Gypsy Moth (GM) Detection Survey
Lymantria dispar (L.)

Gypsy moth (*Lymantria dispar* (L.)) was initially introduced into the Eastern U.S in the mid 1800'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 a variety of objects, such as RV's, firewood, furniture and other recreational equipment that has been left outdoors. The gypsy moth is the most destructive forest pest in the Eastern United States and large areas of the Northeastern US are under a federal quarantine to prevent the spread of this pest.

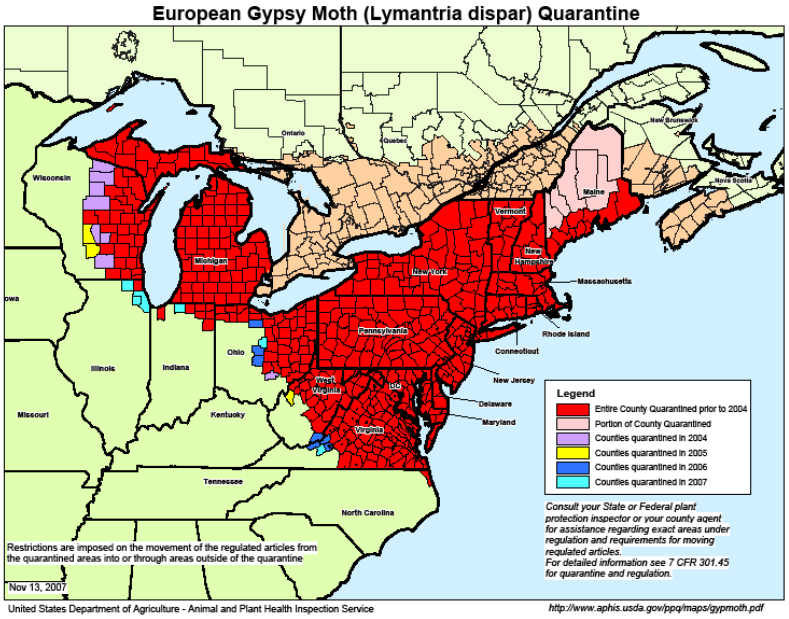


Image from http://www.padil.gov.au

Male Gypsy Moth

Traps are baited with a female sex-pheromone and only attract males.

Light Brown Apple Moth (LBAM)
Epiphyas postvittana (Walker)
Detection Survey

The first discovery of light brown apple moth (LBAM, Fig 1.) in the continental United States occurred in March of 2007 in the Bay area of California. This pest has been established in Hawaii since the late 1800's. LBAM is a native pest of Australia and has been introduced into India, New Caledonia, New Zealand, and the United Kingdom (CAB International, 2005). Currently, the entire state of Hawaii and the California counties of Alameda, Contra Costa, Marin, Monterey, San Francisco, San Mateo, Santa Clara, Santa Cruz, and Solano are all under a federal domestic quarantine order administered by the USDA. This quarantine has been established to prevent the dissemination of the LBAM and to establish restrictions on the interstate movement of certain regulated articles from the quarantined areas. LBAM could cause substantial economic losses to apple, grape, and pear crops if introduced throughout the continental United States. LBAM is highly polyphagous insect and would probably cause additional economic damage to other crops and sectors of the U.S. economy, e.g. domestic and international trade. Also, because LBAM can occur in nursery stock, this industry could provide another pathway for its introduction outside of the quarantined area in addition to movement on agricultural commodities.

Fig. 1. LBAM. http://www.tortricidae.com/lbam.asp

BIOLOGY (modified from LBAM National Survey Guidelines)

LBAM is a member of the moth family Tortricidae whose members are commonly called leaf rollers. There are generally two to four generations of LBAM per year across its native range (Wearing et al., 1991). Eggs are deposited in masses on the upper surface of leaves of smooth-leaved host plants. Early instars feed on tissue beneath the leaf surface on the underside of leaves inside self-constructed silken webs (Thomas, 1998). Larger larvae construct feeding niches between two leaves, a leaf and fruit, in the bud, or on a single leaf (Thomas, 1998). Larvae go

through five, six or seven instars. Pupation occurs within these rolled leaf sites. The larvae overwinter but do not undergo diapause. There is no available data on cold tolerance for LBAM, but there is potential that if populations or individuals are introduced in Montana the cold climate might prevent overwintering and permanent establishment of this pest. Since LBAM does not go into diapause at low temperatures, it is expected that lower temperatures will have a detrimental effect on the insect. Adults do not readily disperse out of favorable habitats (Danthanarayana, 1983) and only about 10% of the population migrates (Wearing et al., 1991).

HOSTS

LBAM has a host range in excess of 150 plant genera in over 70 families, including nursery stock, cut flowers, stone fruits, pome fruits, grapes, and citrus. Important plants in Montana on the list of "primary" hosts are cherries, apples, pine trees, potatoes, and alfalfa. In the state of Montana nearly1.6 million acres of hay alfalfa, 12,000 acres of potatoes and 2,000 orchard acres are planted or harvest annually. The sweet cherry crop averages around 2,000 tons of fruit production annually.

ECONOMIC DAMAGE

Damage is caused by larval feeding on the foliage, buds, shoots, and fruits of host plants (Wearing et al., 1991). Fruit damage has the greatest economic impact. The larvae feed mainly on the fruit surface, often where a leaf is tied to the fruit or between fruits, which causes the formation of large irregular blemishes (Wearing et al., 1991).

Jackson Trap, USDA/APHIS/PPQ

NATIONAL SURVEY

Starting in 2008, a national survey for LBAM was funded through USDA-APHIS-PPQ. This survey was designed to determine the potential presence of LBAM in other states including Montana, and to facilitate early detection, eradication, and or management of infestations. State survey levels were determined based on NAPPFAST risk modeling (Figs. 2, 3). Based on climate and land use criteria, Montana is categorized as "Low" risk for the introduction of LBAM. This designation recommends the placement of 50 LBAM traps monitored for 3 months. All traps and the female sex-pheromone based lure for LBAM were provided by

USDA-APHIS-PPQ. This survey had the goal of not only determining presence or absence of LBAM, but also establishing a framework within the state of Montana for conducting a similar survey in an emergency pest detection situation.

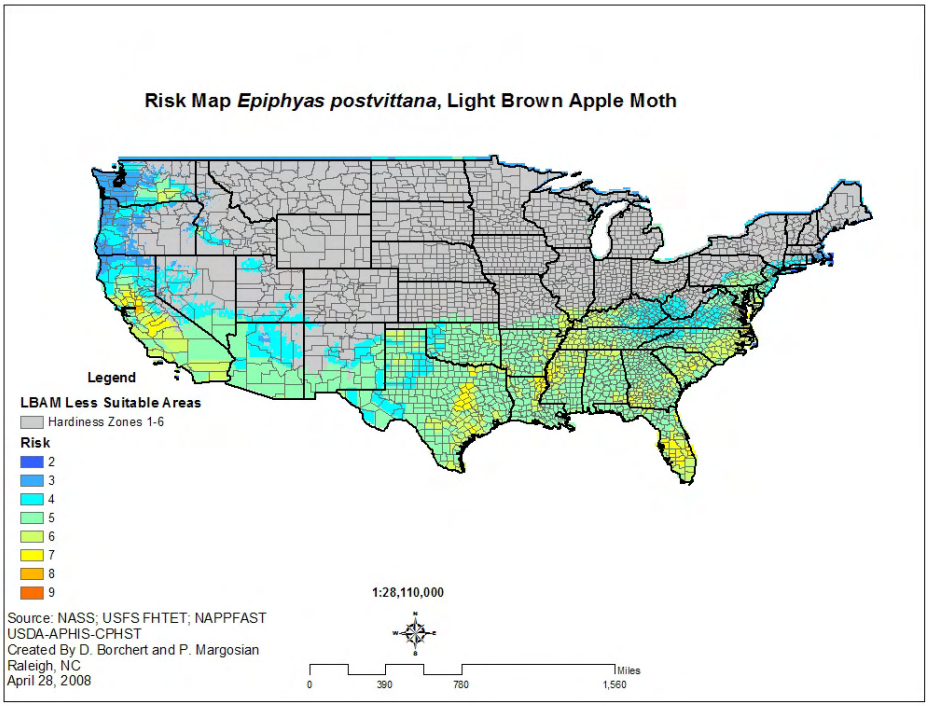


Figure 2. Risk Map for LBAM with all USDA Plant Hardiness zones.

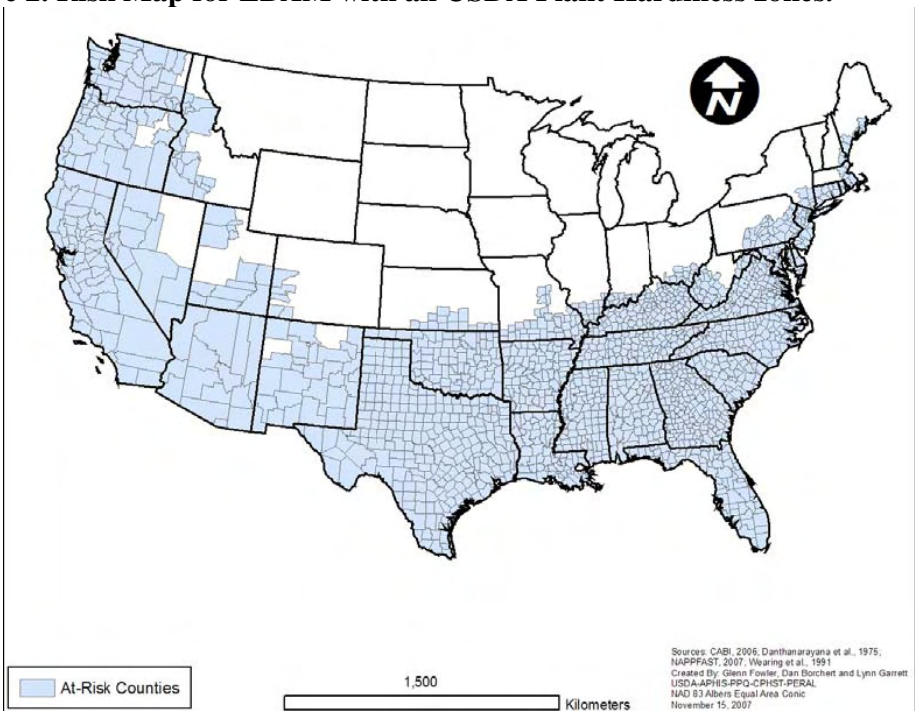


Figure 3. Risk Map for LBAM with USDA Plant Hardiness zones 7-10.

MONTANA SURVEY

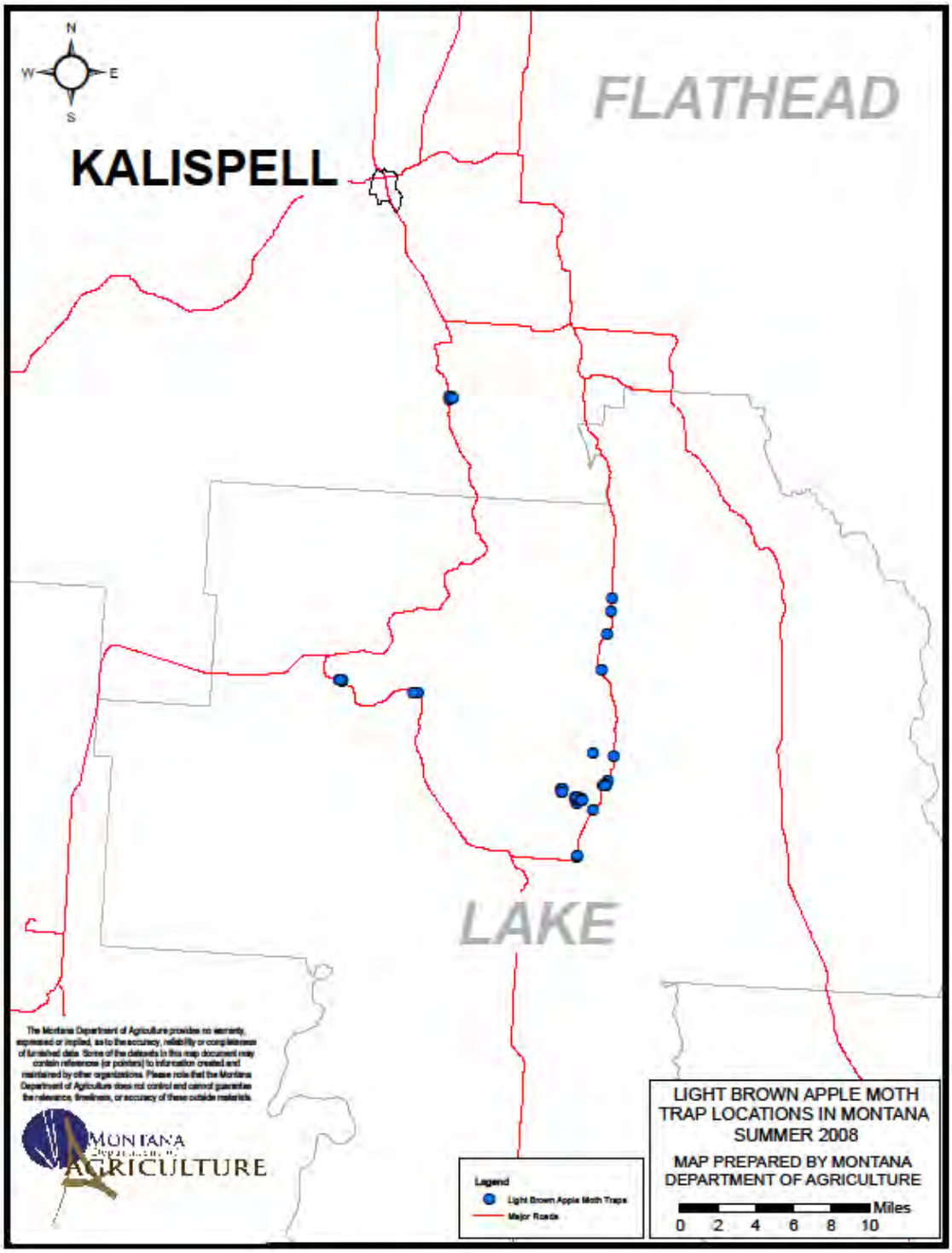
Survey protocols followed the 2008 Light Brown Apple Moth National Survey Guidelines (USDA 2008, http://www.aphis.usda.gov/plant_health/plant_pest_info/lba_moth) published by USDA-APHIS-PPQ. All traps and the female sex-pheromone lure for LBAM were provided by USDA-APHIS-PPQ. Survey planning, execution, and initial trap screening were completed by Montana Department of Agriculture personnel. *Jackson* type fruit fly traps were used by MDA and all traps were placed in the area around Flathead Lake. This higher risk area of Western Montana was targeted due to the fruit production that occurs there. Nurseries in that area were also targeted. All traps were placed in Lake or Flathead counties during the beginning of July; traps were checked once in August and then removed in September. All traps were screened for suspect moths by the MDA State Entomologist.

RESULTS

No light brown apple moths were caught by MDA personnel in 2008. *Adoxophyes negundana* (McDunnough) (image below) was the most commonly trapped suspect tortricid moth caught in LBAM traps in 2008.

Image of shimmering gold *Adoxophyes* moth

Location of LBAM traps placed in Montana



Larvae are voracious predators and feed on over 500 different species of plants. Important potential native tree hosts of the Gypsy Moth in Montana include Aspen and Western Larch. Older larvae will also actively feed on Pines and Spruce. Many landscape and urban trees and shrubs across Montana would be subject to GM defoliation. There have been several positive GM traps in Montana in recent years: Cascade (1989, 1990), Gallatin (1988), Glacier (2001, 2003, 2007), Lewis and Clark (1988), Liberty (1992), Missoula (1996), Park (2001), and Yellowstone (1993). All of these moths were certainly moved through anthropogenic means and this human caused movement of immobile egg masses and pupae represents the most significant entry pathway of the Gypsy Moth into Montana.

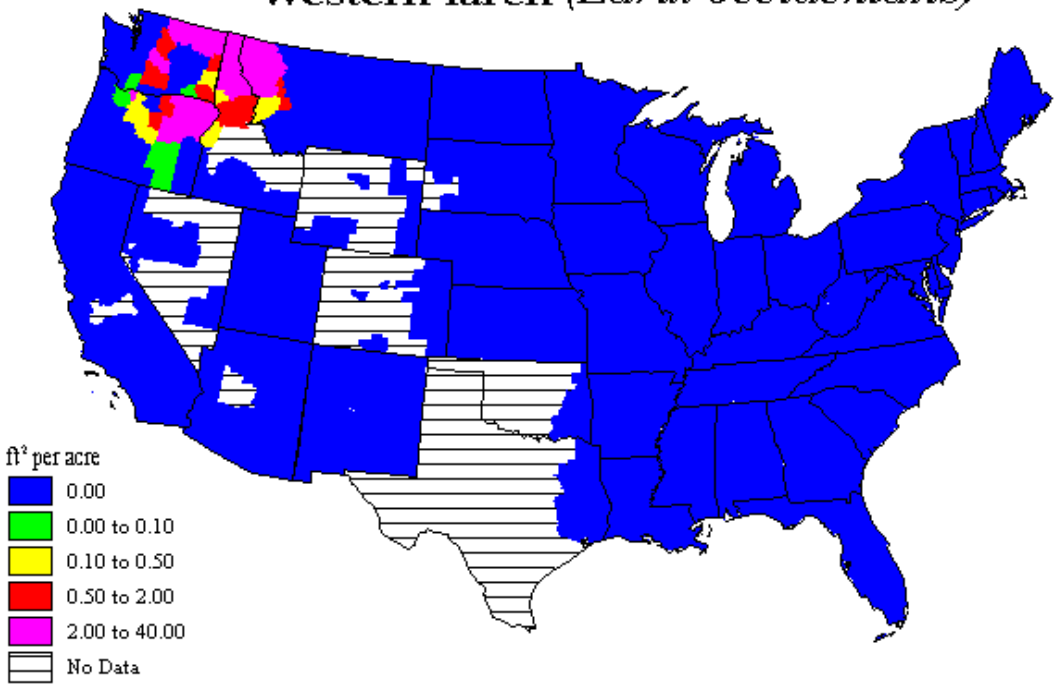
Major native Montana host plants are generally concentrated in the Western half of the state (see Western larch and quacking aspen distribution maps below), but suitable landscape and urban gypsy moth host plants can be found across Montana.

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 sets traps in Mineral and Missoula Counties and the USDA-FS sets traps in a large number of campgrounds, as well as other public recreation areas. All traps were placed by early June, and checked throughout the summer at two to three week intervals.

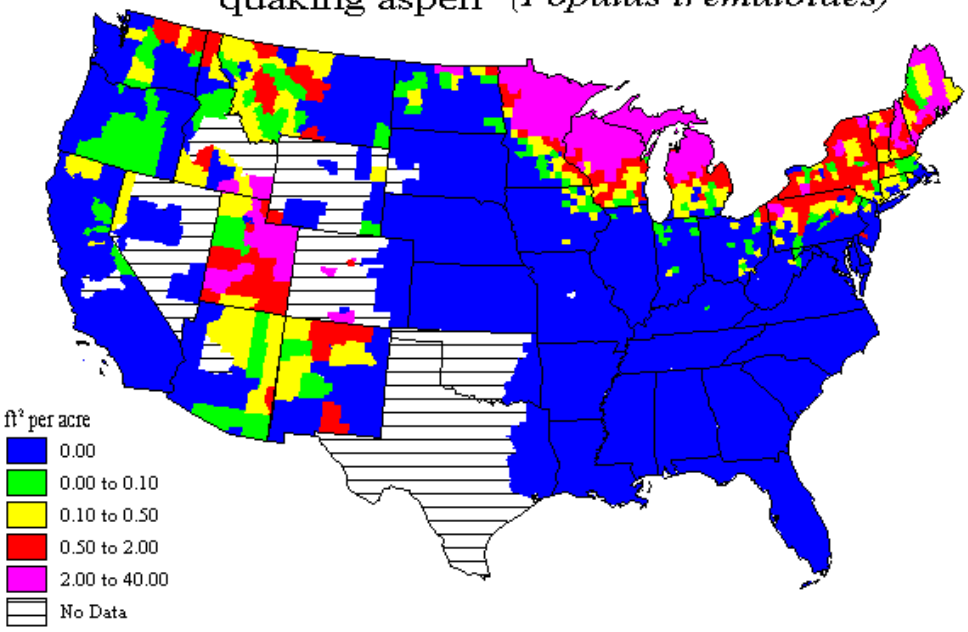
RESULTS: 135 GM traps were placed by MDA personnel in 2008, and no suspect moths were found.

Potentially important native Montana host plants of the Gypsy Moth

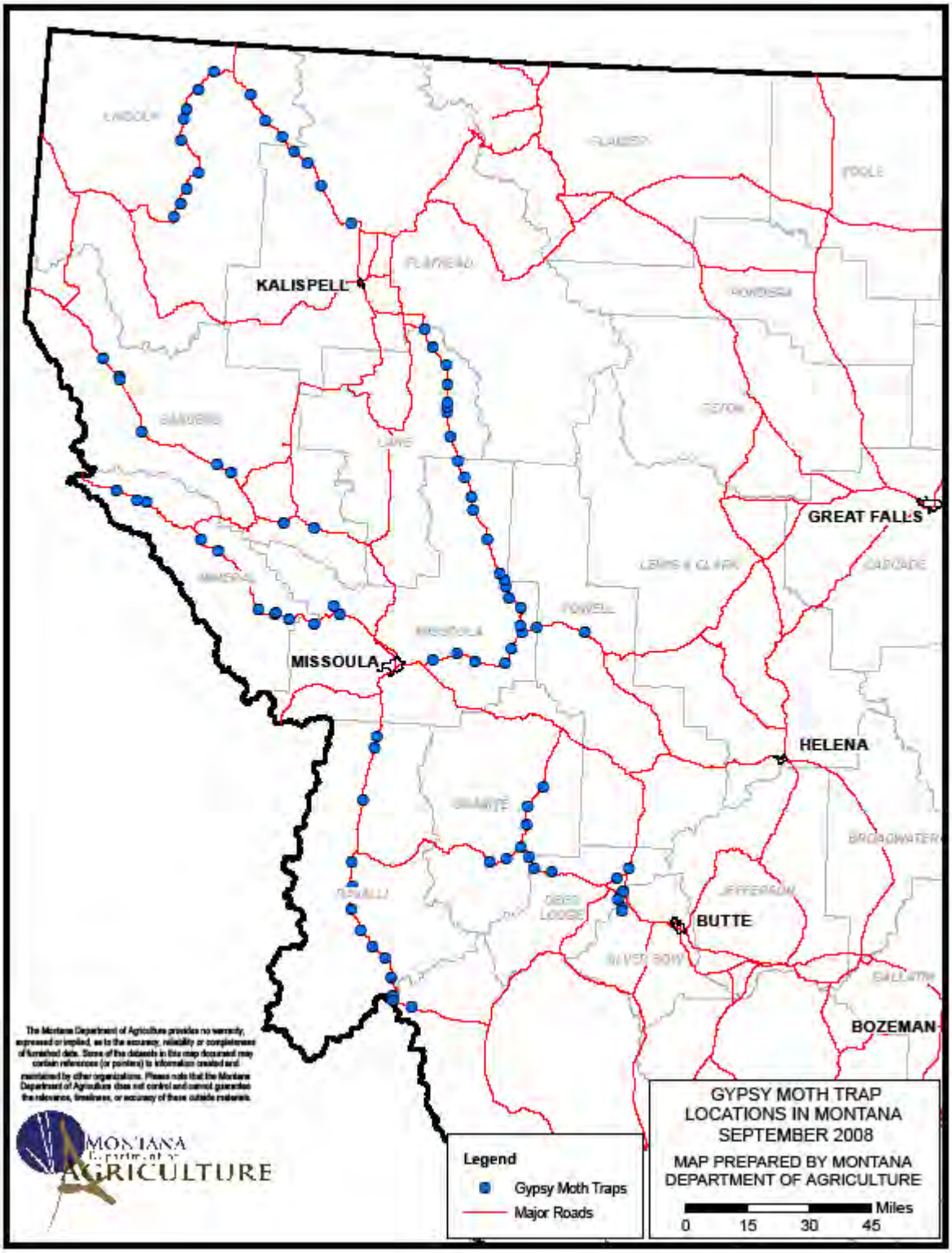
western larch *(Larix occidentalis)*



quaking aspen *(Populus tremuloides)*



Locations of gypsy moth traps placed in Montana by MDA



2008 MDA GYPSY MOTH TRAPS BY COUNTY	
Total Number of Traps	**County**
5	POWELL
20	MISSOULA
8	LAKE
13	RAVALLI
7	GRANITE
9	DEER LODGE
2	SILVER BOW
10	MINERAL
15	SANDERS
23	LINCOLN
18	FLATHEAD
5	LAKE
135	**Total**

Kelsey Redmond placing a Gypsy Moth delta-trap in Powell County near a fishing access and campground.

Rosy Gypsy Moth (RGM) Detection Survey
Lymantria mathura Moore

Both the gypsy moth and the rosy gypsy moth are members of the moth family Lymantridae. This family includes several native tussock moth forests pests and many members of the family are serious plant defoliators.

Images from http://www.padil.gov.au

Female (left) and male (right) Rosy Gypsy Moth

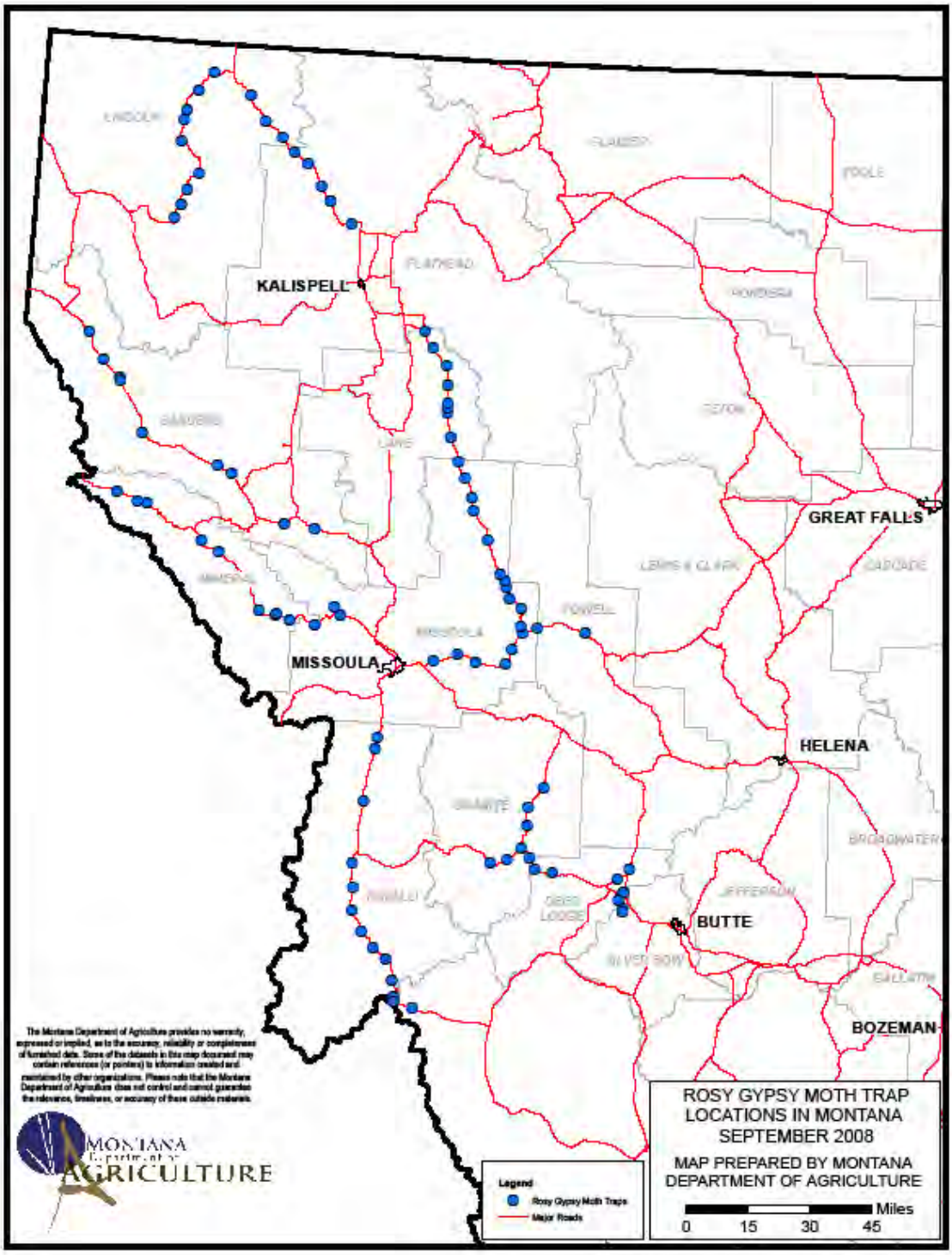
Rosy gypsy moth larvae are polyphagous and feed on a diverse range of deciduous trees. Hosts include oaks, willows, fruit trees, birches, and ashes. Larvae can feed on some conifers, but those hosts are generally not preferred and result in lower levels of survivorship. This moth is native to China, Bangladesh, India, Japan, Korea, Pakistan, Taiwan, and the Russian far East and is not established anywhere in North America.

The surveys for both gypsy moths were linked because of sampling location and high risk area similarities. The rosy gypsy moth and other exotic moths in the CAPS surveys are considered to have a higher risk of introduction in the western portion of the state, and also to pose a higher risk to that area should they be introduced.

2008 MDA ROSY GYPSY MOTH TRAPS BY COUNTY	
Total Number of Traps	**County**
5	POWELL
20	MISSOULA
8	LAKE
13	RAVALLI
7	GRANITE
9	DEER LODGE
2	SILVER BOW
10	MINERAL
12	SANDERS
26	LINCOLN
18	FLATHEAD
5	LAKE
135	**Total**

RESULTS: No Rosy Gypsy Moths or suspects were trapped by MDA personnel in 2008.

Locations of rosy gypsy moth traps placed in Montana by MDA



Siberian Silk Moth (SSM) Detection Survey
Dendrolimus sibiricus (Tschetverikov)

The Siberian silk moth is a polyphagous defoliator of conifers. Laboratory tests in the US have indicated that Douglas-Fir would be a highly preferred host in the Western states. In its native range, Russia, Kazakhstan, North and South Korea and Mongolia, SSM is responsible for damage similar to that done by the European gypsy moth in outbreak areas of Eastern North America.

Image from http://www.padil.gov.au

SSM adult male

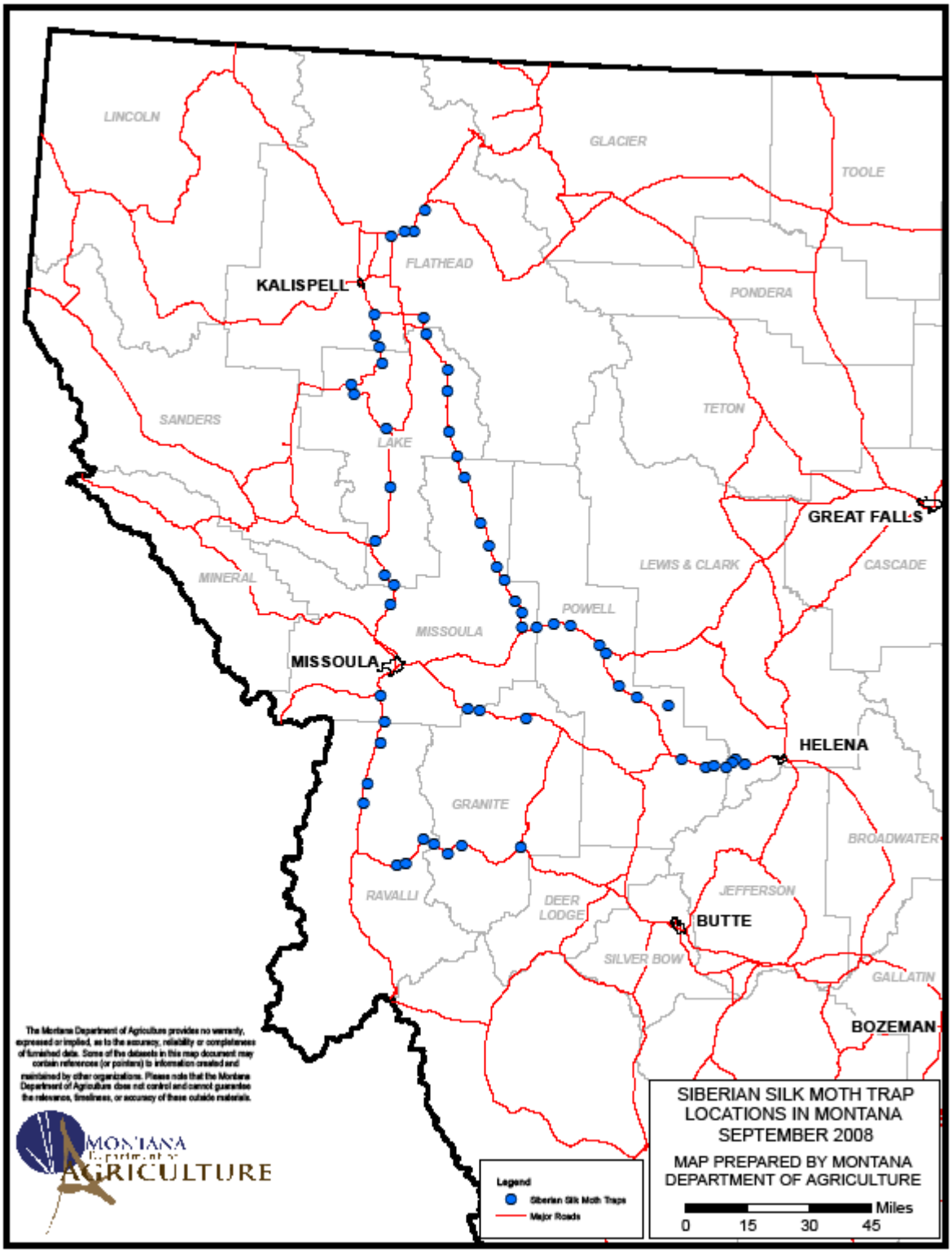
If established in Western North America, the impact on forest health would probably be greater than that of the gypsy moth on Northeastern forests because conifers are more prone to mortality when repeatedly defoliated. Infestations can lead to slower forest growth, tree death in cases of repeated infestation, and unsightly forests that are not attractive for recreation, thus reducing tourism a potentially large issue in Montana and other western states . Trapping for this moth involves green Gypsy Moth milk carton traps that are modified to capture a larger moth (40-80mm).

Shane Delzer placing a SSM trap the first week of July in Ravalli Co.

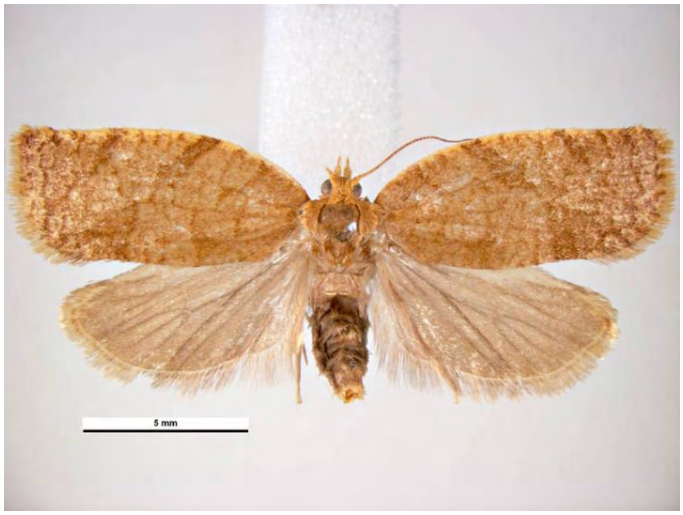
RESULTS:
A total of 60 SSM traps were placed in the following counties; Lewis and Clark, Powell, Missoula, Lake, Flathead, Granite, and Ravalli. No Siberian Silk Moths or suspects were trapped or submitted. The most commonly collected moth in the SSM traps was the forest tent caterpillar, *Malacosoma californicum* (Packard) (image below *Malacosoma* sp.).

Western forest tent caterpillar

Locations of Siberian silk moth traps placed in Montana



Summer Fruit Tortrix (SFT) Detection Survey
Adoxophyes orana (Fischer von Röslerstamm)



Images from http://www.padil.gov.au

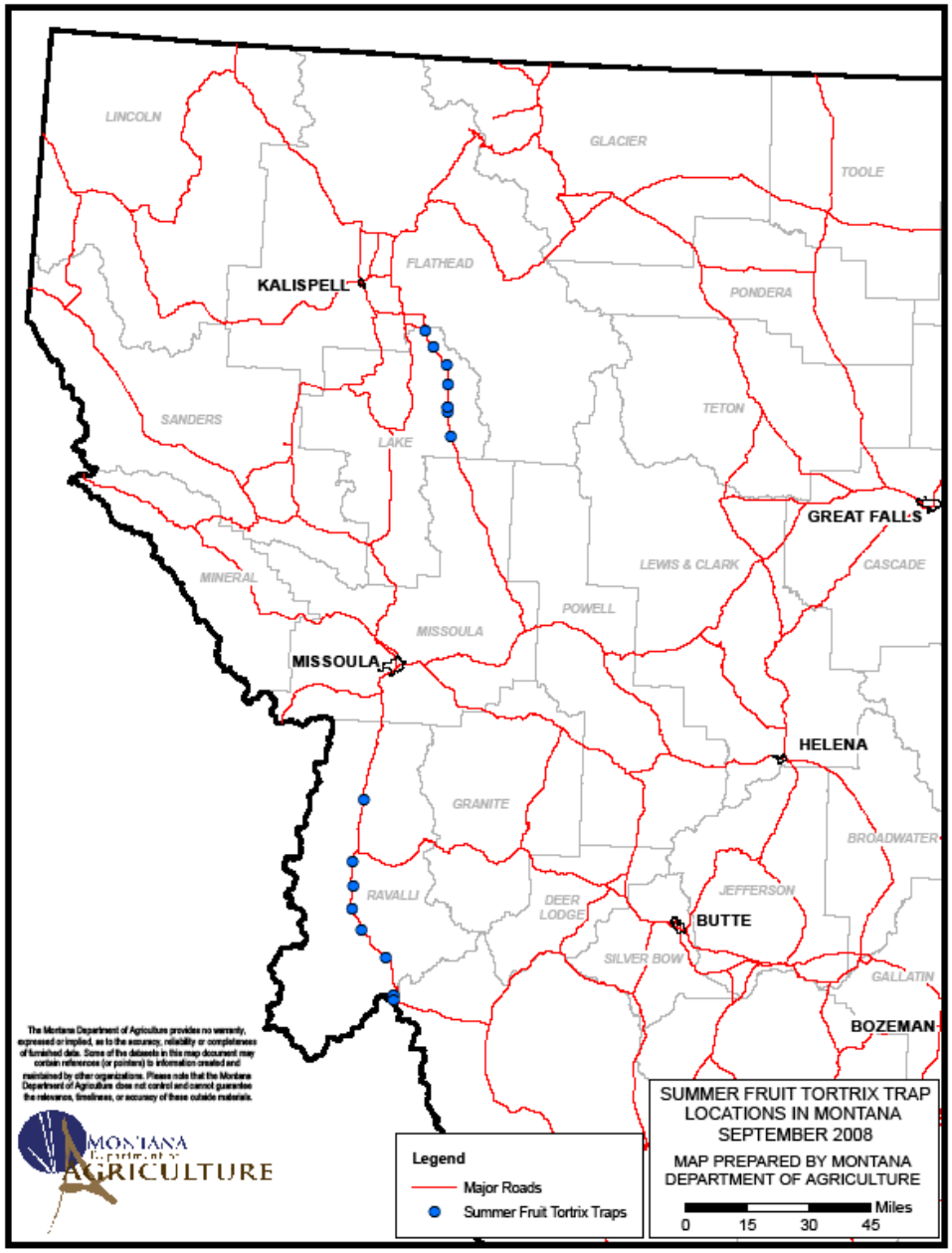
Adult female SFT

The summer fruit tortrix (*Adoxophyes orana*) can be a serious pest of most fruits, but particularly apples and related fruits. While Montana does not have a large fruit industry, this is a section of the economy that has potential for growth. The growth of the Montana fruit industry is dependent on the management of native pest populations and the exclusion of new exotic pests. Besides fruit trees, this pest feeds on many plants, including roses and other ornamentals. This survey was conducted using Pherocon® Wing Traps baited with a species specific pheromone. Traps were placed in high risk fruit growing regions of Western Montana.

Images by R. Coutin/OPIE

SFT damage

RESULTS: No summer fruit tortrix moths were trapped and no suspect moths were submitted.

2008 MDA SUMMER FRUIT TORTRIX TRAPS BY COUNTY	
Total Number of Traps	**County**
47	LAKE
8	RAVALLI
11	FLATHEAD
66	**Total**

Locations of summer fruit tortrix moth traps placed in Montana