



The National Institute *of* Invasive Species Science

G l o b a l  
O r g a n i s m  
D e t e c t i o n &  
M o n i t o r i n g

# **Integrating Invasive Species Data:** Solutions for Data Collection, Management, and Dissemination

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**Graduate Research Assistant**  
**University of Wisconsin-Madison**



## The Problem



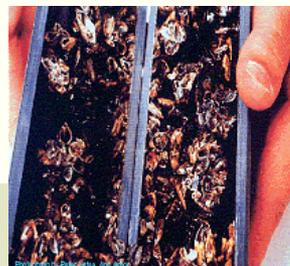
- **Invasive species**

- Impact biodiversity, ecosystem function, human health, and the economy
- \$120 billion spent annually in the US
- 46% of species on threatened and endangered list are listed because of invasive species



- **Issues of Data Synergy**

- Large data gaps (spatial and temporal)
- Crosier and Stohlgren 2004 (Weed Technology)
- Crall et al. 2006 (Frontiers in Ecology and the Environment)
  - 319 databases
  - 43% not online





## Why not share data?

- **Sensitive Data**
  - Threatened and endangered species
  - Private property
  - Biological control agents
  - Species of cultural significance
  - Data not yet published
- **Inability to Share**
  - Data on paper, not digital
  - No website to provide data online
  - No database management system in place



## Partners

- Major partners

- Colorado State University-NREL
- United States Geological Survey-USGS
- National Aeronautics and Space Administration-NASA



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### Species Info

Interested in a specific species? We are collecting data on key invasive species.  
Type a species:

Search By:	For:
Scientific Name:	<input type="text"/>
Common Name:	<input type="text"/>
NRCS Code:	<input type="text"/>

### In The News

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### In Your Area

What's in your area? Find out!

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<http://www.niiss.org>



## Implementation of sensitive data security

- Different levels of access to website pages and functionality based on user's login
  - User Levels: Guest, User, Tester, Instigator, Expert
- Data sharing agreement required
- Uploaded data assigned to project
  - Project Roles: Contributor, Reviewer, Authority, Manager
  - Can assign data sensitivity during upload
  - Given four "data fuzzing" choices: 7.5 min, 30 min,  $\frac{1}{2}^{\circ}$ ,  $1^{\circ}$
  - Exact locations can be used in general analyses

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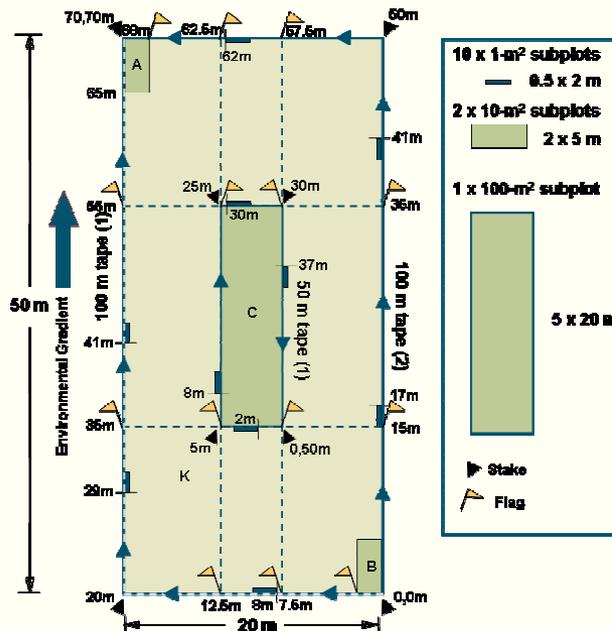
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Jarnevich, C. et al. 2007. Balancing data sharing requirements for analyses with data sensitivity. *Biological Invasions* 9:597-599.



# Gather Data

- **Field Methods**
  - Description
  - Equipment needed
  - How to setup
  - References
- **Field Tools**
  - Project Envelope
    - use with ArcGIS
    - survey full environmental range of species
  - EcoNab
    - field data collection program that runs on a PDA with Palm OS
  - GODMSurveyor



# Field Tools

The Past



+ Manual entry

The Future



+ Automatic upload



## Browse Data

- By Organization
  - university, non-profit, etc.
- By Location
  - politically defined locales such as states, counties, national parks, wildlife refuges
- By Species
  - scientific name, common name, NRCS code
- By Project
  - data contributed by project members and managed by project managers
- By Map

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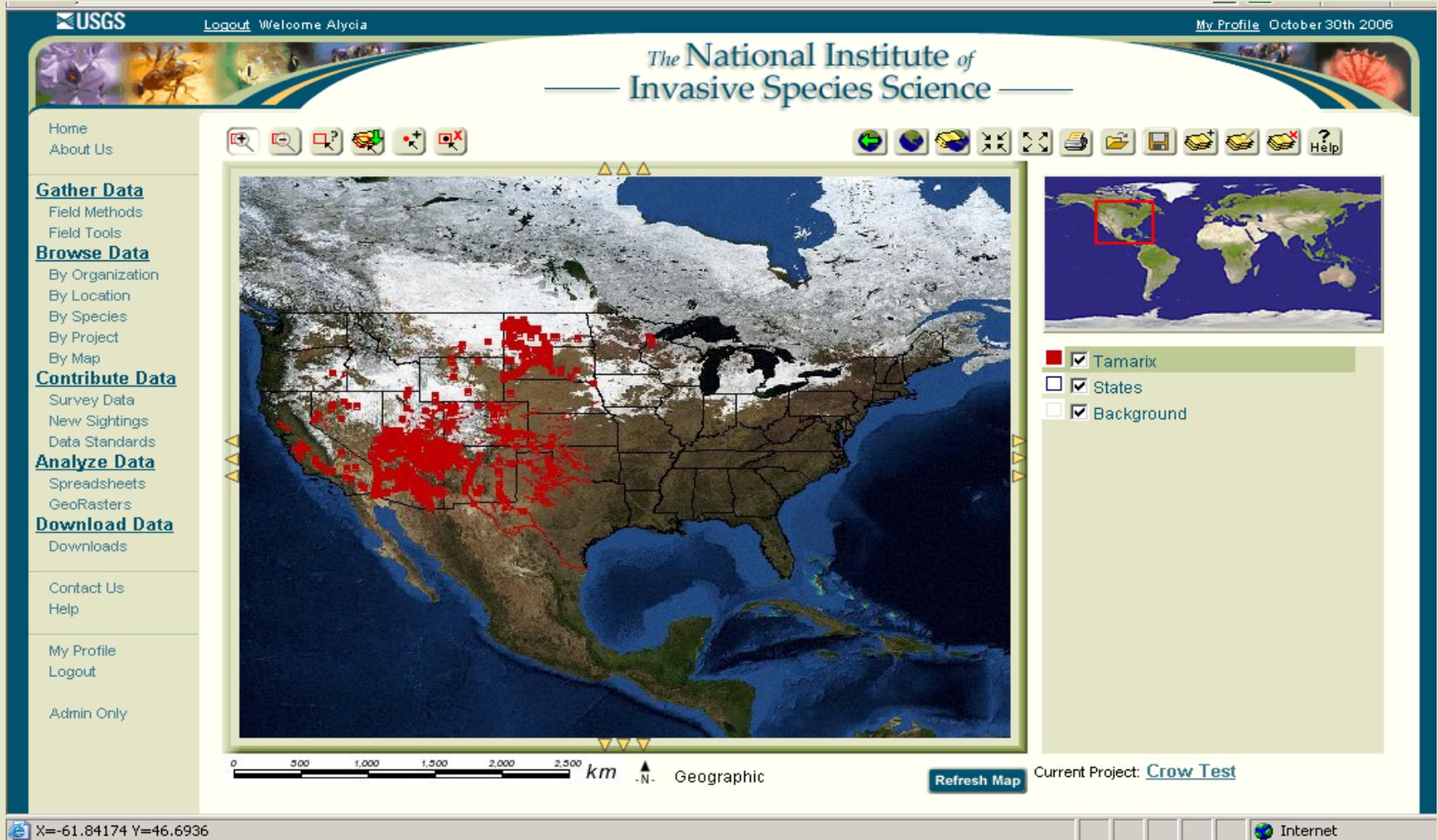
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# Example Map: *Tamarix sp.* locations





# Example Map – Points, lines, polygons

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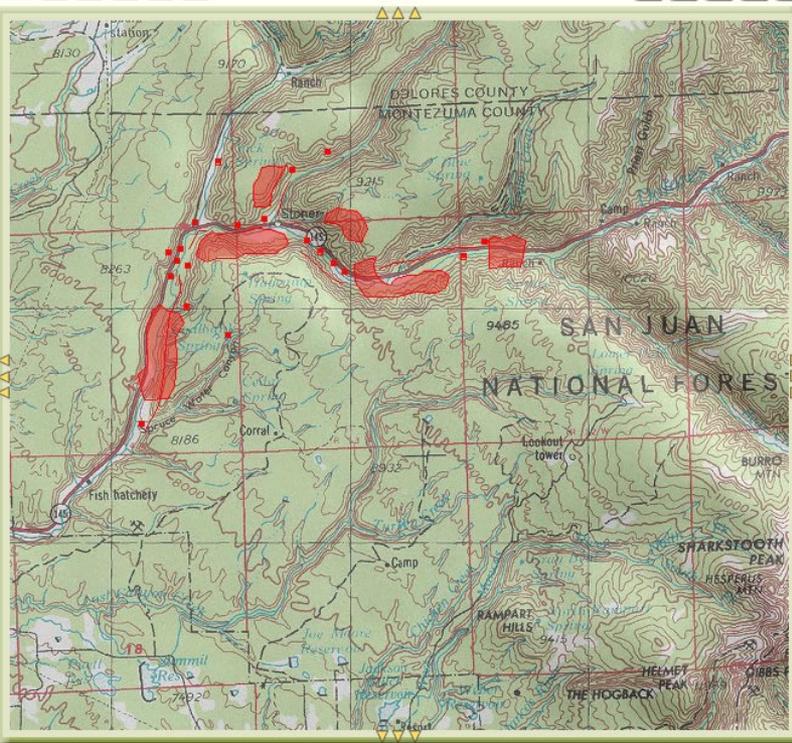
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- Delores Polygons
- Delores Lines
- Delores Points
- States
- Background

0 2,000 4,000 6,000 8,000 10,000 12,000 meters

Projection: UTM, Zone 12N

Refresh Map

Current Project: [JimMapProject](#)



## Contribute Data

### • Survey Data

- tab-delimited text file or shapefiles
- single species or many species
- many locations or single political boundary
- captures organism location, date, attributes, auxiliary data, treatment data

### • New Sightings

- enter single point sighting

### • Data Standards

- set of standards users can follow to upload disparate data in a standard format

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# Contribute Data: Survey Data

**Next Step:** Select a data structure below by clicking on a table.

**Dominance:**

Dominant	Secondary	Tertiary
Tamarix	Bromus tectorum	Euphorbia esula
Tamarix	Euphorbia esula	Bromus tectorum
Bromus tectorum	Euphorbia esula	Tamarix
Euphorbia esula	Bromus tectorum	Tamarix

Species are entered in columns based on which are the most common. Example: A survey of the most abundant weeds along a road.

**Specified Species:**

Tamarix Cover (%)	Bromus Cover (%)	Picea Cover (%)
12	5	15
25	4	9
7	7	12
34	2	13

Each column has information on a different species but of the same attribute. Example: Percent cover of various tree species.

**Organisms by Row:**

Organism	Cover (%)	Height (m)
Tamarix ramossissima	80	1
Eleagnus angustifolia	60	3
Bromus tectorum	50	4
Euphorbia esula	12	2

**Single Species:**

X	Y	% Cover
-104.5	40.56	15
-104.36	40.38	9
-105.94	41.6	12
-103.58	39.98	13

**Describe the columns in your file**



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Column Has:

Organism

Contains:

Organism Name

Format:

Scientific Name

Dominance:

Primary (1st)

Column Has:

Organism

Contains:

Organism Name

Format:

Scientific Name

Dominance:

Secondary(2nd)

Column Has:

Treatment

Contains:

Control Agent

Value Format:

Custom Code

Column Has:

Treatment

Contains:

Number

Target species column:

DOMINANT

Control agents are:

In another column

Column:

BIOCONTROL

Units are:

In next pull down menu

Units:

Count per hectare

Column Has:

Attribute

Contains:

Number

Species column:

DOMINANT

Attribute types are:

In next pull down menu

Type is

Infested Area

Units are:

In next pull down menu

Units:

Meters Squared

DOMINANT	SECONDARY	BIOCONTROL	NUMBER	INFESTEDAR
tamarix	Eleagnus angustifolia	Diorhabda elongata	100	100
Euphorbia esula	Descuraina sophia	Apthona lacertosa	500	1000
Euphorbia esula	Agropyron smithii	Apthona nigriscutis	500	500

# Contribute Data: New Sightings

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[Add a new sighting](#) [Help](#)

**Ensure proper project**  
Your current working project is [NIISS - General User](#) [Change?](#)

**Please select a species**  
The species for this sighting: [Browse for a species](#)

**Presence/Absence:**  Present  Absent

**Describe location information**

**Projection Type:**  Latitude / Longitude  UTM

X (Longitude or UTM Easting):

**Y (Latitude or UTM Northing):**

**UTM Zone:**

**Datum: \***

**Area Name (optional):**

**Enter the date of the observation**

**Date:**

# Contribute Data: Add Point Via Map

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Map toolbar: Search, Zoom In, **Add Point**, Zoom Out, Full Screen, Print, Save, Refresh, Help

Map layers legend:  
 Delores Polygons  
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 Delores Points  
 States  
 Background

Scale: 0 2,000 4,000 6,000 8,000 10,000 12,000 meters  
Projection: UTM, Zone 12N  
Refresh Map Current Project: [JimMapProject](#)

# Multiple Ways to Contribute Data

1) GISIN exchange protocol

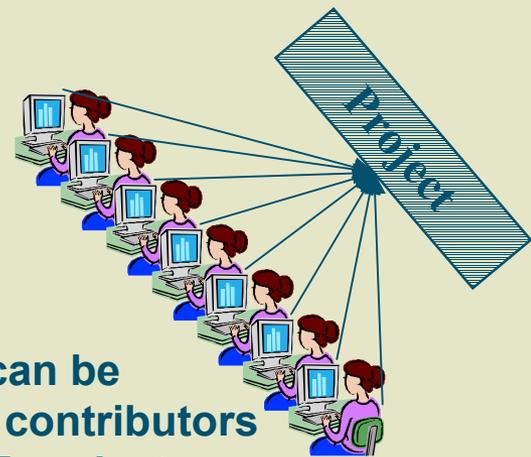
2) Your database export to spreadsheet, survey addition

3) Survey addition from shapefiles or spreadsheets

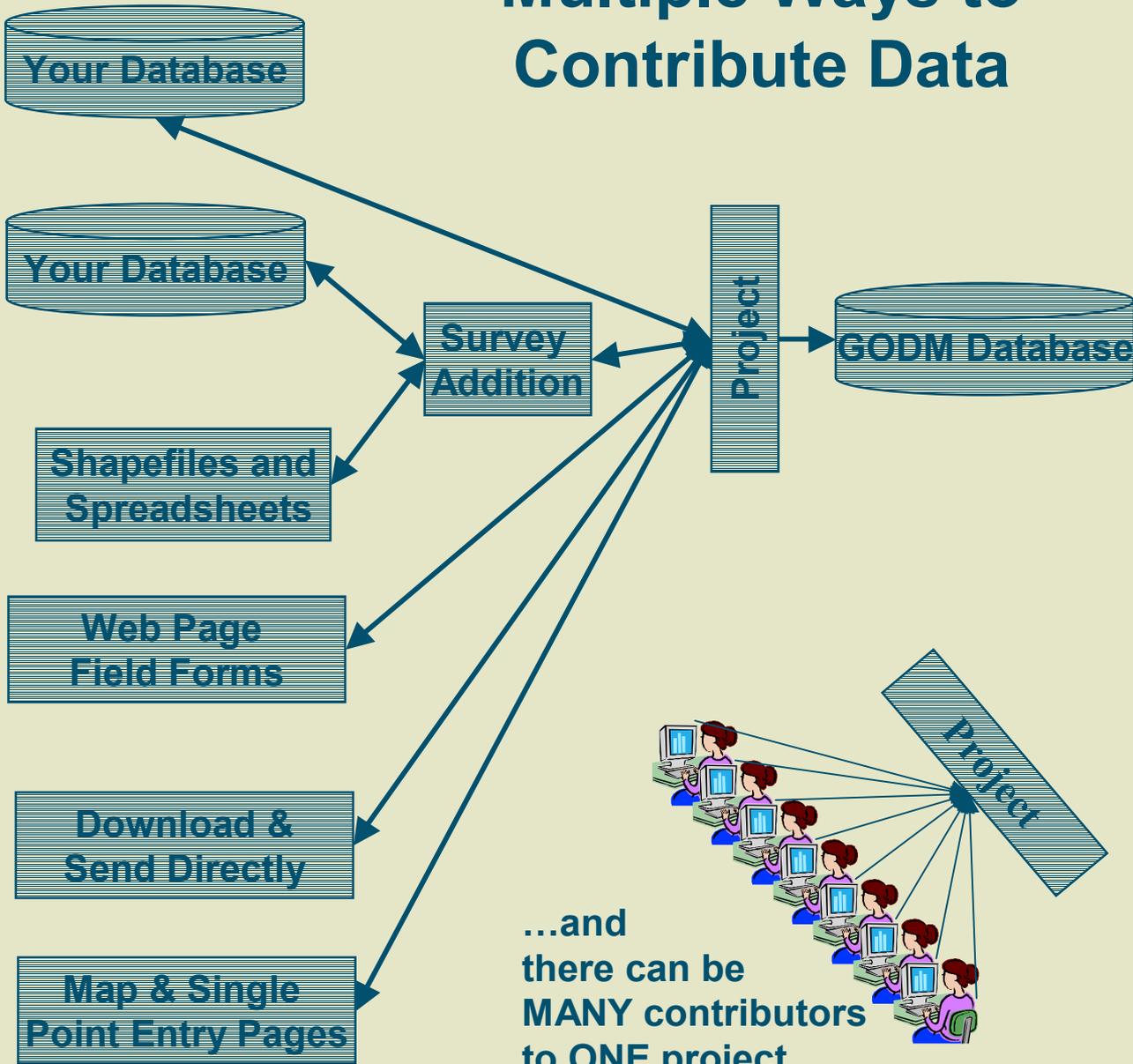
4) Field form data entry on the web

5) Direct from GPS or PDA

6) Enter single coordinates or click on map



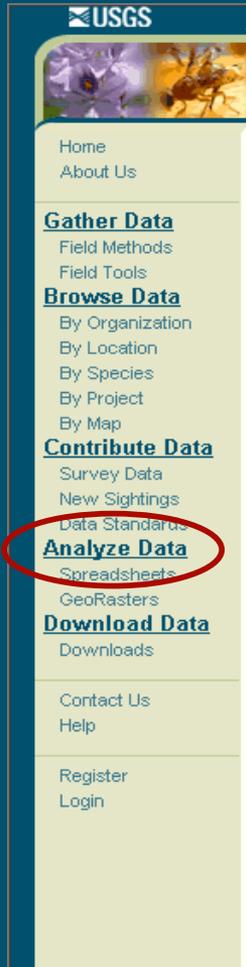
...and there can be MANY contributors to ONE project





## Analyze Data

- Spreadsheets
  - manage and create spreadsheets of data from the database
  - columns include project name, visit date, scientific name, common name, present, percent cover, height, location data, raster layers
  - can filter by species, area, start and end date, project
- Georasters
  - Upload georasters
  - Download georasters
- Statistics
  - Descriptive statistics (mean, min, max, etc.)
  - Simple and multiple linear regression
  - Regression tree
  - Simple and multiple logistic regression



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Many of the features on this page are under construction!

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Alewife Test Data Set - MOnsoon	<input type="button" value="New"/>
test12	<input type="button" value="Delete"/>
western test proj 3 data	<input type="button" value="View Data"/>
empty spreadsheet?	<input type="button" value="Update Data"/>
GSENM tamarisk- test data- do not delete	<input type="button" value="Download Data"/>
Testing for defect	<input type="button" value="Analyze Data"/>
Testing for defect 2	
California Tamarisk Quads	
Colorado Dalmation Toadflax	
Tamarisk from Needles Quad	

# Analyze Data: Multiple Logistic Regression

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## Analysis Settings

Select analysis settings

**Analysis Type:** Multiple Logistic Regression

**Response Variable:** Present

**# of Predictors:** 6

**Predictor # 1:** Average annual precipitation,

**Predictor # 2:** Average annual temperature,

**Predictor # 3:** Elevation,

**Predictor # 4:** Distance to Water,

**Predictor # 5:** MODIS EVI three year mean,

**Predictor # 6:** MODIS EVI three year range,

[Continue](#)

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# Analyze Data: Multiple Logistic Regression



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### Analysis Results

#### Results of Multiple Logistic Regression:

**Response Variable:** Present

Variable	Coefficient	P-Value
Model Intercept:	17.28823	0
Average annual precipitation,	0.07562426	0
Average annual temperature,	-0.1597557	0.0901
MODIS three year composite of EVI , Range	-0.001052232	0
MODIS three year composite of EVI , Mean	0.001473194	0
Elevation,	-0.01004329	0
Distance to Water,	0.0001222648	0

**Null Deviance:** 2787.353

**Residual Deviance:** 1012.422

**Deviance explained:** 0.637

**AIC (Akaike's Information Criterion):** 1026.422

**AICc (AIC corrected for small sample size):** 1026.473

[Graphs of residuals versus fitted](#)

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Surface	Legend
	

When you click "Save", your raster will be saved to your 'GeoRaster' folder where you can then add it to our map application to view it along with your original data used to create the predictive surface.

# Analyze Data: Map Display

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0 50 100 150 200 250 300 350 400 450 500 km

Geographic

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- CO LIDA pres
- CO LIDA abs
- dalmation toadflax
- States
- Background

0 50 100 150 200 250 300 350 400 450 500 km

[Refresh Map](#)

# Download Data

- allows you to download organism locations as a textfile, csv file, or shapefile



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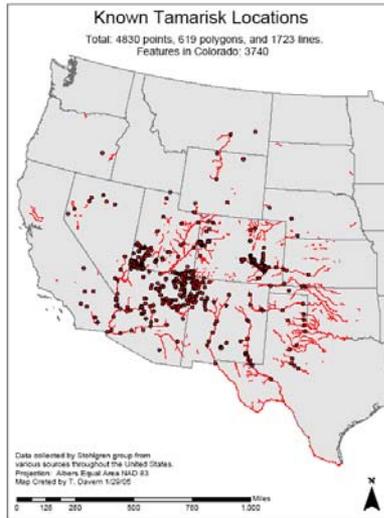
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West (East-West Coordinate: Float)	North (North-South Coordinate: Float)	East (Unknown: Float)	South (Unknown: Float)	Height (Attribute: Float)	Average annual precipitation, Gray (GIS Layer: Float)	Average annual temperature, Gray (GIS Layer: Float)	Minimum average annual temperature, Gray (GIS Layer: Float)	MODIS three year average EVI, Range (GIS Layer: Float)	MODIS three year average EVI, Mean (GIS Layer: Float)	MODIS three year average EVI, Date of Peak (GIS Layer: Float)
-99.969	38.858	-99.969	38.858	1.692	56.266	11.888	4.2353	2090.8	610.69	172.73
-100.07	38.814	-100.07	38.814	2.1	56.238	11.905	4.2223	1917.7	805.95	184.39
-99.938	38.714	-99.938	38.714	1.597	56.405	11.986	4.3495	2162.1	1037.4	194.96
-99.915	38.811	-99.915	38.811	1.4	56.311	11.974	4.3188	2070.4	825.44	181.42
-99.849	38.942	-99.849	38.942	1.597	58.561	11.692	4.1783	2398.4	1027.6	191.25
-100.05	38.921	-100.05	38.921	0.4	59.294	11.597	4.0366	2044.1	974.59	188.92
-99.833	38.857	-99.833	38.857	2.1	57.733	11.844	4.2797	2140.7	670.49	176.06

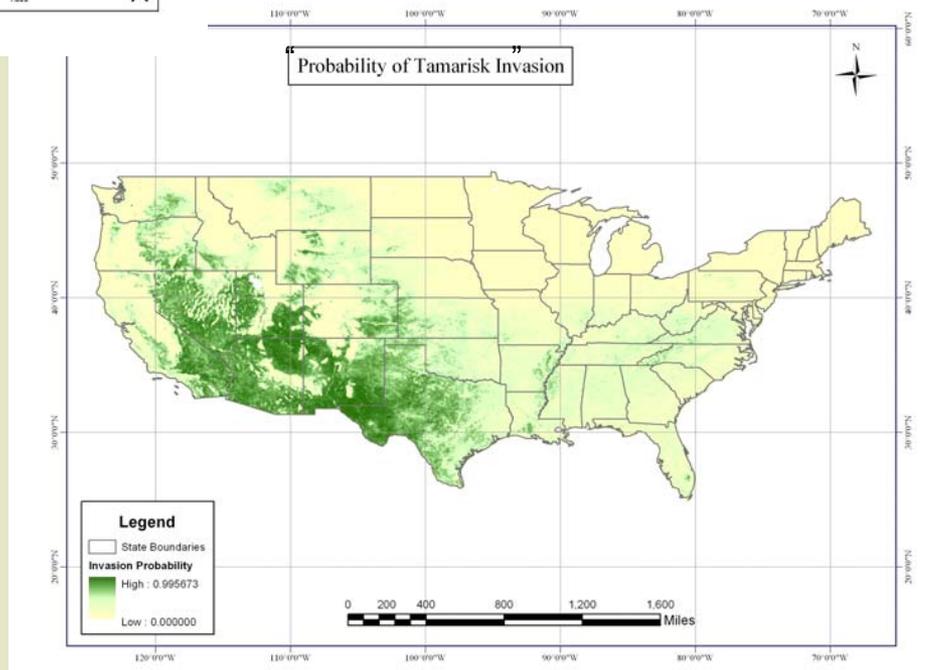
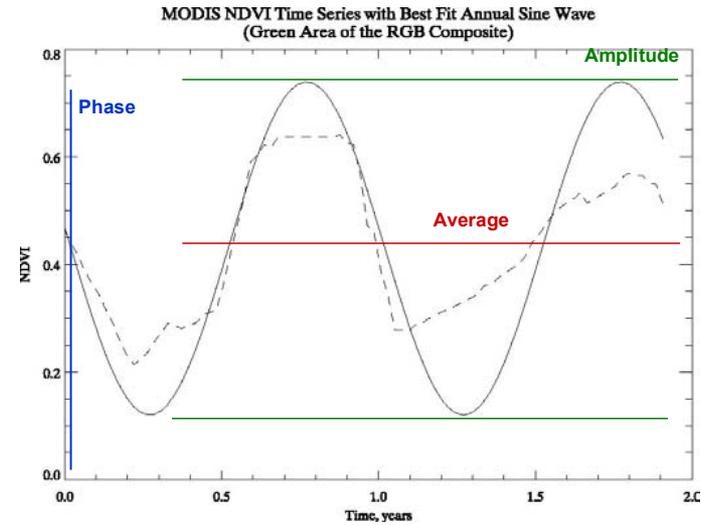
Input Field Data

Automatically add satellite data

# Field Observations



# Satellite Data



# Predictive Models

Morisette, J.T., C.S. Jarnevich, J.A. Pedelty, A. Ullah, W. Cai, T. Stohlgren, J. Gentle, J.L. Schnase. 2006. A tamarisk habitat niche map for the continental USA. *Frontiers in Ecology and the Environment* 11:14-17



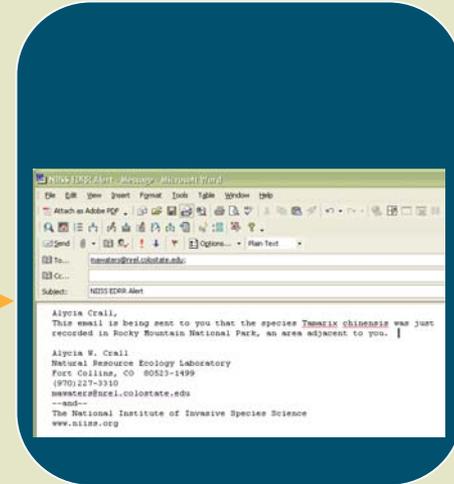
## NSF Project 2006-2009

- Geared towards citizen scientist organizations in need of a data management system
- New Features
  - Online tutorials
  - Monitoring protocols
  - QA/QC protocols
  - Customizable data entry forms
  - Cheap, easy to use digital field tools



# Additional New Feature

- Early Warning System
  - automatically sends emails out to users to warn them of a new non-native location on adjacent lands





## Our Role in the Midwest

- Free Web-Based Data Management System
  - Caveats
    - Short term grants primarily focused on new features
    - Limited customer support staff
- Joint Grant Opportunities
  - More cost effective to pool existing resources rather than reinventing wheel across US
  - Provide support staff and hardware for larger user base

# Acknowledgements:



Tom Stohlgren, Catherine Jarnevich, Tracy Davern, Geneva Chong (USGS), Jim Graham, Greg Newman, Paul Evangelista, Dave Barnett, Rick Shory, Suni Kumar, Sara Simonson, Nate Ament, and Mohammed Kalkhan (CSU), with help from . . . John Kartesz (BONAP), Bruce Peterjohn, Pam Fuller (USGS), Curt Flather (USFS), John Schnase, Jeff Morisette, Ed Sheffner, Woody Turner (NASA) and many others!



For more information contact:

