map). The remaining traps were placed at sites rich in *Pinus*.

A pheromone strip that attracts EPSM male adults was placed in the tanglefoot of the trap. EPSM traps were checked and pulled for re-examination by the state entomologist three times, beginning in late June and ending in mid-August.

Twenty apple maggot traps were placed throughout Lawyer nursery, wherever an apple tree or *Cretaegus* could be found on or near nursery operations. These traps were placed in early July and changed and sent to the state offices in mid-July. The second group of traps was sent to the state offices in early August.

The goal of the AM survey was to ensure that the stock of Lawyer Nursery, the state's largest, was free of the pest. Although Lawyer Nursery sells little or no fruit producing apple trees in Montana, it does sell *Cretaegus*, and numerous fruiting apple trees lie on or near the nursery property.

The emerald ash borer survey was unique in several respects. It called for a large number of trees, preferably 100, to be inspected at a site for D-shaped exit holes, a tell-tale sign of EAB. Additionally, trees at each site were categorized into basic categories, e.g., ash, elm, poplar, or conifer. This information could help in defining areas that would be most damaged by an EAB infestation. In all, eight EAB surveys were completed, using parks and residential areas for sites.

Results

There were no positive findings of GM.

One EPSM was found at a site in urban Kalispell. This positive finding occurred during examination of EPSM traps by the state entomologist, further stressing the importance of the reexaminations of the last traps prior to reaching any final conclusions about EPSM or gypsy moth.

All AM traps were examined and found to contain no AM.

No EAB D-shaped exit holes were found, and few or no ash trees were found at sites.

Conclusions

Perhaps the most important conclusion to be reached is that all the hard work by the people who monitor and control pest populations is paying off. In regards to the one positive EPSM find, it appears to be an isolated incident because another trap close in proximity contained no EPSM. It does however seem prudent to trap urban Kalispell at higher densities next year to ascertain if any EPSM survived the winter.

The rest of my conclusions are less formal and can be divided into two categories: 1) practical pieces of advice I would like to hand down to my successor, and 2) things I learned during my CAPS internship that go beyond the pests.

This would be my list of advice to future CAPS interns, all of which I had to learn the hard way:

- Take your time in placing the traps, in spite of your desire to get them out as soon as possible. Inevitably, a good site appears a quarter mile after the bad site where you just placed the trap. Traps should be placed at a spot in the road that can be accessed easily going either way. There should be good visibility of both lanes of traffic. In short, highways are dangerous. Consider your own safety.
- Stay organized and stay on top of the paperwork. This will save you a lot of time.
- Put time into learning the insects. I just looked at a dozen pictures or so of each insect on the internet and thought this would suffice. It did not.
- Eschew shortcuts, in terms of roads. My "shortcuts" almost always cost me more time than they were worth. And despite what your Montana highway map tells you, that paved road may turn out to be thirty miles of dirt and boulders.

- Try not to drive the stretches of road between Seeley Lake and Swan Lake or Thompson Falls and Noxon at dawn or dusk. I found these to be the two worst roads for deer. Of course, in western Montana, that is a relative statement.
- Plan your route so that you are not driving East to West at dusk so the sun does not get in your eyes.
- If you wear a polyester shirt, you will not be shocked by static electricity every four miles when you get out of the car. I wore cotton all summer, and I am still gun shy about touching car doors.

As far as CAPS beyond pests goes, I truly loved this job. People drive and fly thousands of miles to take in the scenery that I got paid to drive through every day. Here is some of what I saw. I saw the great diversity that exists among insects. I saw a geologist's dream: roadcuts, roadcuts, and more roadcuts. I saw dozens of osprey, dozens of bighorn sheep, dozens of turkeys, an elk, two moose, two bull snakes, a red fox, a coyote, and a turtle. I saw red-tailed hawks hunting chipmunks in the Big Hole. I saw a sparrow or some other small bird wriggle itself out of the grasp of a raptor. I almost stepped on a skunk near Kalispell.

There is something to be said for driving through the same areas as the summer cycles on, too. I saw rivers that bulged over their banks in June shrivel up in July and August. I saw all of western Montana dry up and some of it catch fire. I saw the changes in flowering vegetation, as the chokecherries gave way to the herbaceous plants which yielded to the ninebark. Not everything I saw was so pleasant. I saw enough roadside trash and knapweed to get depressed by them and wonder if either one of them could ever be controlled.

Those concerns aside, the internship was like a three month course in natural history. Add to that the flexibility in scheduling that allowed me to keep an infant daughter out of daycare, and I simply cannot express enough gratitude to the Montana Department of Agriculture and my supervisors for the opportunity to participate in the CAPS program.

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http://www.emeraldashborer.info

McManus et al. *Forest Insect and Disease Leaflet 162: Gypsy Moth*. U.S. Department of Agriculture Forest Service. U.S. G.P.O.: Washington, D.C., 1992.

Miller et al. *Forest Insect and Disease Leaflet 59: European Pine Shoot Moth*. U.S. Department of Agriculture Forest Service. U.S. G.P.O.: Washington, D.C., 1970.

Surveys of *Phytophthora ramorum,* cereal leaf beetle, and Karnal bunt
Molly Miller
Montana Department of Agriculture
Summer 2006

Going into this summer internship, I was not really sure what to expect. I was not familiar with any of the pests (*Phytophthora ramorum,* cereal leaf beetle, or Karnal bunt). For the *P. ramorum* survey I expected to find more plant material at the nurseries that would be hosts. I was surprised by how few of the nurseries carried Douglas fir and viburnum, while plants such as roses and lilacs were abundant. I also did not expect to be confronted with opposition from nursery owners. Even when I tried to explain why I was there, some nursery owners felt that they were being singled out and felt that the survey made their nursery appear like it might have a disease. Overall, I felt this was a good experience since at most of the nurseries I was able to complete the duties and most of the people were cooperative.

At some of the locations there were few samples of Rhododendron, lilac, Douglas fir, and viburnum available. Therefore, it was not feasible to collect forty samples from every nursery. At a few locations there was opposition to the survey since nursery owners and managers were unsure of why they were chosen to be tested. Nursery owners and managers were also worried that customers would see the gloves and disinfectant, and would think there was something wrong with their nursery. Thus, it became apparent that it was important to state what the survey involved to the manager immediately upon arrival and that it was voluntary. Nursery owners and managers also wondered when they would be hearing the results and whether they would be receiving a certification if their nursery was free from *P. ramorum.*

***Phytophthora ramorum* survey:**

Phytophthora ramorum is the causal agent for a disease known as Sudden Oak Death (SOD) or *P. ramorum* blight. This agent is a fungus and is of concern in North America and Europe for three reasons: 1.) high level of local destruction, 2.) lack of knowledge of its epidemiology, and 3.) its high prevalence in nurseries. This disease affects numerous species including oak, Rhododendron, roses, Douglas fir, lilacs, and viburnum. Sudden Oak Death has been known to occur in coastal areas of California since 1995, causing widespread dieback of tanoak and several oak species (coast live oak, California black oak, Shreve's oak, and canyon live oak) in California's central and northern coastal counties. *P. ramorum* has been found in nurseries in at least twelve continental European countries, in Washington State, in British Columbia, and in Oregon State. How *P. ramorum* originally entered Europe and the United States is unknown.

Fungal spores are spread to new locations mainly by the nursery trade and are spread locally by vectors, soil, water, tools, and articles associated with humans. California nurseries sent potentially infected plant material to all 50 states, with Montana receiving a number of shipments from one or more of the confirmed positive nurseries.

There are two categories of hosts, each of which are susceptible to the pathogen in different plant parts: bark canker hosts and foliar hosts. Bark canker hosts become infected on their trunks. Mortality may occur in as little as two years. Foliar hosts become infected on their leaves and twigs. They only occasionally die from the infection (http://www.invasivespecies.net/database/ species/ecology.asp?si=5638&fr=18sts=sss). Thus foliar hosts, such as California bay laurel and Rhododendron species, do not die from the disease, but they do play a key role in the spread of *P. ramorum*, acting as hosts for inoculum, which may then spread (California Oak Mortality Task Force, http://nature.berkeley.edu/comtf/html/ about_p_ramorum.html). There is no known treatment for *P. ramorum*, so elimination of the infected host materials is the only method to control the pathogen.

According to the Global Invasive Species Database, *P. ramorum* spreads aerially and generally infests trees and plants above the soil line (including leaves, shoots, woody stems, and bark). Fungal infections on the bark develop into cankers, which produce red/brown/black sappy exudates (bleeding). Cankers can occur on the trunk from the root crown up to 20 m above the ground, but do not occur below the soil line in the roots. Aerial seeps not connected to the root collar are a good indication that a tree is infected. When the outer bark is removed, mottled areas of necrotic (dead and dying) and discolored inner-bark tissue with black “zone lines” around the edges may be seen. When cankers girdle the trunk, death of the tree occurs resulting in a rapid change in the color of the foliage. Fungal infections on the leaves cause spotting and browning, often at the edge or tip of the leaf. Infections on the twigs cause branch drooping and dieback. On conifers, the pathogen causes needle blight and dieback of young shoots of Douglas fir, coastal redwood, and grand fir. On yews, symptoms are a needle blight of the young foliage resulting in an aerial dieback.The optimal growth temperature for *P. ramorum* is 20ºC. It grows best in areas with wet climates and constant mild temperatures, resembling the central California coast (Global Invasive Species Database, http://www.invasivespecies.net/database/species/ ecology.asp?si=5638&fr=18sts=sss and Department for Environment, Food, and Rural Affairs, http://www.defra.gov.uk/planth/ pestnote/newram.pdf).

The objective of the 2006 *P. ramorum* National Nursery Survey was to determine the distribution of *P. ramorum* in the nursery system in the United States. The statewide survey was important so that Montana can continue to certify that nursery stock for export is free from *P. ramorum.* The survey also contributed to identifying potential infestations and provided the basis for further delimitation, control measures, and regulatory action. The survey consisted of collecting a total of 600 samples according to USDA APHIS PPQ protocols from fourteen nurseries in the following cities: Hamilton, Missoula, Great Falls, Helena, Corvallis, Plains, Polson, Bozeman, Billings, Kalispell, Big Timber, and Miles City. Cities that were expected to be surveyed but were not because of logistics and time restraints were Wolf Point, Glasgow, and Terry. Samples were shipped to the Montana State University Plant Diagnostic Laboratory for testing. All of the samples submitted came back negative for *P. ramorum*.

In the future, I would call the nursery ahead of time to ask their permission and explain what the procedure would involve. More samples could be taken from nurseries that contain more host species, especially wholesale nurseries, and fewer from nurseries with fewer host species.

Cereal Leaf Beetle survey:

For the cereal leaf beetle (CLB) survey, I expected grain to be easier to find in some of the counties, such as Rosebud, Carbon, Phillips, and Petroleum counties. The survey required finding grain fields throughout the county, which was difficult when the grain was clustered in one area. In other counties, however, there were abundant grain fields to take samples from, especially up on the northern hi-line of Montana. Later in the survey it was hard to find grain that had not flowered, so not as many fields were able to be sampled as earlier in the survey.

The cereal leaf beetle, *Oulema melanopus*, is a defoliating pest of small grains, including malting barley, oats, and wheat. It has been present in Montana for over a decade, and has spread to all but a handful of counties on the northern Hi-Line of Montana. This survey was important to observe the natural expansion of the range of CLB and to delimit its range in Montana for regulatory purposes. Feeding by CLB reduces the yield of crops and increases the cost of production through the use of pesticide application to standing crops and the costs of compliance with various quarantines. The survey determines the current range of CLB in Montana, which benefits Montana grain and hay producers.

According to the Montana State University Extension Service, CLB was first detected in Michigan in 1962, Utah in 1984, and Montana in 1989. In Montana it was first found in Yellowstone County, and the following year it was detected in Yellowstone, Stillwater, and Carbon counties.

Both the adults and larvae of cereal leaf beetle damage grain crops through their foliar feeding. The adult beetles are 3/16 inch long. They are very active during the cooler parts of the day and evenings, but may disappear during the heat of the day. They overwinter as adults in field edges and standing grass, moving into grain fields and feeding on small grain and grass foliage after they become active in the spring. They prefer spring grains over winter grains and barley and oats over wheat. The adults chew completely through the leaf, between the veins, resulting in a linear streaking of the leaf. Eggs hatch in four to 23 days, depending on the temperature. The larvae have a yellow body with brown head and legs. The body is protected by a layer of slimy fecal material, which makes them look like a slug. The larvae feed on the leaf surface between veins, removing all the green material down to the cuticle resulting in an elongated windowpane in the leaf. Severe feeding damage can give a frosted appearance to the field. Larval feeding differs from adult damage in that it is wider and limited to the upper surface of the leaf (http://www.ext.colostate.edu/pubs/insect/05596.html).

When the larvae have completed their feeding, they shed their slimy covering and drop to the ground, hollowing out an earthen cell for pupation. The pupal stage takes 10 to 14 days to complete. When new adults emerge from pupation, they feed briefly on grasses, before leaving the field and finding a protected overwintering site. The larvae are the most damaging stage and the target of control measures. The boot stage (one larva per flag leaf) is a critical point in plant development and impact of cereal leaf beetle feeding damage can be felt on both yield and grain quality. Once the flag leaf emerges, feeding is generally restricted to the flag leaf, which can significantly impact grain yield and quality (http://scarab.msu.montana.edu/ipm/clb.html#A3).

Montana’s wheat industry is a valuable component of Montana agriculture. Montana ranks fourth in the nation for wheat production; in 2004 over 173 million bushels of wheat were produced. Wheat and wheat products are Montana’s leading exports, making up 78% of the state’s agricultural exports. Cereal leaf beetle not only impacts the standing crop, but also has an impact on exports due to quarantines and required treatments. Thus, a detrimental pest such as cereal leaf beetle affects the exportation of Montana grain, especially to California and Canada, which have regulatory controls. This survey allows the state to analyze the expansion of cereal leaf beetle and determine the impact of introducing parasitoids as a biological control measure.

The USDA has introduced several parasitoids in an effort to reduce the costs of cereal leaf beetle to producers. Two parasitoids have been introduced in Montana, *Tetrastichus julis* and *Anaphes flavipes*. The parasitic wasp *T. julis* attacks the larval CLB reducing survival and undergoes range expansion almost simultaneously with the beetle. It has one to two generations per year. An average of five *T. julis* have been found in a single cereal leaf beetle larvae (http://scarab.msu.montana.edu/ipm/clb.html#A3). According to the Colorado State University Cooperative Extension, the success of the biological control varies with cropping systems, with greater success in dry land systems than in irrigated systems (http://www.ext.colostate.edu/pubs/insect/05596.html). The parasitoid *T. julis* was found in Carbon, Cascade, Big Horn, Flathead, Lake, and Gallatin counties. This survey provided information on the natural expansion and success of artificial introductions of the parasitoids. Thus the survey inspected for adult, larvae, and eggs of cereal leaf beetle, as well as the parasitoid *T. julis* within the larvae.

In 2004, *T. julis* was released in Toole, Jefferson, Meagher, and Richland counties. It was recovered in 2004 from Toole, Jefferson, and Meagher counties. For the 2006 survey, however, *T. julis* was not recovered in any of these counties, while all of the counties were surveyed for the parasitoid. The counties surveyed in the 2006 census that contained the parasitoid *T. julis* were in the south (Big Horn, Carbon, and Gallatin Counties), center (Cascade County), and northwest (Lake and Flathead Counties).

Surveys were conducted on malt barley, oats, spring wheat, and winter wheat crops. At least five fields in each county were surveyed, with two sub-samples of 50 sweeps each, per field. A GPS point was marked at each field to record where sites had been sampled. The survey methods were conducted in accordance with the established protocols used by the Montana Department of Agriculture.

A total of 36 counties were surveyed for CLB. I surveyed 27 of these counties. The following counties were surveyed for cereal leaf beetle and biological control by all of the interns in the Montana Department of Agriculture Pest Management Section: Glacier, Toole, Pondera, Liberty, Hill, Chouteau, Blaine, Phillips, Valley, Daniels, Sheridan, Roosevelt, Lewis & Clark, Richland, Wibaux, Fallon, Rosebud, Big Horn, Yellowstone, Carbon, Wheatland, Broadwater, Madison, Gallatin, Treasure, Flathead, Lake, Missoula, Jefferson, Gallatin, Meagher, Cascade, Teton, Judith Basin, Fergus, and Petroleum.

A majority of the farms producing cereal grains in Montana are located in the northern portion of the state, along the Hi-Line. However, a majority of the positive samples were taken in the southern part of the state.

Cereal leaf beetle prefers younger plants. Therefore, sampling was done in fields that contained earlier stages of grain. This determined not only which fields were sampled, but also where sampling was initiated.

Cereal leaf beetle adults were found in Teton, Carbon, Wibaux, Lewis & Clark, Broadwater, Big Horn, Yellowstone, Treasure, Cascade, Flathead, Lake, and Missoula counties. Small larvae were found in Carbon, Big Horn, Flathead, and Lake Counties, while large larvae were found in Carbon, Big Horn, Treasure, Flathead, Lake, and Gallatin counties. Eggs were harder to find, being only in Wibaux and Big Horn counties.

The counties in the south east part of the state were surveyed first during the end of May. These counties included Rosebud, Big Horn, Treasure, and Yellowstone counties. Wheatland, Yellowstone, and Carbon were surveyed during the last week of May and first week of June. During this time the grain was still young and just entering the jointing stage. It had not started to flower yet. During the middle of June the following counties were surveyed: Chouteau, Liberty, Hill, Phillips, Fergus, Teton, Blaine, Roosevelt, Sheridan, Daniels, Valley, Richland, Wibaux, and Fallon counties. At this point the grain was starting to flower and ripen. Cereal leaf beetle prefers grain that has not yet flowered and is still in the younger stages. Therefore, grain was sought that had not yet flowered.

During the last week of June the following counties were surveyed: Pondera, Glacier, Toole, Liberty, Hill, and Blaine. During the first week of July, which was the last week of the survey, the following counties were surveyed: Cascade, Judith Basin, Fergus, Petroleum, Wheatland, and Meagher. Young grain was sought after, but it was difficult to find five young grain fields in each county.

Figure 1. This picture shows the damage caused by cereal leaf beetle feeding in Carbon County.

The counties on the northern hi-line had more wind than the counties in the southern regions, where more cereal leaf beetle was found. The wind could possibly be a deterrent to cereal leaf beetle establishments in areas such as Daniels, Valley, Roosevelt, Sheridan, Judith Basin, and Petroleum counties.

Karnal bunt survey:

Going into the Karnal bunt survey, I did not expect to find any Karnal bunt because it has never been found in Montana ever since the survey began in 1996. I also think the survey will require good record-keeping since there is a designated amount of samples that must be taken from each county.

Karnal bunt (KB) is a fungal disease of wheat and triticale caused by the fungus *Tilletia indica*. The disease was discovered in 1931 in northern India. The first discovery of KB in the U.S. was in Arizona in March 1996. It is currently only found in three states: California, Arizona, and Texas. According to the USDA Animal and Plant Health Inspection Service (APHIS), KB can cause significant reductions in seed weight and viability if seed is severely infected. However, the main effect of KB is to impart a fishy odor and taste to wheat flour. Karnal bunt is spread mainly by the planting of infected seeds. Ideal conditions for the development of the fungus are cool weather, rainfall, and high humidity at the time of heading.

Karnal bunt is spread through spores that can live in the soil five years or more. The mechanical action of harvesting causes infected grains to rupture, liberating the resting spores (teliospores) of the fungus from the infected grains. Compared to other bunt species, KB is difficult to control. Chemical seed treatments used on other bunt species cannot be used on KB because there is insufficient chemical in the plant at heading when infection occurs. There are no known biological controls at this time (http://www.defra.gov.uk/planth/pestnote/karnal.pdf).

Montana has participated in this survey since 1996, in which time Montana has never been found to have KB. It is considered a priority pest nationwide and is identified on the CAPS Western Region Pest List. According to the Invasive species and Pest Management of the USDA, APHIS, PPQ, the sole purpose of the national survey is to provide U.S. certifying officials the ability to issue phytosanitary certificates required by any and all countries to which we export (or may export) wheat. Participation in the survey enables Montana and U.S. officials to continue to certify that wheat entering export markets originates where Karnal bunt is not known to occur. This survey will also assist in detecting potential infestations and provide the basis for further delimitation and control measures if infestations are found.

The minimum sampling requirement is one 4-pound sample from a selected county with 1,000,000 bushels of production. Each 4-pound sample represents approximately 1,000,000 bushels of host crop. The sample consisted entirely of one species and each sample contained grain from a single county. Sample distribution is proportionate to each county's contribution to Montana's total wheat production according to statistics provided by USDA National Agricultural Statistics Service. The sample collection takes place at the Montana Department of

Agriculture State Grain Laboratory located in Great Falls, Montana. The samples were submitted to Olney, Texas to be analyzed using an optical sorter. All survey data was entered into the NAPIS database.

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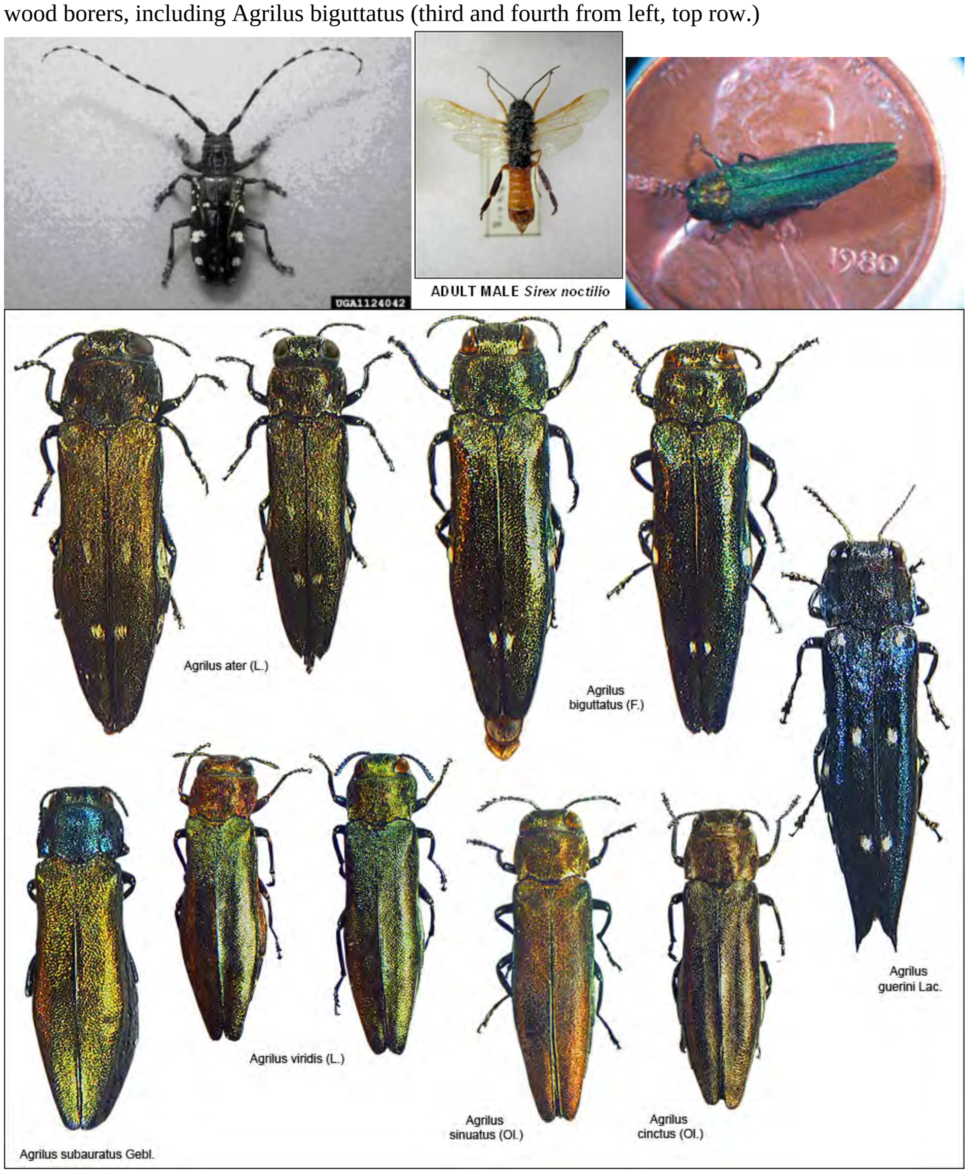
USDA Survey Manual for P. ramorum

National Karnal Bunt Survey of Wheat Grain handbook prepared by the Invasive Species and Pest Management (USDA, APHIS, PPQ)

Survey of Exotic Wood Boring Insects
Morgan Rocchio
Montana Department of Agriculture
Summer 2006

This survey was conducted to help determine the presence of four non-native wood boring species of insects in Montana. These insects are the Emerald Ash Borer (*Agrilius planipennis*), European Wood Wasp (*Sirex noctilio*), Asian Long Horned Beetle (*Anoplophora glabripennis*), and Metallic Beetle (*Agrilus biguttatus*) (Figure 1). Early detection of a non native wood boring species, would aid in implementing early eradication procedures, and would provide warning for surrounding areas.

Figure 1. From left to right, Asian Longhorned beetle, male European wood wasp, Emerald ash borer. Below, assorted metallic wood borers, including Agrilus biguttatus (third and fourth from left, top row.)



The Emerald Ash Borer was first discovered near Detriot, Michigan in 2002. It has since been found in Ohio, Indiana, New Jersey, Maryland and Ontario. The Asian Longhorned Beetle found its way to Brooklyn in 1996 on a crate shipped in from China. It has since been found in New York, New Jersey, Chicago, and Toronto. The Japanese Beetle, (metallic colored beetle) “was accidentally introduced to a nursery in Riverton, NJ in 1916. It's likely that the beetle larvae (white grubs) arrived in the soil ball of nursery stock. The beetle is currently present in all states east of the Mississippi River except Florida” (Held).

It is important for us to be aware of wood boring insects in our state early on, for the sake of Montana’s tree population and economic impacts these insects incur. The non-native wood borers lay their eggs in trees, which causes branches to die off and eventually brings death to the entire tree. Ways these insects are spread are through contaminated wood made into crates and other shipping products. This is the reason for placing traps in industrial areas.

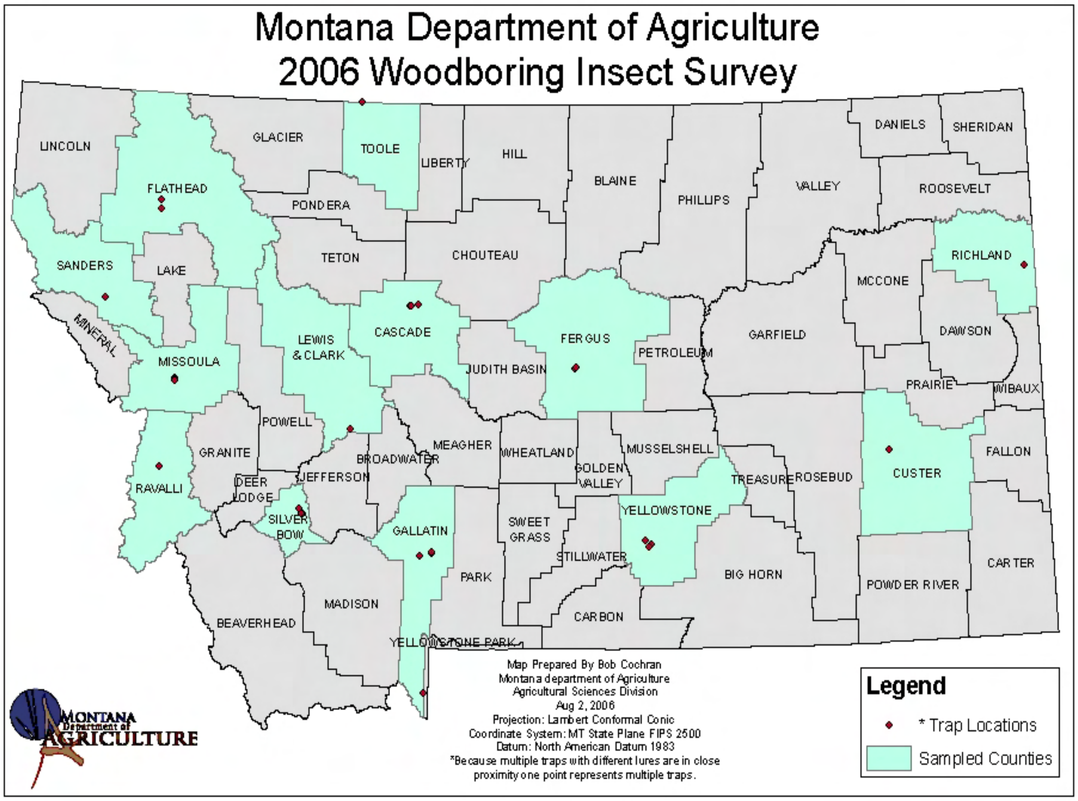
Lindgren funnel traps (Figure 2) were used for collecting insects in thirteen cities across Montana from May until August. The traps were baited with substances such as ethanol and pheromones. A diluted marine antifreeze and water mix sat in the cup at the bottom of the trap. Suspect bugs are attracted to the trap and fall down a series of funnels into the cup; waiting to be collected. All traps were marked with a GPS unit for future reference, should any questionable bugs be found. A questionnaire sheet was also filled out when the traps were initially set up noting location, GPS, surrounding wood products and similar information.

Figure 2. Lindgren funnel trap similar to those used in the exotic woodboring beetle survey in Montana.

LINDGREN FUNNELTRAP
FOR *Sirex noctilio*

A rotation was made around Montana to collect the insects with cups being emptied and refilled with antifreeze every two weeks. The samples were run back to Helena generally a few times a week. Traps were set up in sets of three; using three different attracting fluids.

Figure 3. Map showing location of traps and counties sampled in Montana during the exotic wood boring beetle survey.



Locations were usually industrial businesses with yards where the traps could hang on the fence. Locations were typically chosen based on areas that carried potentially contaminated wood supply, or at risk trees. The Montana cities were: Miles City with 3 traps, Billings with 9 traps, Sidney with 6 traps, Lewistown with 6 traps, Bozeman with 9 traps, Kalispell with 9 traps, Missoula with 9 traps, Plains with 3 traps, Sweet Grass with 3 traps, Great Falls with 9 traps, Helena with 3 traps, Butte with 6 traps and West Yellowstone with 3 traps.

Fortunately, none of the target insects were found in Montana, although a rare giant lacewing was located in a Great Falls trap.

This summer’s job was very educational for me. I appreciate having a job where I am learning new things and am out in the field, rather than sitting at a desk all day. This study has heightened my attention to knowing about Montana’s invasive species, and has prepared me to share this information with others. The most exciting moment was in Sidney, Montana where I found a giant dung beetle in one of the traps. It was surely the bug highlight of the summer! I thoroughly enjoyed traveling nearly 20,000 miles across Montana during this summer. It let me appreciate Montana’s beauty, and gave me many hours to reflect on many things. I love working for the Montana Department of Agriculture and hope to come back for the summer of 2007!

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