A Nationwide Application for Managing Invasive Exotic Species

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Presentation Outline

- Why iMapInvasives?
- Development Challenges
- Software technology
- iMapInvasives in Arizona
- Concluding remarks and questions
Ecological Economic and Health

"On a global basis...the two great destroyers of biodiversity are, first habitat destruction and, second, invasion by exotic species”
- E.O. Wilson

Yellow Starthistle / Purple Starthistle
Centaurea solstitialis / Centaurea calcitrapa

Quagga Mussel
Dreissena bugensis

Northern Crayfish
Orconectes virilis

Rock Snot
Didymosphenia geminata

Prickly Russian Thistle
Salsola tragus
Collaborative partnership

Developing a customizable web-based solution for all taxa

Invasive species data entry, aggregation, mapping, decision making, and agency action
Valuable Partnerships

- Florida Natural Areas Inventory
- The Nature Conservancy
- New York Natural Heritage Program
- NatureServe

Developer

FREAC
FLORIDA RESOURCES AND ENVIRONMENTAL ANALYSIS CENTER
Participating States
Technical Development Challenges

• Different database attributes among states
• Different hardware /software / web standards among states
• We want to develop once, use many times (customizable by states)
Management Challenges

• Different legal requirements among project participants
• iMapInvasives “ownership”
• Flexibility in code and resource sharing
• Use open source software if possible
• Utilize computer industry and GIS standards if possible
• Minimize use of plug-ins and vendor-specific extensions and APIs
Major iMapInvasives Software Technology

- Map server: ESRI’s ArcGIS Server
- Database: PostGIS, PostgresSQL
- Languages: Python, JavaScript
- Web development: Django
- Mapping API: OpenLayers
“open source sandwich” is a term used to describe an internet map where the map image is made with a commercial product and everything else is open source.
Defining the “Open Source Sandwich”
Products Used in Open-Source Sandwich

- Programming Languages: **Python**, JavaScript, HTML
- Web Development Framework: **Django**
- Secondary Development Framework: **MooTools**
- Mapping API: **OpenLayers**
- Map Services: **ESRI’s ArcGIS REST Server**, 3rd Party Maps (Google, Bing, etc.)
- Database: **PostgreSQL/PostGIS**
- Web Server: Apache
Top: Browser

- Programming Languages (client-side): HTML, Javascript
- Mapping API: Open Layers
- Secondary Framework: MooTools
Map Background Image: ESRI’s ArcGIS REST Server, 3rd Party maps (Google, Bing, etc.)

Map Data: ESRI’s ArcGIS REST Server

Map Vector Layer: PostgreSQL/PostGIS, Python
Bottom: Server

- Programming Languages: **Python**
- Database: **PostgreSQL/PostGIS**
- Web Development Framework: **Django**
- Web Server: **Apache**
What is OpenLayers?

JavaScript library for creating interactive maps in web browsers with no server-side dependencies

- Implements an open source JavaScript API similar to Google Maps API
- Implements industry standard WMS and WFS protocols
- Separates map tools from map data
OpenLayers

- Works with other maps (WMS, WFS, ArcGIS Server, MapServer, even Google Maps / Virtual Earth, etc.)
- Tons of built in controls
- **Complete control over everything**
PostgreSQL/PostGIS

Open source database used by many large websites.

- Provides the ability to query any piece of information at any time (even spatial queries)
- Results can be passed on to another part of the system for further processing.
MooTools

• This is an object-oriented Javascript framework designed to help easily develop clean, cross-browser, elegant code

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anoplophora glabipennis</td>
<td>Asian Long-horned Beetle</td>
</tr>
<tr>
<td>Anthriscus sylvestris</td>
<td>Wild Chervil</td>
</tr>
<tr>
<td>Aralia elata</td>
<td>Japanese Angelica Tree</td>
</tr>
<tr>
<td>Artemisia absinthium</td>
<td>Mugwort, Common Wormwood</td>
</tr>
<tr>
<td>Arthraxon hispidus</td>
<td>Small Carpgrass, Hairy Joint Grass, Arthraxon, Hairy jointgrass, Small 0</td>
</tr>
<tr>
<td>Avena sterilis</td>
<td>Animated Oat, Animated Oats</td>
</tr>
</tbody>
</table>

“Growls” when user makes changes

Useful for record sorting and pagination
• ArcGIS Server and REST Interface

• REST interface allows us to request bits of the map from a URL
  
  - Result from the URL
What is Django?

high-level Python web-based framework for rapid development of web applications

- Define data models in Python but can still use SQL as needed
- Automatic creation of administrative interfaces
Python & Django Work Together

Django is based on Python. Designed for rapid development of web applications. Uses DRY Principle – Don’t Repeat Yourself
Ensuring a Successful Multi-Participant Project

- Keep vision of common goal in mind
- Define project constraints and limits
- Identify funding stream
- Regular Communication
- Flexibility
- Patience
Common Uses - Searching the Map

Search by...

- Species
- Location
- Organization
- Observation ID#
- Assessment
- Treatment
- Survey
Common Uses - Searching the Map

- View other observations within one area.
- View details of an observation.
Common Uses - Data Entry

<table>
<thead>
<tr>
<th>WHO</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Observer Name</td>
<td></td>
</tr>
<tr>
<td>Phone Number</td>
<td>Email</td>
</tr>
<tr>
<td>Observers Organization</td>
<td></td>
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<tr>
<td>Project Name (if applicable):</td>
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</table>

<table>
<thead>
<tr>
<th>WHAT</th>
<th></th>
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<tbody>
<tr>
<td>Common Name OR Scientific Name:</td>
<td></td>
</tr>
<tr>
<td>Did you submit a voucher?</td>
<td>YES</td>
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| Voucher Repository Information: |  |

<table>
<thead>
<tr>
<th>WHERE</th>
<th></th>
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<tbody>
<tr>
<td>Observation Date (Month/Date/Year):</td>
<td></td>
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<tr>
<td>UTM X:</td>
<td>E</td>
</tr>
<tr>
<td>UTM Y:</td>
<td>N</td>
</tr>
<tr>
<td>UTM ZONE (please circle one):</td>
<td>17</td>
</tr>
<tr>
<td>OR</td>
<td></td>
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<tr>
<td>LONGITUDE:</td>
<td></td>
</tr>
<tr>
<td>LATITUDE:</td>
<td></td>
</tr>
<tr>
<td>COORDINATION COLLECTION METHOD:</td>
<td></td>
</tr>
<tr>
<td>1) GPS</td>
<td>2) WEB MAP SERVICE (e.g. Google map)</td>
</tr>
<tr>
<td>(e.g. directions, plant removal, associated species, site description, property ownership):</td>
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<table>
<thead>
<tr>
<th>NOTES</th>
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More Uses of iMapInvasives

Data for Action

• Assessment
• Survey
• Treatment data

Early Detection

• Generating reports from current data
• Alerts for new incoming data
  – Suspicious distance
**Data Entry - Advanced**

**Assessment:** Polygon showing localized distribution of a single invasive Distribution, Disturbance, Maturity, Density

**Treatment:** Steps taken to remove or control invasive Barrier, Bio-agent, Chemical, Fire, Grazing, Mechanical, Shooting, Trapping

**Survey:** Intentional and systematic search for a specific invasive species Survey Type, Goals, Presence/Absence, Export for GIS modeling

**Occurrence:** Group of geographically similar observations of a single species
Assessment Data: Beyond basic observation info

- Capturing the scope and intensity of an infestation for further follow-up
## Survey Information

<table>
<thead>
<tr>
<th>Lead Contact *</th>
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<tbody>
<tr>
<td>Targeted Species Detected *</td>
<td>Abutilon theophrasti, Acer ginnala, Acer platanoides, Acer pseudoplatanus, Adelges tsugae, Aegopodium podagraria, Agrilus planipennis, Allanthus altissima, Aria caryophylea, Akebia quinata</td>
</tr>
</tbody>
</table>
Strategic Data → Strategic Action

• Barrier
• Bioagent
• Chemical
• Fire
• Flame-weeding
• Grazing
• Mechanical
• Shooting
• Trapping
Generating Approaching Region and Early Detection Reports

Approaching Region
Reported next door but not in the area of interest.

Early Detection
Reported in the area 1 to 3 times.

Presence Established
Reported four or more times. Has probably established presence in the area.
Suspicious Distance alerts for state administrators

- A new report appears suspiciously far from other known occurrences
  - Could be a candidate for EDRR, or a misidentification

- The new report is forwarded to appropriate regional contact
Reports by __________ ...
Different user levels for controlled functionality

- Public Page
- Level 1: View Only
- Level 2: Enter Observation Data
- Level 3: Enter Assessment Data
- Level 4: Enter Survey Data
- Level 5: Project Manager
- Level 6: Enter Treatment Data
- Level 10: State Administrator
Future Plans

• Continue to use and improve existing data gathering methods.

• Possibly develop stand alone applications for Android and iPhone.

• Develop advanced data collection tool on ESRI platform

• Leverage social media sites as data collection tools
Data Sharing

Northern Arizona University

iMapInvasives
geotracking invasive exotic species

ARIZONA COOPERATIVE EXTENSION

GLOBAL INVASIVE SPECIES INFORMATION NETWORK

National Biological Information Infrastructure

onIndigenous aquatic species
• Core functionality for all users
• Customizable for state or province
• Over $300K in development
• Regular updates from user feedback
• Low start-up and subscription cost
• State or province lead agency/organization
Thank you!
Please contact Sabra Schwartz with any questions
sschwartz@azgfd.gov