

# *Invaders of Texas*

## *A Citizen Science Program to Detect and Report Invasive Species*

**Project Period:** 2005-2009 (Five-Year Report)

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### **Project Abstract:**

The *Invaders of Texas* program is an innovative campaign whereby volunteer citizen scientists are trained to detect the arrival and dispersal of invasive species in their area and report them into a statewide detection and mapping database. The idea is simple. The more boots on the ground and trained eyes watching for invasive species, the better our chances of responding to new and existing threats thereby lessening or avoiding economic and ecological damage invasive species can cause to native ecosystems.

The *Invaders* program is a collaborative project managed by the Lady Bird Johnson Wildflower Center in Austin, TX with support from the U.S. Forest Service Forest Health Protection, U.S. Forest Service National Forests and Grasslands in Texas, Texas Forest Service, Texas Parks and Wildlife and Texas Master Naturalists.

The overarching goals of the *Invaders* program are to

- 1) Train a large, geographically distributed cadre of citizen scientists to find and report outbreaks of selected invasive species in Texas,
- 2) Validate and use that data to develop maps of invasive species to improve our understanding of invasive species distributions in Texas,
- 3) Partner and provide information to regional resource managers and agencies to control and/or eradicate invasive species and, where possible, provide opportunities for volunteers to help in these eradication efforts, and
- 4) Through continuing education, bring our volunteers to a level at which they can train the next generation of citizen scientists.

Since its inception in 2005, the *Invaders* program has hosted 31 workshops and trained over 700 citizen scientists. These citizen scientists have logged over 3,300 hours in the field and collected over 8,000 species observations (Table 1). This five-year report gives a broad outline of the *Invaders of Texas* citizen scientist program and includes our accomplishments and lessons learned.

**Table 1.** – *Invaders of Texas* program’s overall performance, 2005-2009.

<b>Year</b>	<b>Workshops</b>	<b>Trained</b>	<b>Total</b>	<b>Observations</b>	<b>Hours</b>
<b>2005</b>	1	19	19	270	412.67
<b>2006</b>	7	185	204	400	587.92
<b>2007</b>	6	70	274	1,008	670.50
<b>2008</b>	4	75	349	3,480	802.92
<b>2009</b>	13	353*	702	3,308	817.50
<b>Total</b>	<b>31</b>	<b>702</b>		<b>8,466</b>	<b>3,291.50</b>

\* Includes 108 citizen scientists trained online.

## **I. Introduction**

*Citizen Scientists* are volunteers who participate as field assistants in scientific studies. They are not paid, and most are not scientists. Many major and well-known programs have adopted the citizen scientist model such as the Cornell Lab of Ornithology’s Backyard Bird Counts, Audubon’s Christmas Bird Counts and Texas Parks and Wildlife’s Nature Trackers. Currently, there are very few citizen science programs focused on invasive species, and the ones that do, usually focus on citizen-based eradication efforts. Over the last five years we have developed a very successful citizen science program that emphasizes invasive species detection and reporting that has substantially improved our knowledge of the distribution of invasive plants in Texas. In addition, this program provides much needed baseline data that supports rapid response, control and management and restoration efforts by federal, state and municipal resource managers.

The *Invaders* program centers around a statewide network of citizen scientist teams trained to seek out and report outbreaks of harmful invasive species in their local areas. These teams are organized geographically into regional satellite groups connected to local resource managers who coordinate appropriate responses to control the spread of unwanted invaders. The program was piloted in 2005, and in 2006 and 2007 the program was introduced in twelve geographically distinct areas in Texas. In mid-2008 we received funding to hire a full-time coordinator and in 2009 conducted 13 training workshops, almost doubling the number of satellites and citizen scientists.

## **II. The Satellite Network** – [http://www.texasinvasives.org/invaders/satellite\\_results.php](http://www.texasinvasives.org/invaders/satellite_results.php)

Regional teams, called satellites, are the foundation of the *Invaders of Texas* program (Figure 1). Texas covers a vast amount of space; therefore it would be impossible for a centralized organization to provide expert assistance to all citizen scientists. Satellites offer a local network connected with local experts to help with local issues and answer local questions. One of the lessons we have learned is the importance of strong leadership within the satellites. The satellite leader is the main contact for the satellite, and is responsible for keeping the satellite organized, putting together field trips and work days, helping answer questions from the individual citizen scientists, and recruiting more members to the satellite. Once satellite leaders feel comfortable with the program, they are allowed to conduct their own “mini-workshops” to recruit citizen scientists into their satellites.

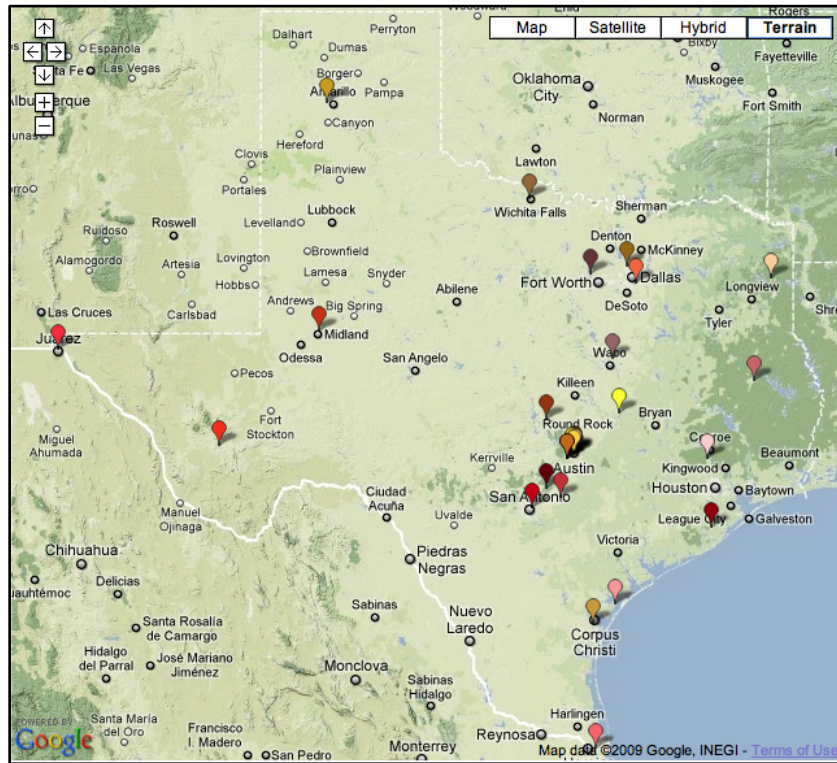


Figure 1. – Locations of *Invaders of Texas* satellite groups.

### III. Recruitment & Training

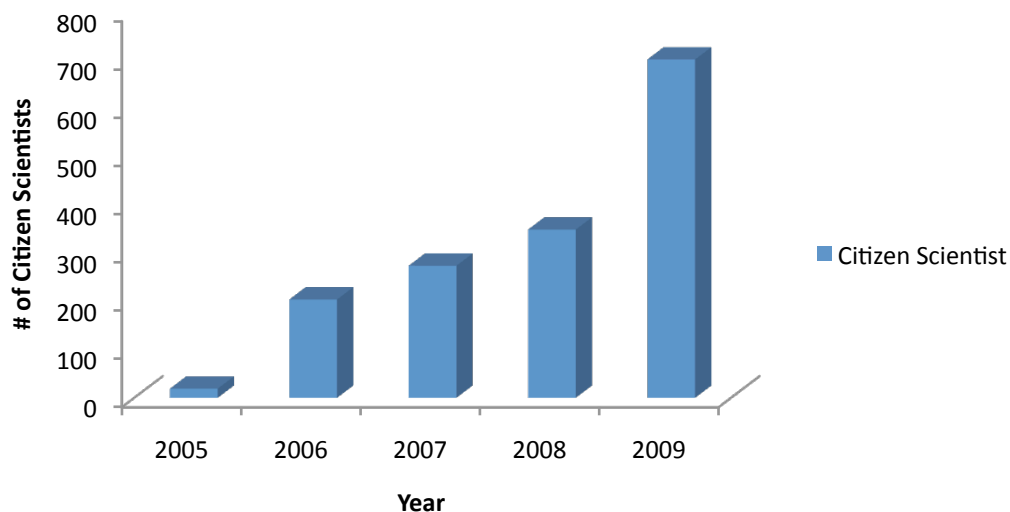
A. *Recruitment* – [http://www.texasinvasives.org/invaders/workshop\\_results.php](http://www.texasinvasives.org/invaders/workshop_results.php)

Citizen Scientists are recruited through local volunteer based conservation organizations such as Texas Master Naturalist, Native Plant Societies and Master Gardeners. The Texas Master Naturalist program provides most of our citizen scientists. Texas Master Naturalist chapters are well established throughout Texas and the volunteers are already versed in the local flora and fauna. The local host is responsible for the bulk of recruiting and locating a venue for the workshop. The local host is also responsible for supplying a list and specimens of 10-12 local invasive plant species that are commonly found and easy to identify. We have found this approach allows individuals to become familiar with invasive species in their area and reduces the anxiety associated with trying to learn a large number of invasive species in one day.

B. *Workshops* – <http://www.texasinvasives.org/invaders/toolkit.php>

All workshops are organized by the local host and administered by personnel from the Wildflower Center or the Texas Forest Service. The workshop is a 1-2 day intensive training using the 33 page *Invaders of Texas* training manual. Individuals are taught to identify local invasive plants, field safety, how to use a GPS, how to collect data, and how to submit the data into the online database (Appendix I). Once an individual has completed a workshop they are

free to login and start making species observations. To date, thirty-one workshops have been conducted throughout Texas (Appendix II) training over 700 citizen scientists (Figure 2).



**Figure 2.** – Total number of citizen scientist from 2005-2009/

#### C. Online Training – <http://www.texasinvasives.org/training/>

In an effort to recruit more citizen scientists, an online training module was launched in 2009 to recruit outside the satellite network. The online training also serves as an enrichment tool for existing citizen scientists and educates the public about invasive species in Texas. The online training includes eight modules modeled after the eight chapters in the *Invaders of Texas* training manual. Each module is accompanied by a quiz. Once completed, individuals can create an account and start reporting species observations. To date, 108 individuals have gone through the online training.

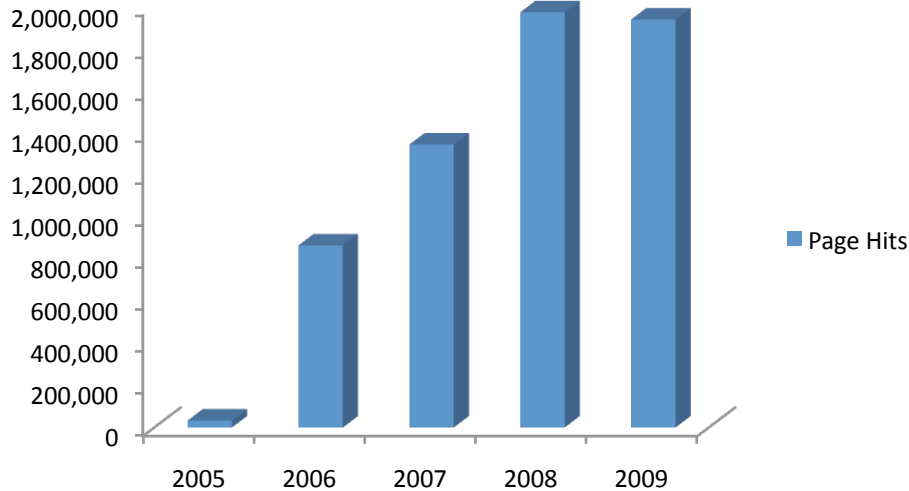
#### D. High School Invaders

In 2008, we began exporting the Invaders program into high school science classes. We have held one teacher-training workshop for 10 science teachers and two workshops (approximately 150 students) at area high schools. We have found the Invaders program to be exceptionally popular with high school science teachers not only because it is an important environmental issue (invasive species), but also because it involves field work, data collection, GPS and mapping, digital imaging and computer technology. The online training modules have become a particularly effective tool for recruiting students and teachers in high school science classes.

### IV. Website

Texasinvasives.org is home to the *Invaders* program and features an Invasive Plant Database, the Early Detection and Reporting Database (EDRD) containing species observations submitted by

citizen scientists and the Invaders Mapping Application. The website also contains downloadable invasive species publications, links to national, regional, state and local invasive species initiatives and many other resources. Over the last five years, texasinvasives.org has positioned itself as the number one clearinghouse for invasive species information in Texas (Figure 3).



**Figure 3.** – Total page hits at texasinvasives.org from 2005 to 2009.

*A. Invasive Plant Database* – [http://www.texasinvasives.org/invasives\\_database/](http://www.texasinvasives.org/invasives_database/)

The invasive plant database features 140 plant species that occur in Texas and have been listed as invasive in other states. The interactive database includes the Texas Department of Agriculture’s list of 33 noxious weed species and Texas Parks and Wildlife’s list of 13 prohibited aquatic plant species. Citizen scientists can report occurrences of any species in the invasive plant database and new species can be added to the database as needed. For each species, the invasive plants database provides a description and image along with information on taxonomy, distribution, habitat, history of introduction, ecological threat, management techniques and links to additional resources.

*B. Early Detection and Reporting Database* – <http://www.texasinvasives.org/observations>

Based on North American Weed Management Association (NAWMA) standards, the Early Detection and Reporting Database performs four functions:

- 1) It serves as the data submission system for citizen scientists to report invasive species observations,
- 2) It includes a “behind the scenes” validation system so that validators can verify species observations submitted by the citizen scientists,

3) It provides an easily accessible venue for government and non-government organizations to download species observations, and

4) It feeds GPS coordinates and species observations to the Invaders Mapping Application.

*C. Invaders Mapping Application* – <http://www.texasinvasives.org/observations/mapping.php>

The *Invaders Mapping Application* uses a Google map interface to plot validated species observations submitted by citizen scientists. Visitors to the website can map observations by satellite or by species or any combination of satellite and species. The mapping application includes all the functionality and ease of use provided by Google Maps and all map points are linked to individual records in the Early Detection and Reporting Database. Because each map point is linked to an individual and satellite, we have found the maps act as a reward for the citizen scientists and have inspired lighthearted competition among satellite groups.

## **V. Data Collection, Validation and Sharing**

### *A. Species Observations*

For each invasive species occurrence, citizen scientists record the species, date observed, time spent in the field, GPS coordinates, amount of disturbance, patch type, species abundance and notes about the location onto a field data sheet. These data, along with a digital image that they are required to upload for validation purposes, constitute a single species observation. Upon returning from the field, citizen scientists login and enter their field data into the Early Detection and Reporting Database. There is a one-to-one correspondence between the field data sheet and the online data entry form to facilitate data entry.

One of the lessons we learned is that citizen scientists are uncomfortable making their own scientific decisions. Originally, citizen scientists were required to report numerous ecological parameters for each observation but this proved to be intimidating and resulted in fewer species observations. Since the primary goal for the program is to develop baseline maps of targeted invasive species, we scaled back the collection criteria in favor of more observations while still meeting the minimum North American Weed Management Association (NAWMA) standard. This change has proven effective and has increased the amount of species observations submitted by the citizen scientists.

### *B. Validation*

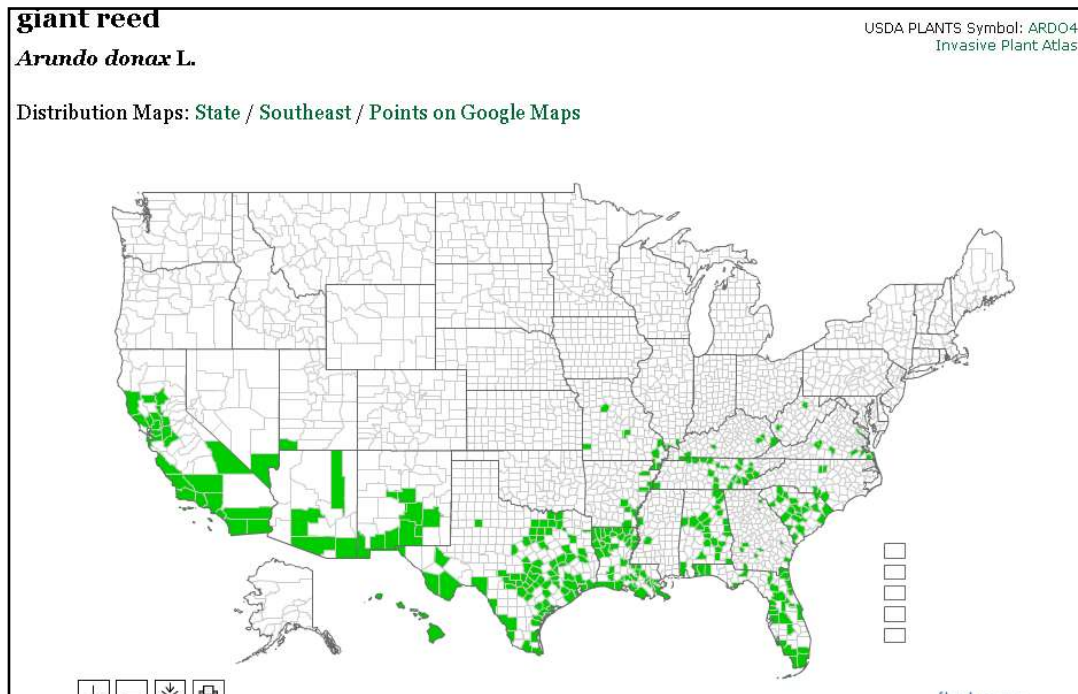
Citizen science-based projects are often criticized for lacking the rigor of traditional scientific studies. For this reason, we validate all species observations submitted by citizen scientists. Species observations are validated using the GPS coordinates, images and other information submitted by the citizen scientist. If, for some reason, a species observation does not pass the validation test (ex. GPS coordinates are off or the invasive species is misidentified), the citizen scientist is contacted by the satellite leader or program coordinator and given the opportunity to correct the mistake.

Only valid observations are made publicly available in the Early Detection and Reporting Database (<http://www.texasinvasives.org/observations/>) the Mapping Application (<http://www.texasinvasives.org/observations/mapping.php>) or for export.

### C. Data Sharing

All data in the Early Detection and Reporting Database is freely available for export to Microsoft Excel. Once exported, the data can be easily converted to KML, XML, CVS, or MDB files and imported into any Geographic Information System for further analysis.

In addition to the export feature, we share *Invaders of Texas* data with the Early Detection and Distribution Mapping System (EDDMapS) developed by the Center for Invasive Species and Ecosystem Health. EDDMapS is a national effort to collate multiple datasets to map the spread of invasive species throughout the United States. As indicated in Figure 4 and at <http://www.eddmaps.org/texas/>, the species observations from the *Invaders of Texas* program are making a significant contribution to this national effort.



**Figure 4.** – County map of *Arundo donax* in the United States (EDDMapS). Most counties highlighted in Texas are contributions from the *Invaders of Texas* program.

## V. Outreach and Public Awareness

The *Invaders of Texas* program and its companion website (<http://www.texasinvasives.org/>) have attracted statewide media attention appearing in newspapers, on radio shows and in local television news. In addition, we and our partners have traveled the state and beyond giving professional and public presentations about the program (Appendix III). The website, [www.texasinvasives.org](http://www.texasinvasives.org), averages between 3,000 and 5,000 visitors per month with traffic from 225 Texas cities, 1,140 cities in the U.S. and over 100 countries. The *Invaders of Texas* program

is taking the invasive species message to the general public and enlisting their aid to detect and report invasive species in their neighborhoods.

## **VI. Summary**

The *Invaders of Texas* program is an unqualified success in Texas and we believe other states could and should enlist the aid of their citizens to detect and report invasive species. As the program has developed over the last five years, we have had many successes and learned many lessons. Of all the lessons learned, four program features stand out as having contributed the most to the program's success:

- 1) Network – The network of satellite groups with strong local leadership is essential in a state as big as Texas.
- 2) Technology – Seamless integration between all *in situ* program features (citizen scientists, satellites and workshops) and the web-based data entry and mapping systems allowed us to effectively manage a geographically distributed network.
- 3) Cooperation – Partnerships between satellite groups and local resource managers who can assist citizen scientists and coordinate appropriate responses to control the spread of unwanted invaders.
- 4) Support – Dependable and repeated funding from state and federal partners (Texas Forest Service, U.S. Forest Service Forest Health Protection, U.S. Forest Service National Forests and Grasslands in Texas, Texas Parks and Wildlife and others) gave the program stability and provided for a full time coordinator to expand the program and respond to the needs of the citizen scientists and satellite leaders.

With these features as the foundation of the *Invaders of Texas* program over 700 citizen scientists have collectively logged some 3,000 hours and submitted over 8,000 species observations. This information is being used by resource managers to control and eradicate invasive species, by scientists to predict their distributions and by policymakers to understand the scope of the invasive species problem in Texas.

The Lady Bird Johnson Wildflower Center appreciates the opportunity to partner with the U.S. Forest Service Forest Health Protection, U.S. Forest Service National Forests and Grasslands in Texas, Texas Forest Service, Texas Parks and Wildlife, Texas Master Naturalists and others on the *Invaders of Texas* Citizen Science program. As described in this five-year report we have made significant progress along each of the program's major dimensions including the number of citizen scientists engaged in the program, the number and quality of species observations, the amount of territory covered by satellites, and the widespread participation by regional coordinators, volunteers, and cooperating agencies. Through this program, presentations, partnerships, and the website the Wildflower Center and its partners have positioned themselves as the state leaders on this important issue threatening Texas' natural heritage.



## APPENDIX I: Invaders of Texas Workshop Agenda

Time	Activity	Instructor	Chapter
9:00 – 9:15	WELCOME AND INTRODUCTIONS	SL	
9:15 – 9:45	ABOUT THE INVADERS OF TEXAS PROGRAM: A general overview of the Invaders of Texas Citizen Science Program (PowerPoint).	PC	1
9:45 – 10:00	DEMONSTRATION: Data collection and data entry demonstration.	TG	
10:00 – 10:30	INTRODUCTION TO INVASIVE SPECIES: General overview of invasive species issues and activities in Texas (PowerPoint).	PC	2
10:30 – 10:45	FIELD PREPARATION: Group projects, field safety, field equipment.	PC	3
10:45 – 11:00	BREAK		
11:00 – 12:00	SPECIES SELECTION: Web resources, USDA Codes, Invasive Species Lists, Identification Lab	PC, SL	4
12:00 – 12:45	LUNCH		
12:45 – 1:15	DATA COLLECTION: Data sheets and definitions, frequently asked questions.	PC	5
1:15 – 1:30	USING GPS: What it is, receiver set up, and decimal degrees.	PC	6
1:30 – 2:00	DIGITAL IMAGING: Tips and techniques for taking verifiable images.	PC	7
2:00 – 3:00	FIELD TRIP	PC	
3:00 – 3:45	DATA ENTRY TUTORIAL: Logging in, data entry, and photo upload procedures.	PC	8
3:45 – 4:00	WORKSHOP EVALUATION and CLOSING	SL	

### KEY

PC – Program Coordinator

SL – Satellite Leader

**APPENDIX II: Citizen scientists training workshops conducted from 2005-2009.**

<b>Date</b>	<b>Satellite</b>	<b>Location</b>	<b>Ecoregion</b>
<b>2005</b>			
6 Jun	Travis County Invaders	Austin, TX	Edwards Plateau
<b>2006</b>			
29 Jul	Hill Country Invaders	Kerrville, TX	Edwards Plateau
19 Aug	Mid Coast Invaders	Rockport, TX	Gulf Coast Prairies and Marshes
26 Aug	Pineywoods Invaders	Lufkin, TX	Pineywoods
25 Sep	Houston-Galveston Invaders	Houston, TX	Gulf Coast Prairies and Marshes
3 Oct	Tierra Grande Invaders	Fort Davis, TX	Trans-Pecos
7 Oct	Trans-Pecos Invaders	El Paso, TX	Trans-Pecos
13 Nov	Cross Timbers Invaders	Fort Worth, TX	Cross Timbers and Prairies
<b>2007</b>			
18 May	Houston-Galveston Invaders	Houston, TX	Gulf Coast Prairies and Marshes
2 Jun	Heart of Texas Invaders	Waco, TX	Blackland Prairies
8 Sep	City of Austin Invaders	Austin, TX	Edwards Plateau
29 Nov	Cross Timbers Invaders	Fort Worth, TX	Cross Timbers and Prairies
30 Nov	Cross Timbers Invaders	Glen Rose, TX	Cross Timbers and Prairies
<b>2008</b>			
24 Mar	Rio Grande Valley Invaders	Brownsville, TX	South Plains
6 Jun	Capital Area Invaders	Austin, TX	Edwards Plateau
23 Aug	Tierra Grande Invaders	Alpine, TX	Trans-Pecos
1 Nov	San Antonio Invaders	San Antonio, TX	Edwards Plateau
15 Nov	Highland Lake Invaders	Burnet, TX	Edwards Plateau
<b>2009</b>			
24 Jan	Cradle of Texas Invaders	Angleton, TX	Gulf Coast Prairies and Marshes
21 Feb	Llano Estacado Invaders	Midland, TX	Rolling Plains
28 Mar	Blackland Prairies Invaders	Dallas, TX	Blackland Prairies
4 Apr	Cypress Basin Invaders	Kellyville, TX	Pineywoods
18 Apr	Rio Grande Valley Invaders	Weslaco, TX	South Plains
30 May	City of Austin Invaders	Austin, TX	Edwards Plateau
6 Jun	San Antonio Invaders	San Antonio, TX	South Texas Plains
13 Aug	Moody High School Invaders	Corpus Christi, TX	Gulf Coast Prairies and Marshes
22 Aug	High Plains Invaders	Amarillo, TX	High Plains
19 Sep	Rolling Plains Invaders	Wichita Falls, TX	Rolling Plains
17 Oct	Comal County Invaders	New Braunfels, TX	Edwards Plateau
24 Oct	Pineywoods Invaders	Lufkin, TX	Pineywoods
12 Dec	Hornaday Invaders	Austin, TX	Edwards Plateau

### APPENDIX III: Publications and Presentations about the *Invaders of Texas* program.

<b><i>Invaders of Texas in the Media</i></b>
August, 2008 - The Grama Gazette, Newsletter of the Native Plant Society of Texas, Garland Chapter. Spring, 2008 - Eye on Nature - Texas Parks and Wildlife E-newsletter. September, 2008 - Wildlife Pro - <a href="http://www.wildlifemanagementpro.com/2008/09/23/invaders-of-texas-aims-to-aid-conservation/">http://www.wildlifemanagementpro.com/2008/09/23/invaders-of-texas-aims-to-aid-conservation/</a> . June, 2008 - TPWD News Release, Conservation License Plates Support Texas Wildlife, Parks, Fisheries. Spring, 2008 - Wildflower Magazine. 2008 - TPWD Dangers of Invasives Species brochure. December, 2008 - TPWD News Release, Texans Urged To Help Stop Invasive Plants. February, 2009 - My West Texas News – Aliens from other countries, space have landed in Midland County by Burr Williams. April, 2009 - Scripps Howard Foundation Wire – Growing volunteer interest in tracking invasive species surpasses funding by Heather Lockwood. April, 2009 - Happy News – Recent Rains Benefit Spring Wildflowers in Texas. Spring, 2009 - Wildflower Magazine. May, 2009 - KVUE – Invasive species threaten Central Texas natives. Nesom, G. 2009. <i>Phontinia serratifolia</i> (Rosaceae) Naturalized in Texas. <i>Phytologia</i> 90:375-377.
<b><i>Invaders of Texas Presentations</i></b>
May, 2006 - Lone Star Native Plant Conference, Nacogdoches, TX September, 2006 - Natural Areas Conference, Flagstaff, AZ September, 2006 - East Texas Forest Entomology Seminar, Nacogdoches, TX October, 2006 - Texas Master Naturalists Annual Meeting, Hunt, TX February, 2007 - Weed Science Society, San Antonio, TX March, 2007 – SE-EPPC Conference, Athens GA August, 2007 – TPWD Wildlife Diversity Advisory Committee, Austin, TX September, 2007 - Texas Rare Plant Conference, Austin, TX November, 2007 – Texas Invasive Plant Conference, Austin, TX November, 2007 – Texas Invasive Plant Conference, Austin, TX January, 2008 - Texas Wildlife Diversity Conference, Houston, TX February, 2008 - Native Plant Spring Symposium, Habitat Conservation, Citizen by Citizen, Austin, TX April, 2008 - National Cooperative Weed Management Area Conference, Reno, NV January, 2009 – Coastal Bend Audubon Society, Corpus Christi, TX January, 2009 – Texas Environmental Grant-writers Group, Houston, TX February, 2009 – Guadalupe chapter of Native Plant Society of Texas, Schertz, TX March, 2009 – Rio Grande Valley of Texas Master Naturalist, San Benito, TX April, 2009 – Highland Lakes Master Gardeners, Marble Falls, TX May, 2009 – Wild Basin Restoration Lecture Series, Austin, TX July, 2009 – Oklahoma Invasive Plant and Pest Council Annual Conference, Oklahoma City, OK September, 2009 – Texas Plant Conservation Conference, Austin, TX November, 2009 – Texas Invasive Plant and Pest Conference, San Antonio, TX