United States Department of Agriculture | Forest Service | Northeastern Area State & Private Forestry | 180 Canfield Street Morgantown, WV 26505-3101

Date: March 6, 2008

Subject: Trip Report to the Spray Efficacy Research Group (SERG) International Workshop, Halifax, Nova Scotia

To: Dan Twardus Iral Ragenovich

On February 18-21, I attended and gave a presentation at the Spray Efficacy Research Group International (SERG) Workshop in Halifax, Nova Scotia. SERG International is an association of forest management, regulatory and research agencies, and pesticide suppliers, interested in forest pest management. The primary aim of SERG is to improve application technology and pest management methods associated with the use of pest control products in the context of integrated forest pest management. Members of SERG include: Province of Alberta (ASRD), Province of Manitoba (MNR), Province of New Brunswick (FPL), Province of Newfoundland (DFRA), Province of Nova Scotia (NSDNR), Province of Ontario (OMNR), Province of Quebec (SOPFIM), Province of Saskatchewan (SERM), Canadian Forest Service, and USDA-Forest Service. Approximately 80 people attended the meeting.

A section of the conference was devoted to "Advances and Implementation of Aerial Application Technology and I was requested by SERG to give a presentation on the US Forest Service Spray Advisor model. Spray Advisor is an ArcGIS extension that was developed by the US Forest Service to provide spray managers a tool to help in the planning and assessment of aerial spraying programs. The system allows the user to run AGDISP (Agricultural DISPersal model) which simulates spray deposition and drift and then displays the results spatially. See attachment A (extended abstract) for an overview of my presentation. Other topics during the section of the meeting included:

<u>In cockpit, Real Time, Spray System Integration</u> – A description of the ADAPCO Wingman system. This system has the ability to receive and process real time weather at boom height during application using the Aventech AIMMS-20. The AIMMS transmits the real time weather to the existing on-board Wingman computer. The USFS AGDISP spray drift model (within the Wingman) receives this data and predicts the motion of spray material. The Wingman computer uses the results of AGDISP prediction and calculates a navigation line (flight line) dependent on the prevailing wind conditions at the application height. Forest Protection Limited (FPL) from New Brunswick has purchased a Wingman system to help in the development of using this technology in forest application.

<u>Use of the Wingman in Ontario during the Jack Pine Budworm Program</u> - In 2007, FPL used this system operationally during the Jack Pine Budworm Project in Ontario. At the beginning of the project a few glitches were found with the system and were corrected. Approximately 25,000 acres were treated successfully with the Wingman.

Real Time, Spray System Integration – ADAPCO Wingman Test – In October 2008, the USFS-MTDC in Missoula, MT conducted a field test of the Wingman system in cooperation with FPL. The objective of this trial was to measure the uniformity of modified multiple spray lines as corrected by the Wingman system for optimization (swath displacement). Test results showed that when winds are light and variable, the Wingman system was not able to accurately predict swath offset. According to this field trial, winds should be at least 5mph and from a constant direction before the Wingman system can accurately calculate swath offset.

Flow Controllers: Advances and Concerns – Flow controllers have worked consistently well and most state and federal contracts require flow control in their spray contracts. Aerial applicators have found that the cost savings in pesticide of using flow controllers pays for the system within the first year of use. Most aerial applicators already have the system installed on their aircrafts.

Using Spray Advisor DDS for Aerial Application in Canada - The Canadian Forest Service conducted an herbicide field trial with the objective of measuring spray drift adjacent to the treatment area and to compare these results to drift that was predicted from Spray Advisor. The results from Spray Advisor agreed with the results found in the field. The Canadian Forest Service plans to use Spray Advisor on future herbicide projects to assist in the mitigation of establishing spray buffers in sensitive areas. A Spray Advisor training session has been scheduled in May 2008 for the Canadian Forest Service.

Wind Tunnel Status and Testing – FPL have begun a comprehensive research program into the experimental measurement of aerial spray characteristics and their computational modeling. Experimental work will be conducted at the H.J. Irving Picot Wind Tunnel at the Acadia Research Forest near Fredericton, NB. This facility is presently being upgraded in terms of aerodynamic performance and instrumentation so as to allow a thorough scientific study of aerial sprays. It is an open-circuit tunnel which allows the testing of full-scale pesticide sprays at aircraft flight speeds. Instrumentation at the facility allows the direct measurement of spray droplet sizes and velocities.

Development of a Computation Fluid Dynamics Model for Aerial S pray – This 3-D model shows the air flow around an agricultural aircraft configured for spraying. In the future, this model maybe used to help predict spray drift and how airflow around the aircraft influences spray deposition and drift.

Spray Capture by a Riparian Buffer – A field study was conducted west of Corvallis, OR to evaluate the effectiveness of riparian buffers, as defined by the Oregon Forest Practice Act rules, in preventing herbicide deposition in streams. Twenty two trials were conducted with a helicopter resulting in over 1400 tracer samples. The preliminary conclusion of this study is that riparian buffers as currently defined in Oregon are effective at reducing the amount of deposition to streams. The effect is strongest when the potential for near field drift driven by wind speed is greatest and reductions are shown ranging from 58% to 96% of the fine droplet (driftable) fraction. The reduction is less clear under low wind speed conditions but these conditions are not generally high drift scenarios and absolute deposition to downwind streams is low in these scenarios in any case.

The remainder of the meeting was devoted to Nova Scotia pest management and forestry issues, pest monitoring and decision support, the use of buffer zones in forestry, and forest pest management products (e.g. Bt for sawflies, Baculovirus to control forest pests, and NPV for whitemarked tussock moth, and pheromones for spruce budworm).

In previous years, SERG asked each Province to submit a forest pest conditions report for inclusion to the proceedings of the workshop. I was asked and prepared a report for the US (see attachment B).

I would like to personally thank the International Activities Team for funding my trip to attend this meeting. The workshop is always an educational experience and provides me the opportunity to collaborate and share knowledge with others in forest pest management on the latest developments and advances of new technology.

Respectfully submitted,

Amy Onken

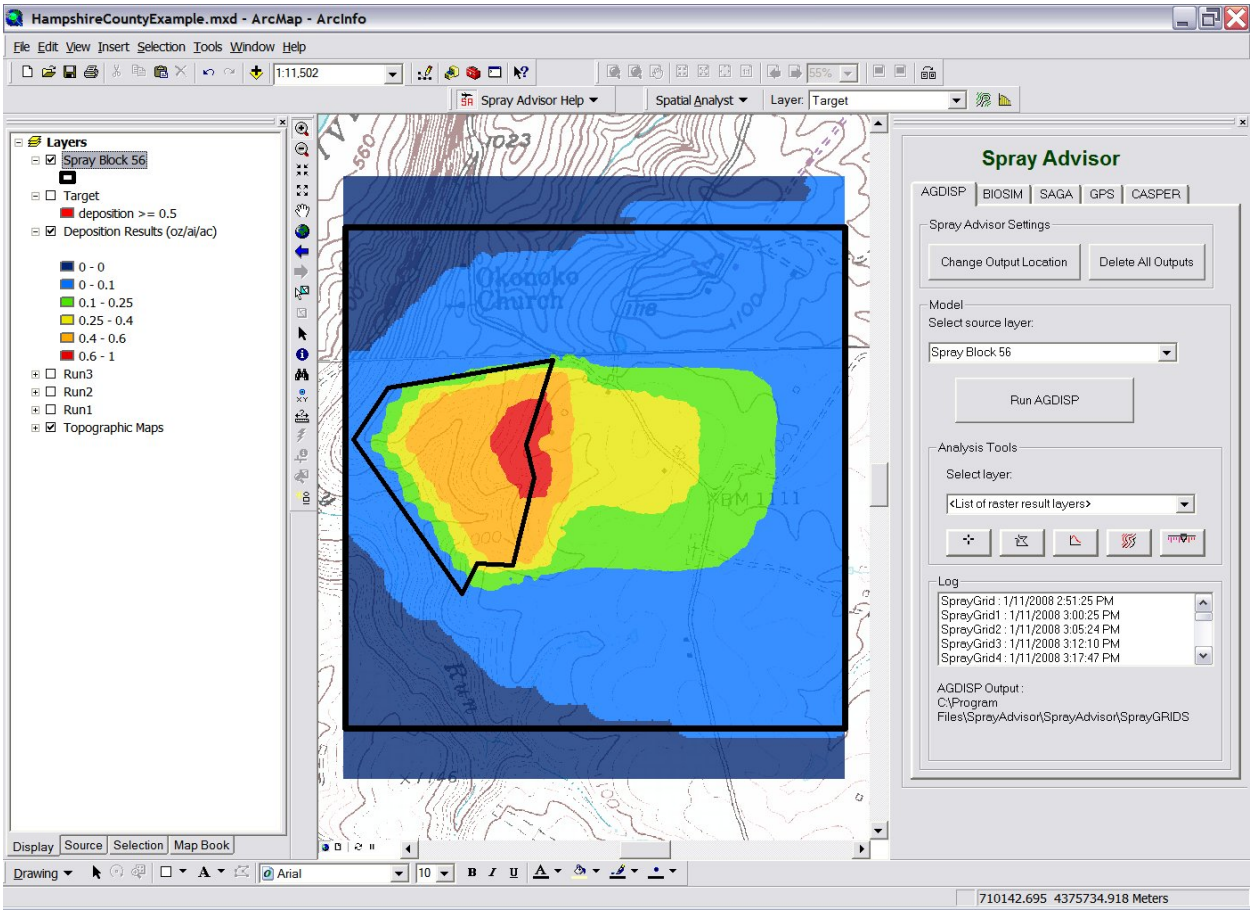
Attachement A

Spray Advisor Update

Amy H. Onken
USDA Forest Service, Forest Health Protection
Morgantown, West Virginia

Jacquelyn M. Strager
Natural Resource Analysis Center, West Virginia University
Morgantown, West Virginia

The USDA Forest Service Spray Advisor ArcGIS 9.x Extension was developed to provide spray managers with a comprehensive decision support toolbox that works within widely available GIS software. The Spray Advisor is used to aid program managers in planning and assessment of aerial spraying programs. The system provides a user interface and a means of visualizing spatial outputs based on the ESRI ArcGIS software platform.

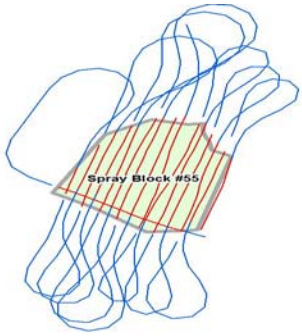


Running the AGDISP model within Spray Advisor

AGDISP (AGricultural DISPeral model) is a stand along software package designed to simulate

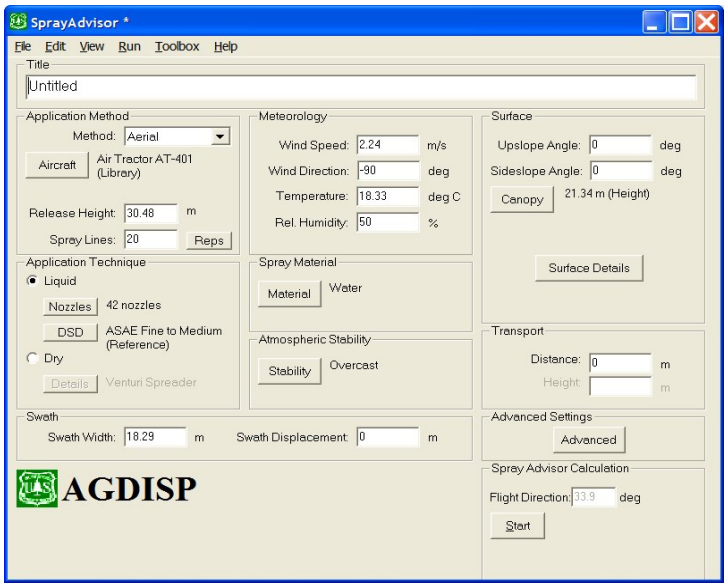
and quantify near-wake spray deposition and drift from aerial application of pesticides. The AGDISP computation engine and user input screens have been incorporated into the Spray Advisor extension in order to allow GIS users to view AGDISP results as spatially explicit datasets. In order to run AGDISP within the Spray Advisor extension, an input feature dataset is required. Two different types of input datasets that can be used are : (1) spray block polygon features which allows users to model and evaluate various spray condition scenarios (i.e. wind speed, wind direction, etc.) to proposed spray block polygons, and (2) spray line features which allows users to model spray drift from actual spray lines flown in the field.

Spray Block (polygon) as source



Spray lines as source

After selecting the input feature to be included in modeling, the AGDISP interface screen appears and the user is allowed to set up all known information about the spray set up, including aircraft properties, application technique, meteorology, spray material, etc.



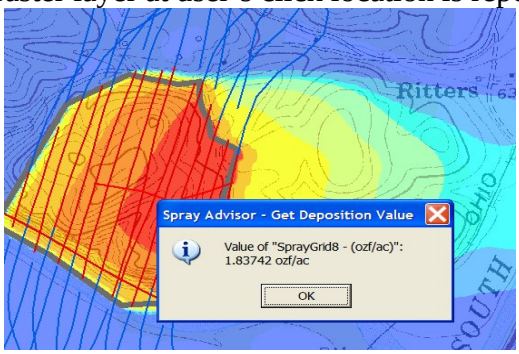
Using AGDISP Output

When calculations are completed, a new spray deposition raster layer is added to the map and data can be analyzed in a number of ways. The datasets are in GRID format and ArcGIS Spatial Analyst functions may be used. Spray Advisor also includes customized tools for analyzing

deposition such as:

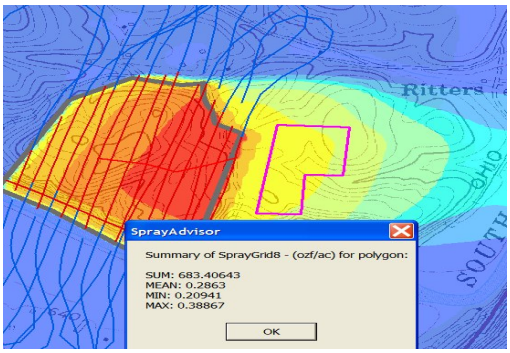
Deposition at point

The value of the deposition raster layer at user's click location is reported, along with units.



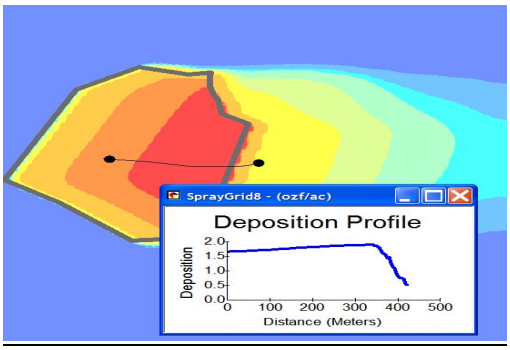
Deposition for polygon

This tool allows the user to delineate a polygon on the map and deposition statistics for the polygon are reported.



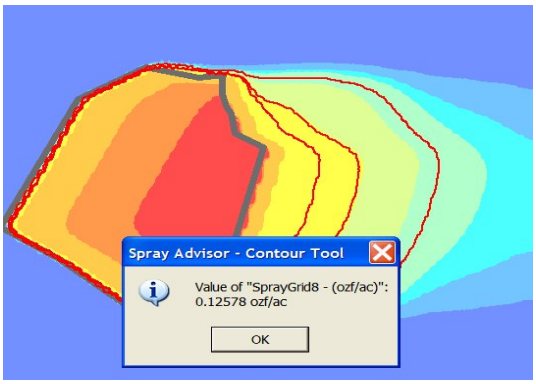
Deposition profile graph

This tool creates a simple line graph showing deposition along a line segment delineated by the user.



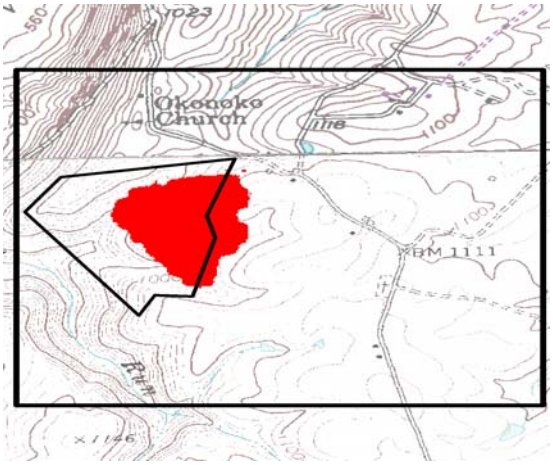
Deposition by contour

By clicking anywhere on the map, a contour line connects points of equal value.



Deposition by threshold value

Users can examine areas that received a certain amount of deposition (e.g. all areas with deposition above 1.0 oz/ai/ac).



Spray Advisor keeps track of every AGDISP model run. All resulting spray grid raster datasets are saved by default, in the current AGDISP output folder. Spray Advisor also saves AGDISP interface settings for each model run.

Current Work

Work on the Spray Advisor is ongoing and the current programming tasks include:

• Continued support for import of spray line information from GPS formats including AgNav, Satloc, and Trimble

• Revision of Spray Advisor AGDISP output grids to specifically identify areas of zero deposition in resulting map layers.

• Inclusion of more complex spray situations, with multiple AGDISP parameter input files (e.g. different meteorological conditions across the spray project area).

• Customizing tools for querying deposition results such as “Custom Contours” where the user selects deposition thresholds and contour lines connect the points of equal values.

Future Plans

Since Spray Advisor is an evolving project, new capabilities are frequently being added. Future software developments include:

• Addition of more complex spray scenarios
- -Complex terrain (topography)
- -Variable rate technology and variable spray conditions
- -Long distance dispersal (far wake)

•Incorporate additional spray-related models and tools
- -GPS input/output
- -BIOSIM insect phenology/efficacy models
- -Computer Aided Spray Productivity and Efficiency Routine (CASPER)
- -Spray Advisor Genetic Algorithm (SAGA)
- -Dose-response modeling tools based on Spray Safe Manager

Cooperators

The Spray Advisor is a cooperative effort directed by the USDA Forest Service. Major collaborators include:

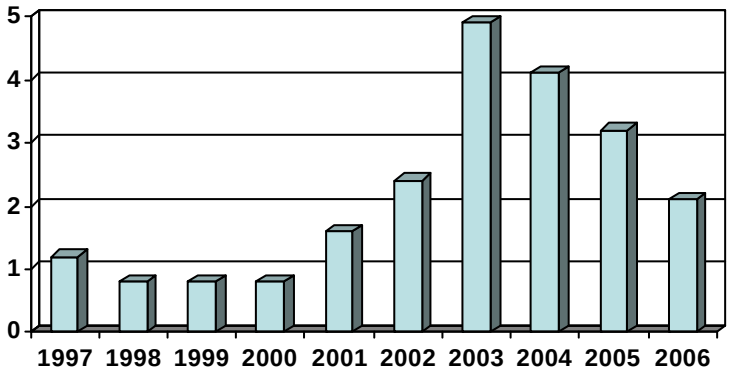
•West Virginia University – Interface development, ArcGIS Spray Advisor extension development
•Continuum Dynamics, Inc. – AgDISP near-wake spray drift model
•SCION (formerly Forest Research Institute, New Zealand) – Programming support and design in dose-response and environmental modeling (Spray Safe Manager)
•Canadian Forest Service – BIOSIM insect phenology and efficacy modeling
•University of Georgia – Spray Advisor Genetic Algorithm (SAGA) and optimization of CASPER

Attachment B
Forest Pest Conditions in the US, 2006-2007

Amy H. Onken
USDA Forest Service, Forest Health Protection
Morgantown, West Virginia

There are approximately 304 million hectares of forestland in the United States, about one-third of the total land area (including Alaska and Hawaii). Native and non-native insects and diseases, and abiotic influences, cause significant damage that affects our forests. The chart below shows the amount of insect and disease caused tree mortality over the past 10 years.

Hectares (Millions) with Insect and Disease Caused Tree Mortality
(Source: Forest Insect and Disease Conditions in the United States, 2006)



Highlighted are some of the major insect pests and disease of concern in the United States. These pests are either causing serious damage or have the potential to do so.

Emerging Insect and Disease Issues

Emerald Ash Borer, *Agrilus planipennis*
Scientists estimate that emerald ash borer (EAB) has been in the United States for 5 to 10 years prior to its detection in 2002. Ash trees throughout southern Michigan had exhibited decline and dieback symptoms for years, for example "Ash Yellows", therefore dying ash trees did not draw much attention. EAB has killed millions of ash trees and no ash species appear to be resistant to EAB. Currently EAB has infested trees in Michigan, Ohio, Indiana, Illinois, Maryland Pennsylvania and West Virginia. The Pennsylvania infestation was found north of Pittsburgh (Allegheny County) in June 2007. After delineation surveys were completed, EAB was also confirmed in Allegheny County. The West Virginia infestation was found in October 2007 when EAB larvae were discovered in a trap tree prepared by the West Virginia Dept. of Agriculture. The infestation is located in the southern portion of the state (Fayette County) and the movement of firewood is believed to be how the insect found its way so far south of the nearest infestations which are Ohio and Pennsylvania.

Western Bark Beetles – Tree mortality from bark beetles increased substantially in many parts of the West in 2003, particularly in forests stressed by widespread and prolonged drought and overstocking. Approximately 4.3 million hectares of bark beetle mortality was detected in 2003. In 2006, mortality decreased in the pinon-juniper woodlands of the southwest due to a reduction in tree stress from a return to more normal weather patterns. Mountain pine beetle, Douglas-fir beetle and spruce beetle were the direct cause of much of the mortality in the west in 2006, affecting over 1.6 million hectares. However, less commonly seen insects (such as fir engravers, pine engravers, western pine beetle, Jeffrey pine beetle, and western balsam bark beetle) caused substantial damage. In total, nearly 1.9 million hectares were affected.

> Mountain Pine Beetle, *Dendroctonus ponderosae* – Mountain pine beetle populations decreased about 8 percent over 2005 levels. Beetles were found in all western states except Arizona and New Mexico, with lodgepole pine being the hardest hit tree species. Mountain pine beetle activity decreased substantially in some states: a 59 percent decrease in Washington and a 42 percent decrease in Idaho. However, these decreases were more than offset by continuing epidemics in Colorado and Oregon, with acreage increases of 32 percent and 45 percent respectively. The States with the highest 2006 acreage in outbreak states are Montana (363,825) and Colorado (269,126).

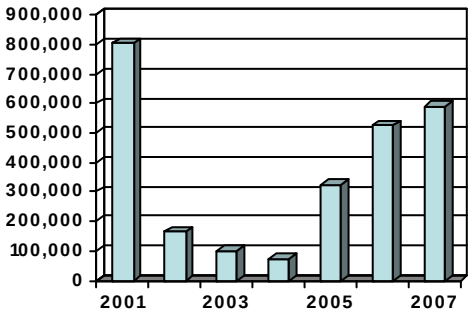
Sirex noctilio woodwasp – In the fall of 2004, a female woodwasp was collected in a New York survey trap and was identified in February 2005 as *Sirex noctilio*. To date, there are 29 counties in New York infested and in July 2006, a female was collected in a trap in Tioga and Bradford counties, PA. In 2007, USDA Forest Service and APHIS supported a trapping grid in New York, parts of Vermont and Pennsylvania. Four additional counties were found infested in Pennsylvania and an infestation was located in Lamoille County, VT. *Sirex noctilio* was also found for the first time in Macomb County Michigan. Surveys will continue in 2008.

Asian Longhorned Beetle, *Anoplophora glabripennis*
The efforts to eradicate Asian longhorned beetle (ALB) infestations in Chicago seems to be successful with four years of no new infested trees found and the quarantine has been lifted. In March 2007, two new infestations were found in New York on Prall's and Staten islands. Approximately 3,000 trees were removed and surveys and treatments will continue in 2008.

Sudden Oak Death, *Phytophthora ramorum*
Sudden Oak Death is a recently recognized disease that is killing oaks and other plant species in 14 counties in California and Curry, Oregon. The pathogen responsible for the disease is *Phytophthora ramorum* and can be found on 100 species across more than 60 host genera. It was first reported in 1995 in the coastal areas north and south of San Francisco, and in southwestern Oregon. Approximately 1.6 million of potentially infected stock was shipped all over the country from Monrovia nurseries in California and only 0.5 million of the infected stock was recovered. During 2006, *P. ramorum* mortality was at the highest level observed since 2000. Recent estimates suggest that more than a million overstory trees have been killed in California, with another million infected. Intensive nursery surveys are being conducted throughout the US and in 2007, a total of 21 positive nursery finds were reported in 6 states: CA (7), OR (2), WA (7), FL (1), GA (3), MS (1).

Historical Highlights

Gypsy Moth, *Lymantria dispar*



Gypsy moth populations have been steadily increasing since 2004. Approximately 588,000 hectares were defoliated in 2007. This is primarily attributable to dramatic defoliation increases in Pennsylvania, Maryland, New Jersey, and West Virginia. For 2008 treatments, approximately 357,533 hectares are proposed for suppression and 161,880 hectares for Slow the Spread.

Western Spruce Budworm, *Choristoneura occidentalis*

Since 1993, Western spruce budworm populations have remained at a historic low level in many western states, but defoliation jumped by 93% from 487,946 hectares in 2005 to 939,673 hectares in 2006. Other than a slight decline in New Mexico, Arizona, and Wyoming, defoliation acreage in other western states increased dramatically, with three states seeing increases greater than 100 percent between 2005 and 2006: 238 percent (724,413 hectares) in Idaho, 152 percent (278,636 hectares) in Montana, and 119 percent (19,466 hectares) in Utah, where budworm defoliation increased not only in extent, but also in intensity. With much of the West experiencing warmer and drier weather conditions, western spruce budworm populations are expected to continue to increase.

Eastern Spruce Budworm, *Choristoneura fumiferana*

Populations of spruce budworm in 2006 increase significantly from 2005, but still remained historically low. The Lake States still have noticeable defoliation. In Minnesota, defoliation increased from 37,475 hectares in 2005 to 118,577 hectares in 2006; in Michigan, the hectares of defoliation increased from 3,844 hectares to 9,793; and in Wisconsin, defoliation decreased from 8,499 hectares in 2005 to 1,011 in 2006. In Alaska, defoliation increased substantially, from 6,475 hectares in 2005 to 21,450 in 2006.

Hemlock Woolly Adelgid, *Adelges tsugae*

Hemlock woolly adelgid continues to spread throughout the generally infested area causing hemlock decline and tree mortality. In 2006, infestations of hemlock woolly adelgid continued to intensity dramatically in the Southern Appalachians. In 2007, sixteen additional counties in Pennsylvania, West Virginia, Tennessee, North Carolina, Kentucky, Virginia, and Georgia were found infested. To date, no infestations have been reported in Vermont.

Beech Bark Disease, *Neonectria coccinea* var. *faginata*

Beech bark disease continues to intensify and spread in eastern Tennessee, western North Carolina, extreme east-central West Virginia, west-central Virginia, and Michigan. In 2006, surveys were completed in West Virginia along the advancing front. Three new infested counties were found increasing the total infected area to more than 1.5 million hectares. Beech

bark disease continued to expand westward in the Upper Peninsula of Michigan. The annual spread rate in Lower Michigan averaged 1.6 kilometers per year from 2005 to 2006.

Common European Pine Shoot Beetle, *Tomicus piniperda*

This insect was discovered in a Christmas tree plantation near Cleveland, Ohio in 1992. State and Federal quarantines have been imposed to reduce the movement of this beetle, which was found in 15 states during 2006. To date, the beetle is a problem mainly for Christmas tree growers.

Dogwood Anthracnose, *Discula destructiva*

Dogwood anthracnose was discovered in southeastern New York in 1978. By 2005, this disease was found in 22 states from Maine to Georgia and west to Indiana and Missouri. The range of dogwood extends from southern Maine to Florida and west to Michigan and eastern Texas. In the Northeast, diseased dogwoods have been found in every county in Delaware, Maryland, Massachusetts, Rhode Island, West Virginia, and Connecticut.

Butternut Canker, *Sirococcus clavigignenti-juglandacearum*

Butternut canker was first identified in 1970 in Wisconsin. To date, the disease is found throughout the range of butternut and is a serious threat to the survival of the species. It is estimated that 77 percent of the butternut trees in North Carolina and Virginia have been killed, and in the northeastern area, most of the monitored trees are infected. There are no viable control measures for this disease, and in 2006, 32 new counties have been affected.