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Emerald Ash Borer First Detector: a volunteer early detection programme[†]

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Abstract

The emerald ash borer (*Agrilus planipennis* Fairmaire) is a serious forest pest in the United States and its range is expanding. In June 2008, emerald ash borer was confirmed in six US states. As of July 2009, it was confirmed in 13 American states, including Minnesota. Detecting its presence early in an infestation will allow forest managers more management options. University of Minnesota Extension partnered with Minnesota Department of Agriculture, Minnesota Department of Natural Resources, and the United States Department of Agriculture Federal National Plant Diagnostic Network, to develop the Emerald Ash Borer First Detectors Programme to help identify the first incidence of emerald ash borer in Minnesota and each Minnesota county. First Detector volunteers are one of the first lines of defence against the establishment of emerald ash borer in Minnesota by helping to identify the first occurrence of emerald ash borer. They can visit properties, collect and safely mail samples to the Minnesota Department of Agriculture, collect seed for genetic conservation, and help educate and inform the public about emerald ash borer. In 2008, 180 First Detector volunteers state-wide were trained in six full-day workshops to identify emerald ash borer and the signs and symptoms of an emerald ash borer infestation. In 2009, the First Detector programme was broadened to include three additional forest pests: gypsy moth (*Lymantria dispar* Linnaeus), Asian longhorned-beetle (*Anoplophora glabripennis* Motschulsky), and Sirex woodwasp (*Sirex noctilio* Fabricius). In 2009, programme organisers trained 233 individuals in the Forest Pest First Detector programme.

Keywords: volunteer training; emerald ash borer; EAB; *Agrilus planipennis*; early detection.

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Introduction

Emerald ash borer (EAB) (*Agrilus planipennis* Fairmaire) is an invasive insect originally introduced from China to the Detroit, Michigan, USA area (Siegert, McCullough, Liebhold, & Telewski, 2008). It was first discovered in 2002, although dendrochronological data shows the first infestation likely occurred in 1997-1998 (Siegert et al., 2008). Once established it attacks and kills virtually all ash (*Fraxinus* spp.) trees native to North America greater than one inch in diameter (McCullough, 2008). Despite its relative newness

to the USA, EAB is a very serious forest pest in the eastern United States. As of July 2009, it had been found in 13 states, seven more than in June 2008. The problem, as reported by Cappaert et al. (2005), is that "the lack of obvious symptoms on lightly infested trees exacerbated the artificial spread of *A. planipennis* before official recognition of the problem and implementation of quarantine regulations." Tree nurseries and firewood movement are major dispersal methods for EAB (Muirhead et al., 2006).

The first confirmed infestation of EAB in Minnesota

was found on May 13, 2009 in St. Paul. Minnesota has the largest ash tree population in the United States (Jacobson, 2010), Michigan having lost that position because of EAB. Minnesota's wetland hardwood forests are more than 50% ash (Native plant communities classification system, 2003). Some Minnesota communities may have a street tree inventory as high as 50% ash (Mueller, D., Minnesota Department of Natural Resources [DNR], personal communication, July 15, 2009; Resource Assessment Unit, Forestry Division, DNR, 2006). This invasive species, often spread by the human movement of infected ash material like firewood, is poised to dramatically change Minnesota's urban and rural forests.

Emerald ash borer is hard to detect for many reasons. Adult beetles typically colonise the upper canopy first (Cappaert et al., 2005; Poland & McCullough, 2006). The adults lay eggs in ash bark crevices and the larvae feed on the phloem and cambium under the bark creating frass-filled S-shaped galleries (Poland & McCullough, 2006). Often EAB overwinter as prepupae, but in early low-density infestations it takes two years for some larvae to complete their development (Cappaert et al., 2005). When the adult emerges, it leaves a small, 3-4 mm wide, D-shaped exit hole (Poland & McCullough, 2006). The adults feed on ash leaves causing superficial, inconspicuous damage. Additionally, according to Cappaert et al. (2005), symptoms of EAB infested trees may be similar to symptoms of ash yellows and secondary infestations of native ash borers. Detection of EAB in early infestations is very hard because the D-shaped exit holes created by emerging adults are often high in the tree canopy away from observing eyes, tell-tale signs of S-shaped larval galleries are hidden under the bark, and symptoms of whole tree decline look similar to other common ash problems.

Early detection of an EAB infestation allows federal, state, and local government agencies and decision-makers to better manage EAB and minimise damage and costs. Since 2007, a statewide interagency coalition has been working to create a network of Minnesota Forest Pest First Detectors, originally called EAB First Detectors, to help detect EAB infestations in Minnesota and in each county. In Minnesota, individuals in the public sector who suspect they may have EAB are directed, through outreach and marketing, to a Minnesota Department of Agriculture (MDA) website or a toll-free phone number for additional questions and assessment. If they still believe they have EAB, or one of the other targeted forest pests, they are directed to connect with a Forest Pest First Detector volunteer who is a local source of research-based information. The Forest Pest First Detector volunteers also arrange site visits, proper handling and mailing of EAB samples to the MDA, and collect ash seed for genetic conservation. In 2008, the First Detector programme was expanded to include three additional

invasive forest pests of special concern: gypsy moth (*Lymantria dispar* Linnaeus), Asian longhorned beetle (*Anoplophora glabripennis* Motschulsky), and Sirex woodwasp (*Sirex noctilio* Fabricius).

Timeline, Materials, and Methods:

2007

Recognising that EAB might come to Minnesota at some point, the MDA EAB Readiness Task Force (Emerald Ash Borer [EAB] Readiness Task Force members, 2008) identified a need to train citizen volunteers to help with detection. Key individuals assigned to track EAB and First Detectors in the MDA, the Minnesota Department of Natural Resources (DNR), and the University of Minnesota Extension (Extension) created the EAB First Detector programme. Developers decided to join with the United States Federal First Detector programme administered through the United States Department of Agriculture Federal National Plant Diagnostic Network (NPDN) which is "designed to train volunteers to detect invasive, exotic plant pathogens, arthropods, nematodes and weeds that pose significant national security, economic, and environmental threats" (Hodges et al., 2007) to utilise this pre-existing network of resources. However, Minnesota developers focused on a single forest pest, which had never been done before within the First Detector network.

Minnesota's nation-leading EAB First Detector programme designed to focus on forest pests is built on the experiences of Minnesota's Soybean Rust First Detector programme from 2004. Organisers created the EAB First Detectors programme to offer a high-level technical educational programme specially targeting professionals, Woodland Advisors, Master Gardeners, Tree Care Advisors, Tree Inspectors, and others who work with or are interested in trees.

2008

In 2008, organisers distributed on-line and print materials to various professional and master volunteer outlets to advertise the EAB First Detector programme to tree and forest professionals, Master Gardeners, Tree Care Advisors, and Woodland Advisors. All interested participants had to apply to the EAB First Detector programme and be accepted. Applicants had to read and understand the responsibilities of the EAB First Detector programme, be willing to commit to the confidentiality protocol and sign the appropriate form, be willing and able to attend the full-day First Detector training, answer several questions describing why they were interested in becoming First Detectors, and list experiences and training they already had that would help the EAB First Detector programme. Additionally, they were asked to assess their knowledge of tree identification, insect identification, EAB, and working

with the public. All applicants were required to have an e-mail address and access to the internet to facilitate programme communication. The applicant pool proved to be so well-suited to the goals of the programme and so engaged with tree and forest care that all 180 applicants were accepted.

Locations for the EAB First Detector training were designed to offer sessions across Minnesota, with special consideration given to areas with a great likelihood of EAB introduction as described by Selness and Venette (2006). Organisers gave additional consideration to major population centres from which to draw likely First Detectors, and available facilities appropriate for this training. Organisers chose dates and times most appropriate to meet the needs of professionals including avoiding prime tree planting season in early spring. Participants could also earn continuing education credits from the International Society of Arboriculture, Society of American Foresters, Master Gardeners, Woodland Advisors, and Tree Care Advisors. Programme organisers proctored the Tree Inspector examination after each session to allow interested participants to take the test as a service to those interested in this certification (the examination is completely separate from the EAB First Detector programme, but the large number of cross-over participants between Tree Inspector and First Detector made proctoring this examination an effective way to draw in high-quality First Detectors). Organisers took all of these actions to further engage this technical audience in forest pest invasive species and reach individuals that regularly spend time looking at and working with Minnesota's trees and forests.

Six EAB First Detector training sessions were held across Minnesota in the spring of 2008. Extension, MDA, DNR, and NPDN leveraged funds and resources to train 180 participants; 167 of whom committed and signed the required confidentiality form and became EAB First Detectors. The demand in the Twin Cities - Minnesota's largest metropolitan area which includes St. Paul, the state capitol, and Minneapolis, the largest city in the state, and all the surrounding suburbs - required two workshops to meet demand. Participants only paid a small sum for each workshop to cover meal costs.

Content for each six-hour workshop during the 2008 EAB First Detector session was a mix of required federal training to become a First Detector and Minnesota specific material for EAB and its management:

1. Federal training consisted of three preset half-hour modules: Module 1-Mission of NPDN and Agricultural Biosecurity; Module 2-Monitoring for High Risk Pests; and Module 3-Quality and Secure Samples Submission (weeds, insects, and diseases);

2. Learning about Minnesota's First Detector programme - why ash is important to Minnesota, and how to identify and collect appropriate ash seeds for genetic storage. The confidentiality form, outlining the protocol to discreetly contact the appropriate authorities, was thoroughly explained and participants were asked to sign and return it;
3. Learning about the history of EAB in its home range, East Asia, and the United States (Poland & McCullough, 2006); how to identify EAB; how to identify ash trees and wood; the EAB lifecycle; symptoms of EAB; how to identify common types of firewood in Minnesota including ash; and what Minnesota is doing to prepare for EAB;
4. Reviewing: the Minnesota Emerald Ash Borer First Detector packet, a resource specially developed for this group. This packet included:
 - a decision tree to determine if EAB is present;
 - a reporting log of First Detector activities;
 - a worksheet and supporting materials; and
 - three fact sheets.

Details of the worksheet and three fact sheets are given in Table 1 (items 1 – 4). Additional materials supplied in each packet included:

- Materials about EAB and its identification, Table 1 (items 5 – 9);
 - Materials about the hazards of moving firewood, Table 1 (items 10 and 11); and
 - Other materials of potential interest to this audience regarding other likely invasive forest pests, Table 1 (items 12 – 15);
5. Each participant also received an EAB Identification Kit which included an EAB beetle and larva, and wood samples with both larval galleries and D-shaped exit holes, to be used when speaking with the public about EAB. Reviewing case studies of EAB first detections in other locations. Participants studied the system for triaging EAB, reports, sample submission forms, and the processes for notification and record keeping regarding EAB First Detector work; and
 6. Learning about working with the public as well as what and where public informational resources are available.

During the breaks and lunch, presenters encouraged participants to study the many displays around the

TABLE 1: Details of materials included in the 2008 Minnesota Emerald Ash Borer First Detector packet.

No.	Title	Author	Date	Publisher	Website (retrieved 18 February 2010)
1	<i>Do I Have Emerald Ash Borer?</i>		2008		http://www.mda.state.mn.us/news/publications/pestsplants/pestmanagement/eab_doihaveit.pdf
2	<i>Ash Tree Identification</i>	Rebek, K., Wilson, M., & adapted by the University of Minnesota	2007	St. Paul, MN: University of Minnesota	
3	<i>Signs and Symptoms of the Emerald Ash Borer</i>	Wilson, M., & Rebek, E.	2005		
4	<i>Native Borers and Emerald Ash Borer Look-alikes</i>	Wilson, M., & adapted by the University of Minnesota	2007	St. Paul, MN: University of Minnesota	
5	<i>Alert Emerald Ash Borer</i> (Brochure No. AGPL-03-2007-04)		2007	Minnesota Department of Agriculture	
6	<i>Pest Alert Emerald Ash Borer</i> (Brochure No. NA-PR-02-04)	McCullough, D., & Katovich, S.	n.d.		http://www.na.fs.fed.us/spfo/pubs/pest_all/eab/eab.pdf
7	<i>Emerald Ash Borer A Threat to Minnesota Ash Trees</i> (No. AGPL-002-2007-04)		n.d.		
8	<i>Emerald Ash Borer the Green Menace</i> (Brochure No. 1769)	United States Department of Agriculture, Animal and Plant Health Inspection Service	2005		http://dnrmedia.wi.gov/main/Viewer/?peid=6f50c833-9245-4b85-ab25-e8942513b331
9	<i>A Reference for Recognizing Insect Galleries in Ash Trees in Minnesota</i> (Brochure No. AGPL01-2008-1)	Minnesota Department of Agriculture	2008		
10	<i>Firewood Alert Don't Buy Bundles of Bad Bugs!</i> (Brochure No. FIWO-004-2007-11)	Minnesota Department of Agriculture	2007		http://www.na.fs.fed.us/firewood/rackcards_bookmarks/fire_alert_tri_panel_lr.pdf
11	<i>Help Keep Our Trees Safe!</i>	Minnesota Department of Agriculture	n.d.		
12	<i>Gypsy Moth Identification Guide</i>	Minnesota Department of Agriculture	n.d.		
13	<i>Gypsy Moth</i> (Brochure No. LYD1120074)		2007		
14	<i>Invasive Pest Alert Sirex Woodwasp</i>		n.d.		http://www.mda.state.mn.us/en/sitecore/content/Global/MIDADocs/pestsplants/insects/sirexwoodwasp.aspx
15	<i>Pest Alert Asian Longhorned Beetle</i> (Brochure No. NA-PR-01-99)	United States Department of Agriculture, Animal and Plant Health Inspection Service	1999		

room. Displays included look-alike EAB insects, EAB beetles and larva, and firewood identification. After the official training ended, participants who pre-registered for the Tree Inspector Examination stayed for the examination.

After participants completed the training and signed the required confidentiality form, they were included in the First Detector database. When questions about EAB arose from the public, the MDA assessed the report and, if required, the MDA gave the citizen information on how to reach their nearest EAB First Detector. As volunteers, First Detectors are not required to make site visits, but they do speak with concerned citizens, further assess the inquiry, help package and mail samples and, if needed, often make site visits. If a site visit is not practical for the volunteer, they contact the MDA and an MDA employee will then visit the site. If a First Detector suspects an insect or infected tree to be EAB they are required to pass the information quickly and securely to the MDA. Confirmation of EAB can only be determined by the Federal or State governments because of the sensitive nature of major invasive species outbreaks and the serious economic effects that can follow. First Detector confidentiality is critical until the appropriate agencies confirm the find. First Detectors cannot tell a landowner they believe it is EAB, only that they are passing the information and/or materials on for additional identification.

In 2008, the MDA received 116 calls regarding EAB and were able to handle them without involving First Detectors. Emerald ash borer First Detectors turned in 11 reports to the MDA about their activities. However, in the 2008 First Detector Survey results, 81 First Detectors responded that: (i) 40 people reported suspect EAB infestations to them; (ii) they made 57 site visits (an additional 750 were reported by one respondent but it is believed that was not done as a First Detector); and (iii) that 1023 people asked them general EAB questions.

2009

In 2009, the EAB First Detector programme expanded to become the Forest Pest First Detector programme, which, along with EAB, includes gypsy moth, Asian long horned beetle, and *Sirex* woodwasp. Organisers included these pests because local forest health experts from the MDA and DNR identified them as special concerns for Minnesota. Because applicant quality was so good in 2008 that all applicants were accepted, 2009 Forest Pest First Detectors participants did not need to pre-apply. Organisers chose workshop training locations based on areas that were projected to have a higher risk of EAB introduction (Selness & Venette, 2006), and focused on those areas which had not been previously targeted in 2008. Two sessions were again conducted in the Twin Cities because of the

large number of applicants in that area. Participants included EAB First Detectors from 2008 in addition to the target audience of tree and forestry professionals, Master Gardeners, Tree Care Advisors, Woodland Advisors, Tree Inspectors, and others who routinely work with Minnesota's trees and forests. Organisers realised EAB First Detectors from 2008 would attend the Forest Pest First Detector training not only to get an update on the status of EAB but also to learn about the three additional forest pests, even though they were already First Detectors. However, organisers also included individuals from neighbouring states interested in Minnesota's First Detector programme as a model for similar programmes in their home states. The four Forest Pest First Detector workshops had 233 attendees.

The workshop agenda was altered based on end-of-workshop evaluations from the 2008 sessions and on a survey completed by EAB First Detectors in the fall of 2008 after participants completed one summer as First Detectors. The most significant change to the First Detector curriculum in 2009 was the addition of three forest pests: gypsy moth, Asian longhorned beetle, and *Sirex* woodwasp. Of respondents to the fall survey, 96% were "somewhat" to "very interested" in "...receiving training on additional forest pests besides emerald ash borer." To allow time for training on these additional pests, and to keep the training within one full day, organisers developed the three required federal First Detector modules: Module 1-Mission of NPDN and Agricultural Biosecurity; Module 2-Monitoring for High Risk Pests; and Module 3-Quality and Secure Samples Submission (weeds, insects, and diseases), for on-line delivery and required participants to complete them before each training session. To view on-line materials visit <http://www.extension.umn.edu/pesticides/2009/eab/>. This allowed 1.5 hours of training for the three additional forest pests.

At the last minute, an additional training workshop was scheduled in Winona, southeastern Minnesota, for the tri-state area of Minnesota, Wisconsin, and Iowa following the discovery of an EAB infestation in Victory, Wisconsin on April 7, 2009, only about 1.5 kilometres from the Minnesota state line. The find in Victory, Wisconsin and the sudden attention to EAB in the tri-state area likely led to the high number of attendees (233), in 2009.

Sixty-six workshop participants committed to become Forest Pest First Detectors. Many people in Iowa, Wisconsin, and even North and South Dakota became very interested in Minnesota's First Detector programme and attended the training to learn from this model; however, only individuals living in Minnesota are eligible to become Minnesota Forest Pest First Detectors. Additionally, some 2009 participants came to the training to learn more about the three additional pests but had already become First Detectors in 2008.

The 2009 Forest Pest First Detector training was again six hours long and included:

1. information about the Minnesota First Detector programme, a review of experiences from the 2008;
2. First Detector programme, and information on triaging reports and working with the public;
3. discussion of new and emerging invasive forest pests in Minnesota and nationally; and
4. diagnosing hosts, damage, and life stages of targeted pests.

During the lunch break, organisers again encouraged participants to study the many displays around the room including all the EAB displays available in 2008 plus gypsy moth, Asian longhorned beetle, and *Sirex* woodwasp look-alike displays. After the session, organisers again administered the Tree Inspector Examination for eligible participants.

Participants of the 2009 workshop were given an updated and expanded Forest Pest First Detector package, which included all the items provided in 2008 (Table 1) plus:

- the Minnesota First Detector Manual, a resource developed specifically for Forest Pest First Detectors;
- materials about Asian longhorned beetle and its identification; and
- material about *Sirex* woodwasp and its identification.

Details of these additional resources are given in Table 2.

Minnesota EAB and Forest Pest First Detectors are trained and kept current by the MDA, Extension, and the DNR via e-mail to identify and detect designated forest pests and to be the local public resource for information about those pests.

In 2009 the MDA received 1814 calls about forest pests of concern, mostly EAB, with 228 calls sent to First Detectors for further investigation. First Detectors submitted five photographs of suspected detections (insect damage) to the MDA for follow-up resulting in the only confirmed find of EAB in Minnesota. In the Forest Pest First Detector 2009 survey, 121 participants responded regarding EAB. In total: (i) 300 people reported suspected infestations; (ii) First Detectors made 309 sites visits; and (iii) 2696 people asked them general questions.

For gypsy moth, First Detectors made 28 site visits and responded to 56 general questions. First Detectors fielded only six questions for Asian longhorned beetle

and two for *Sirex* woodwasp. First Detectors reported volunteering for 1281 hours and driving 12 311 km in 2009, thus saving the MDA and other public agencies time and resources.

Results and Discussion

As a result of the 2008 end-of-session evaluations and the 2008 e-mail survey to EAB First Detectors, organisers expanded the content of the First Detector programme for 2009. Expanding the content helped Minnesota officials and resource managers by adding forest pests to the list of those under close watch by First Detectors, and addressed a training need for more information on additional emerging pests of special concern on the part of First Detectors.

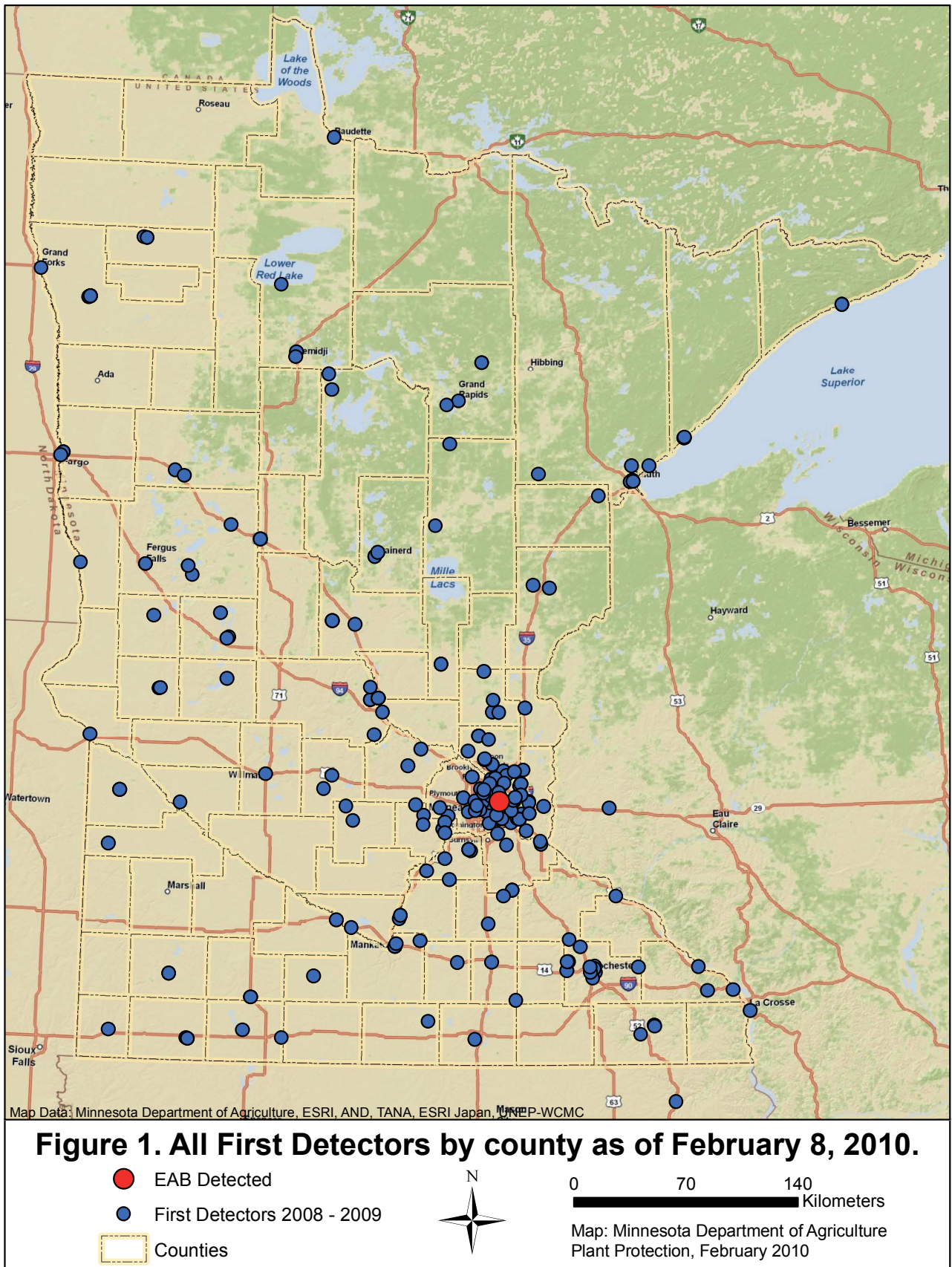
The First Detector programme achieved its original intent as defined by the EAB Readiness Task Force in 2007 by reaching 326 individuals and increasing their technical skills around the early detection of EAB. Of the 326 trained individuals 233 have committed to volunteering for the programme to help with the early detections of EAB, gypsy moth, Asian longhorned beetle, and *Sirex* woodwasp. Figure 1 shows the statewide distribution of First Detectors by county as of February 8, 2010. Also, and possibly more importantly, three First Detectors made the first detection of EAB in Minnesota on May 13, 2009 and reported it appropriately to the MDA thus epitomising the name and intent of this programme. Time will tell how many of the first detections for any of the four pests will be made by First Detectors, but the programme is off to a promising start. Additional First Detectors reported via the 2008 and 2009 annual surveys that, for all forest pests, they received 340 suspected infestations of targeted pests, completed 394 site visits, and fielded 3783 general questions. Finally, the work of the EAB/Forest Pest First Detectors team has received national attention from the NPDN organisers because the programme is the first to focus on a few specific forest pests. The programme is a testament to the ability of motivated employees and farsighted decision makers to identify a problem and work on a multi-organisation collaboration to manage a major public problem both effectively and efficiently.

Conclusion

After two years of EAB/Forest Pest First Detector training events and success with the first detection of EAB in Minnesota, programme organisers are continuing to gauge the needs of state officials and First Detectors to establish the best path for the future. The NPDN provides funding for maintenance of the First Detector list and basic programme coordination, but funds for ongoing First Detector trainings are uncertain.

TABLE 2: Details of additional materials included in the 2009 expanded Forest Pest First Detector package.

No.	Title	Author	Date	Publisher	Website (retrieved 18 February 2010)
1	<i>Insects in Minnesota that may be confused with Emerald Ash Borer</i>	Hahn, J., & Cervenka, V.	2009		
2	<i>Emerald Ash Borer</i>	Hahn, J.	2009	St. Paul, MN: University of Minnesota	
3	<i>Do I Have Gypsy Moth?</i>		n.d.	Minnesota Department of Agriculture	
4	<i>What is a Gypsy Moth?</i> (Brochure No. LYDII120077)		2007		
5	<i>Caterpillars that may be confused with Gypsy Moth caterpillars</i>	Hahn, J.	2009	St. Paul, MN: University of Minnesota	
6	<i>Do I Have Asian Longhorned Beetle (ALB)</i>		2009		http://www.mda.state.mn.us/news/publications/pestsplants/pestmanagement/eab_doihaveit.pdf
7	<i>Do I have Sirex Woodwasp?</i>		2009		
8	<i>WANTED the Asian Longhorned Beetle.</i> (Brochure No. 1655)		2008	United States Department of Agriculture, Animal and Plant Health Inspection Service	
9	<i>Asian Longhorned Beetle vs. Cottonwood Borer</i> (Brochure No. NA-PR-04-00)	McKinney, R., Duerr, D., & Haugen, D.	2004		http://www.na.fs.fed.us/fhnp/alb/pubs/alb_cb/alb_cb.htm
10	<i>Asian Longhorned Beetle or Whitespotted Sawyer?</i> (Brochure No. NA-PR-01-98)	Hoebeke, E. R.	2002		http://www.na.fs.fed.us/fhnp/alb/pubs/alb_wss/alb_wss.htm
11	<i>Pest Alert Sirex Woodwasp</i> (Brochure No. NA-PR-07-05)	Haugen, D., & Hoebeke, E. R.	2005		http://na.fs.fed.us/spfo/pubs/pest_al/sirex_woodwasp/sirex_woodwasp.htm



For EAB, early detection in additional Minnesota counties is the next important step; but for many citizens, landowners, tree and forest professionals in the Twin Cities, managing EAB spread, movement, and infected materials is the greatest educational need, so the learning focus for the Twin Cities is likely to change. Similarly, gypsy moth has been found many times in the state but is still not considered established and has not been found throughout Minnesota. There are many more management options for gypsy moth, so public engagement and education about gypsy moth management may be more important than actual detection for First Detectors. Thankfully, Asian longhorned beetle and *Sirex noctilo* woodwasp have not yet been found in Minnesota, but early detection of both of these pests will be critical to their management. Finally, with the infrastructure of the First Detector programme well-established, and resources and protocol fundamentally developed, it will be easy for organisers to add additional forest pests of special concern to future trainings when those pests appear on Minnesota's distant horizon.

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