EDDMapS - Early Detection and Distribution Mapping System for the Southeast Exotic Pest Plant Council

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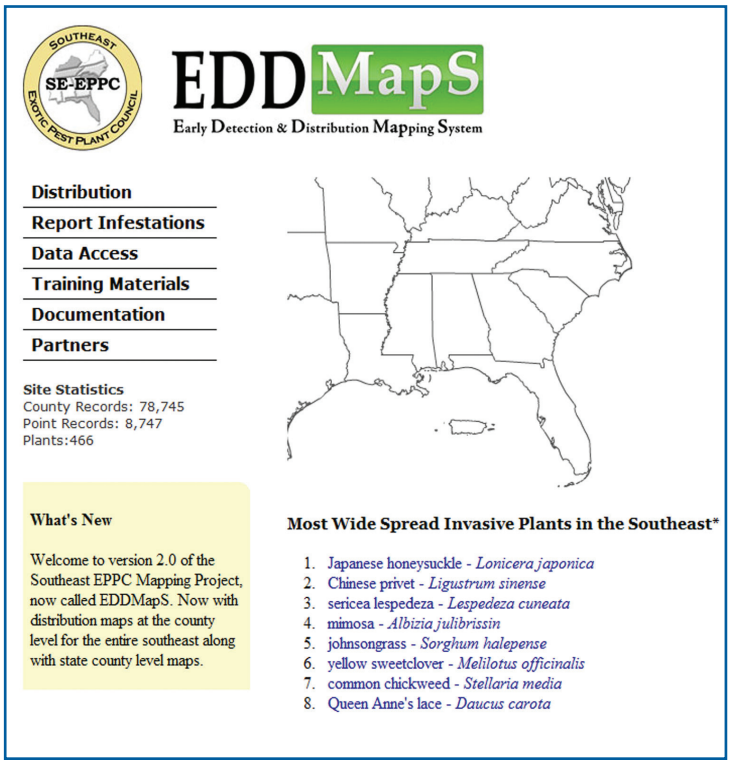
The University of Georgia's Bugwood Network has developed an **E**arly **D**etection and **D**istribution **Map**ping **S**ystem, or **EDDMapS,** to provide a more accurate picture of the distribution of invasive species across the South. EDDMapS will allow land managers, agencies and others to set priorities for early detection and rapid response (EDRR), as well as formulate overall invasive plant management action plans.

EDDMapS has been implemented for use by both the Southeast and the Florida Exotic Pest Plant Councils. It was designed as a tool for each state EPPC to develop more complete local, state and regional level distribution data of invasive plants, identify "leading edge" ranges of new invasive threats, provide a means of implementing EDRR, and help corroborate threats and refine invasive plant lists and management priorities.

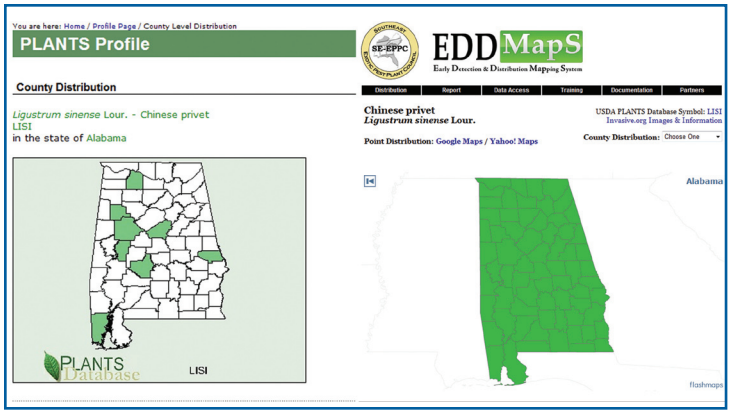
The need for a system that helps to "fill in" species distribution across the South is evident when we look at invasive plant distribution information that is now available through several sources. At present, there are data existing at varying scales, resolutions, availability, and completeness from research projects, herbaria records, natural heritage program inventories, and several regional survey programs. However, due to the diverse nature of these efforts, the data are stored at scattered locations, in different formats, and are not generally available to combine data sets to produce a single overall distribution map.

EDDMapS started by importing county distribution data from the USDA NRCS PLANTS Database to develop species distribution maps and identify gaps in the records. At present, Bugwood is working with the following regional projects to incorporate their data into EDDMapS and share the EDDMapS data back to the cooperators:

- Invasive Plant Atlas of the Mid-South (Mississippi State University).
- USGS National Biological Information Infrastructure
- USDA NRCS PLANTS Database
- USDA Forest Service Forest Inventory Analysis
- Princeton Invasive Species Mapping Program



Southeast EPPC EDDMapS homepage (www.se-eppc.org/eddmaps).



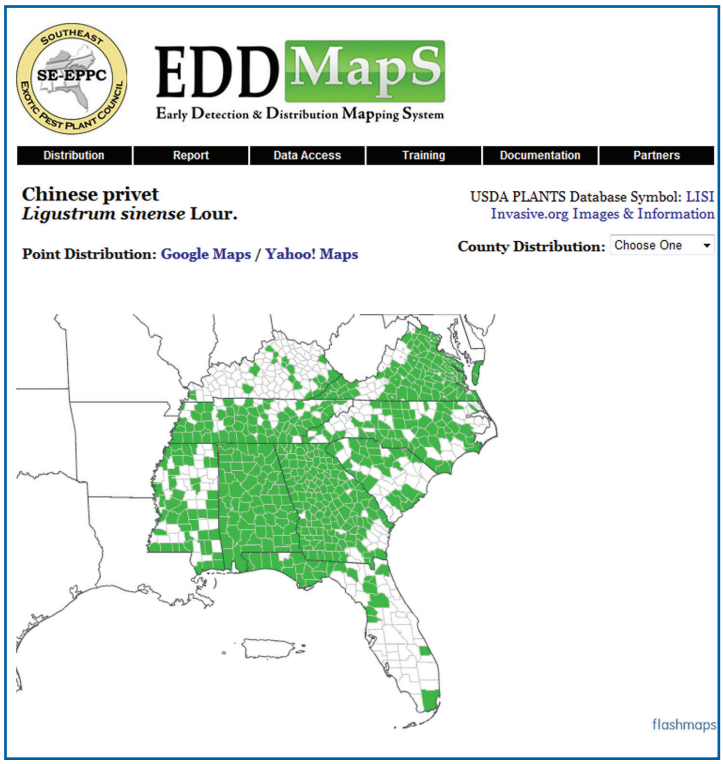
Comparison of two current distribution maps for Chinese privet in Alabama. Data from PLANTS Database reflect only a partial compilation of herbarium records, EDDMapS displays combined PLANTS, USDA Forest Service – Forest Inventory Analysis and herbarium records at the county level.

EDDMapS Technical Details

Internet Mapping Software – The Bugwood Network worked closely with the Flashmaps Geospatial Company to customize their product for EDDMapS which is one of their featured/showcase solutions. The Flashmaps Area Selector product (www.flashmaps.com) is used to display state and southeastern county level distribution maps. This product utilizes Adobe Flash technology to render the maps and provide interactivity. The product connects directly to the Microsoft SQL Server 2005 database and uses Adobe Coldfusion 7 to produce the XML files needed to generate

The Bugwood Network

The Bugwood Network was developed through faculty cooperation between the College of Agricultural and Environmental Sciences and the Warnell School of Forestry and Natural Resources at the University of Georgia, Tifton Campus. The mission of the Bugwood Network is to serve a lead role in development, consolidation and dissemination of information and programs focused on invasive species, forest health, natural resource and agricultural management through technology development, program implementation, training, applied research and public awareness. It has developed, operates and maintains 20 websites that received 120 million hits from 13 million users in 2006. The Forestry Images and Invasive.org image archives created by Bugwood Network include 60,000 images from 1,200 photographers. www.bugwood.org



EDDMapS distribution of Chinese privet across the Southeast.

the maps. All county data is stored using a five-digit Federal Information Processing Standard (FIPS) code. The first two digits are the state code and the last three digits are the county code within the state.

EDDMapS uses Google Maps to display point data (latitude and longitude) for species, and for users without access to a GPS device to select and preview their location on a map. Google Maps allows users to search street maps and satellite imagery of the entire United States. Google released Google Maps (http://maps.google.com/) in February of 2005 and released an API (application programming interface) in June of 2005. New web technologies allowed Google to create a product allowing results to display and zoom very quickly and thus be very easy to use. The Google Maps API allows developers to embed Google Maps into their own websites free of charge. The combination of Flashmaps and Google Maps API allows users of EDDMapS a quick and easy to use web mapping solution currently unique to the EDDMapS product.

Technical enhancements to EDDMapS currently under development include:

- Integration with ESRI ArcIMS to output shape files directly to ArcGIS Desktop software.
- Batch uploading of records from GPS units, Nature Conservancy's WIMS and ArcGIS.
- Ability for users to update/edit past records.

Mapping Standards - The data fields used in EDDMapS are based on the North American Weed Management Association's (NAWMA) Invasive Plant Mapping Standards (http://www.nawma.org/). The standards have been expanded to include links to the Invasive.org website and USDA NRCS PLANTS Database, to include additional fields to support the inclusion of the FLEPPC georeferenced database records (http://www.fleppc.org/EDDMapS/Georeferenced.pdf), and to allow for inclusion of invasive species occurrence data for all taxa (not limited to plants) for future flexibility. Data for each species occurrence record is stored in a Microsoft SQL Server 2005 database. Adobe ColdFusion is used to connect the database to the mapping software and display the records in HTML format for viewing on the website.

The data entry fields are listed and described below:

- Reporter – *Required field*, automatically entered when logging into the web site.
- Date Entered – *Required field*, automatically entered when a record is submitted.
- Pest – *Required field*, choose the pest from the dropdown list, currently containing the list of Invasive Plants of the Thirteen Southern States compiled by Miller, Chambliss and Bargeron in 2004 (http://www.invasive.org/seweeds.cfm). Future versions of EDDMapS will allow users to select any plant in the USDA PLANTS database.
- Observation Date – *Required field*
- State & County – *Required field*; choose the county from the dropdown list on your state entry form.
- Infested Area – *Required for NAWMA standards*; area of land containing the species of interest expressed in acres, hectares, square feet or square meters. This is defined by NAWMA as the actual perimeter of the infestation as defined by the canopy cover of the plants, excluding areas not infested.

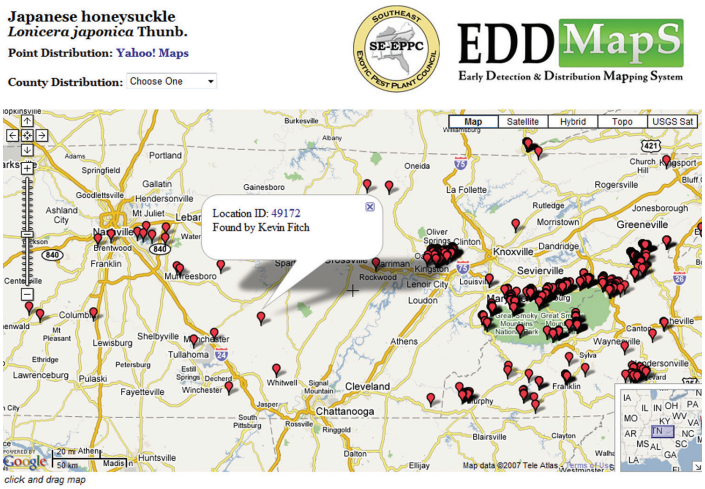


Figure 4.

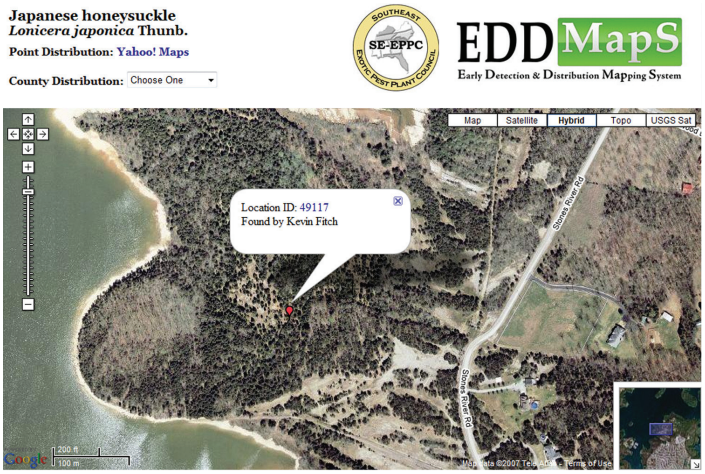


Figure 5.

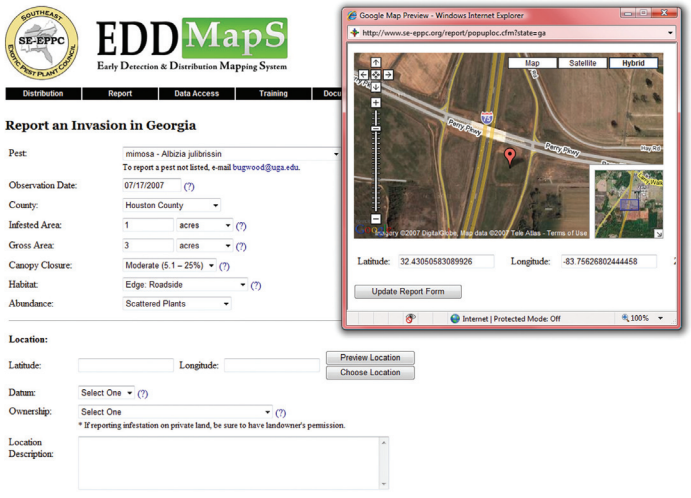


Figure 6.

Figure 4. Display of point data using Google Maps map view for Japanese honeysuckle in eastern Tennessee. Figure 5. Close-up display of point data using Google Maps hybrid view for Japanese honeysuckle in eastern Tennessee. Figure 6. EDDMapS data entry form with "Choose Location" pop-up window.

- Gross Area – General area of land containing the species of interest expressed in acres, hectares, square feet or square meters. This is defined by NAWMA as the area defined by drawing a line around the general perimeter of the infestation, not the canopy cover of the plants, and may contain significant parcels of land that are not occupied by the plant.
- Canopy Closure – *Required for NAWMA standards*; a way to estimate the severity of the infestation. (use drop-down menu)
- Habitat – Used by the original and georeferenced FLEPPC database to describe the habitat in which the occurrence took place. This can be very useful in analyzing large amounts of data on particular species. (use drop-down menu)
- Abundance – Used by the original and georeferenced FLEPPC database to further describe the density of the infestation beyond canopy closure. This is very useful if only one plant exists at the occurrence. (use drop-down menu)
- Location Latitude – *Required for NAWMA standards* and must be entered as **decimal degrees** in order to work with Google Maps. Provide the location as the center of the infestation; if polygon data is recorded, this is the center of the polygon.
- Location Longitude - *Required for NAWMA standards* and must be entered as **decimal degrees** in order to work with Google Maps. Provide the location as the center of the infestation; if polygon data is recorded, this is the center of the polygon.
- Location Datum – *Required for NAWMA standards*; choose NAD83/WGS84 from the drop-down menu for all new data entered.
- Ownership – *Required for NAWMA standards*; choose from drop-down list; provides grouping information based on ownership of the land where the infestation is located.
- Location Description – Additional information on the location of the occurrence, including information about the route taken to locate the infestation or any nearby landmarks.
- Comments – Any additional information useful about the infestation; this can include treatments or a more complete description of the occurrence.
- Voucher Specimen made / Herbarium holding specimen – All reporters are encouraged to submit voucher specimens to their nearest herbarium for verification. This is especially important for any new county records of a plant. If a specimen is made, please provide the name of the herbarium holding the specimen. This can be very useful in the verification process.

- Images – User may upload up to five images of the infestation. Please provide images that can be used for identification of the species. This is also used in the verification process. More information about photographing plants for EDDMapS is available in a Microsoft PowerPoint presentation at http://www.se-eppc.org/eddmaps/training.cfm.

Using EDDMapS

The Bugwood Network developed this tool for use by the state EPPC's. A state coordinator has been appointed by each EPPC to review and verify data and, as appropriate, notify regulatory agencies if there is a new report of a federal noxious weed. State EPPC's are encouraged to train members in species identification, mapping standards and reporting protocols. An EPPC may decide to focus mapping on specific target species on state EPPC lists or to map all invasives.

Collecting location data - Mapping of individual infestations is done using a GPS unit to determine a latitude/longitude point to represent the infestation. Generally a single point can be used to denote an entire infestation. Stand at, or as near as you can, to the center of the infestation. The longer the GPS is stationary at the point, the more accurate the reading. Record the lat/long in decimal degrees (DD.DDD) and be sure the datum is set to NAD83 or WGS84. Either write down the coordinates to five decimal places, or create a waypoint on your GPS unit so that you can write it down later. Be sure to name the waypoint to associate it with the specific point (e.g. "Doug's farm" or "Garlic Mustard #1").

Up to five images of each point can be uploaded to EDDMapS. These are useful in species verification and to provide a more complete characterization of the infestation. Learn specific invasive species diagnostic characteristics and take images with enough detail to make identification possible. This will usually require a series of close-up images of specific plant characteristics and landscape level images to characterize the extent of the infestation. Some considerations for taking these images include:

- To reduce shake in macro and low light level situations, use a tripod when possible.
- Try to position the camera so the sun is behind the camera and avoid shadows on the subject.
- Take multiple images of the same subject and choose the best one.
- Use the highest resolution and best quality images available with your digital camera.
- Upload images to EDDMapS in JPEG format.

Data Entry - Logon to the EDDMapS site and create a user name and password. This will provide state coordinators with your contact information if there is a question regarding the occurrence. Complete the data entry form for each point collected. Upload the corresponding images if available. If you do not have a GPS unit available, use the "Choose Location" Google Maps feature to select the map point where the infestation is located and the corresponding GPS coordinates. Whether you enter GPS coordinates or choose the location from Google Maps, you should always click the "Preview Location" button to verify that the site location on the map is displayed correctly. Submit the completed form; this may take a few minutes if uploading images.

Once the record is submitted, an e-mail is sent to the state coordinator and the point is displayed on the species distribution map. This record is listed as "unverified" until the state coordinator reviews and verifies it. If required, certain data elements can be made "Private" by contacting the EDDMapS site administrator. This is to accommodate any confidentially issues associated with public display of exact locations of certain regulated species.

Implementing EDDMapS at the State Level

A regional EDDMapS train-the-trainer workshop was held for SE-EPPC members in Chattanooga, TN this past June. Participants were encouraged to return to their home state to set up training workshops for their membership and begin contributing state EPPC data to the system. EDDMapS currently contains data from several sources in each of the SE-EPPC states.

An important link with EDDMapS is to the national efforts for Early Detection and Rapid Response promoted by Dr. Randy Westbrooks with USGS. In the EDRR efforts, each state EPPC is encouraged to develop EDRR lists of target species of concern. Survey points for these species can be entered into EDDMapS for reporting to the EDRR network of state agencies and individuals. This, in combination with the vast information and image library provided by Invasive.org, could be the backbone for a national invasive species atlas.

Participation by the state EPPCs in the SE-EPPC's EDDMapS will result in a more complete and thus more useful product for invasive species EDRR and management in the southeast. The Bugwood Network will continue to promote, enhance and expand EDDMapS into additional areas and regions.

If you are interested in using EDDMapS in a project, or submitting data you currently have, please contact Chuck Bargeron at cbargero@uga.edu or at (229)386-3298.