Fingerprinting Native and Non-Native Biodiversity in the U.S.: Phase I

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Challenges with Fingerprinting Biodiversity

- **Quantifying patterns of biodiversity has been hampered by poor taxonomic knowledge of small and uncommon organisms, woefully incomplete surveys over large areas (in the US and elsewhere), inadequate coupled models of field data and high-resolution remote sensing data, and little systematic monitoring to detect the status and trends of all but the most common or charismatic species.**

Challenges with Fingerprinting Biodiversity

- **Fingerprinting biodiversity in the US is facilitated by more complete taxonomic information for many taxa and long-term systematic monitoring of some taxa (e.g., birds, fishes, native and non-native vascular plants, mammals, amphibians) that jointly may provide some insights on the patterns of other biological groups. Adequate data are at least available to test this basic assumption.**

Background Justification for the Project

- **Because there currently exists no coherent scientific or technological framework for biodiversity assessments (especially at continental scales), we embarked on a multidisciplinary research study to advance the science and technology of mapping and modeling patterns of biodiversity (i.e., biological fingerprinting).**

- **We also sought to document the patterns of the invasion of harmful non-native plants, fishes, and birds in the U.S.**

Researc Objectives: Based on Interdisciplinary Research Incorporating

- Data from several remote sensing satellites;
- Synthesis of biodiversity field data sets from Department of Interior (USGS, BLM, NPS, BOR), Department of Agriculture (USFS, APHIS, ARS), non-government organizations (The Nature Conservancy, NatureServe), and universities;
- New Multi-scale Geospatial Modeling-Mapping Algorithms (Web Intrenet Tools); and
- High-Performance Computing Capabilities (HPCC-NASA-USGS) to document, map, and forecast the distributions and abundances of selected native and non-native plants and animals in the United States.

Researc Objectives: Based on Interdisciplinary Research Incorporating

- **Our state of the art research approach is proving successful at local and landscape scales.**
- **We focused on Tamarix spp. (tamarisk, salt cedar) and Bromus tectorum (cheatgrass) as test species for high-resolution mapping and modeling of harmful invasive species; however, our study has expanded well beyond these two species examining other invasive plant species, wildlife and pathogens.**
- **In addition, we tested a new field pixel nested plot (PNP- Kalkhan et. al., 2007a,b) sampling design with link to geospatial information data for using geostatistical modeling and thematic mapping applications into forecasting biodiversity, environmental, and ecological parameters.**

Geospatial Modeling- Thematic Mapping
Web Internet Tools
Through Multiple- Collaborative Teams:

NREL-CSU, USGS-FORT, & NASA-GFSC

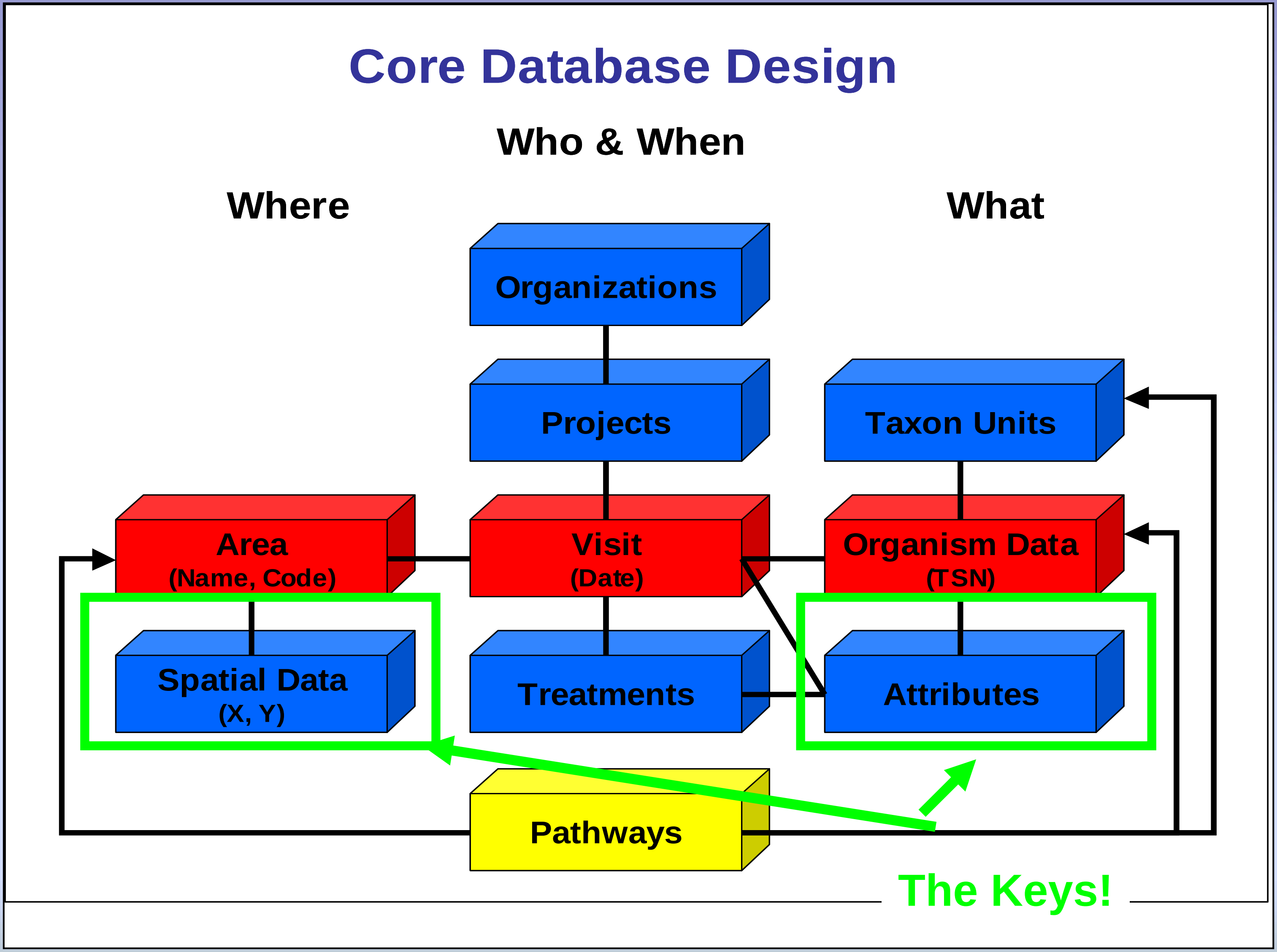
A Global Organism Detection and Monitoring (GODM) System

for Plants, Animals, and Pathogens

Cultural Change

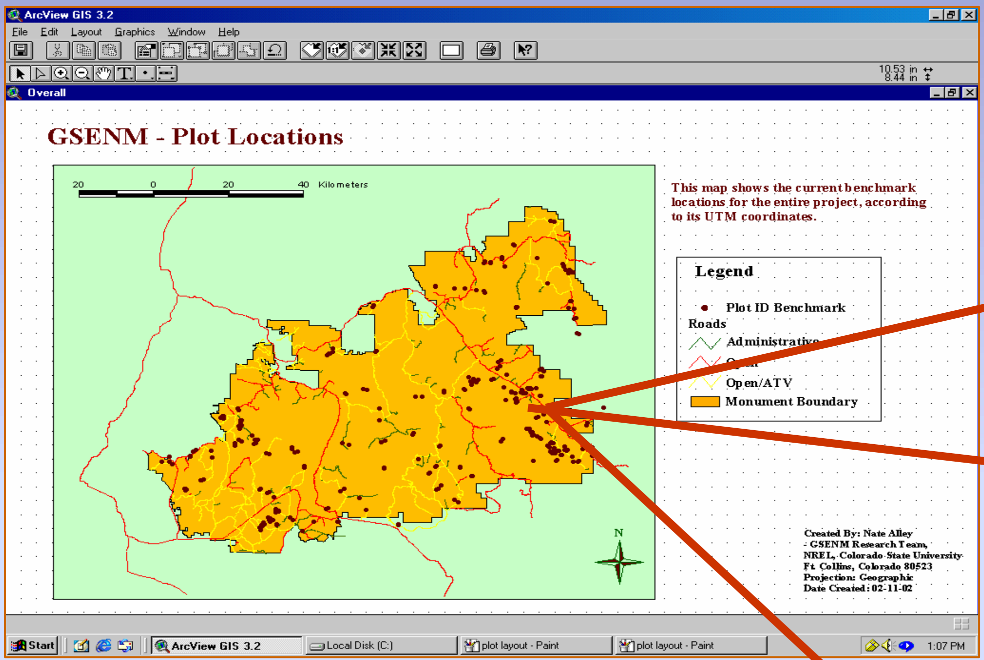
IT Infrastructure

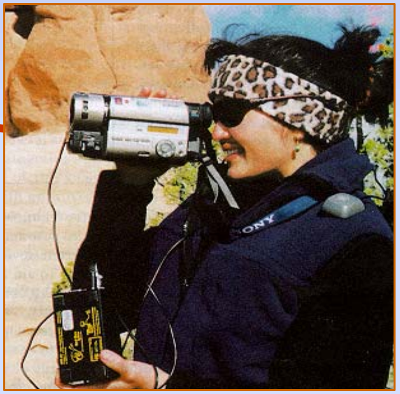
Expertise



Graham, J., G. Newman, C. Jarnevich, R. Shory, T. Stohlgren. 2007. A Global Organism Detection and Monitoring system for Non-native species. Ecological Informatics 2:177-183.

Various Data Types & GIS: Helping Resource Management Activities





PlotName	Date	UTM-E	UTM-N	Elev (m)	Veg Community	tot no. sp	no. native	no. exotic	tot veg cov	BRTE cov	Sand	Silt	Clay
205	5/22/01	422424	4159674	2215	Ponde Pine	49	42	1	14.4	0.05	64.25122	12.82617	22.92261
207	5/23/01	423256	4161403	2258	Piny-Junp	22	19		42.4		60.03738	10.24955	29.71307
206	5/23/01	423484	4160289	2215	Pinyon Pine	25	19		33.85		41.51793	18.89199	39.59007
208	5/28/01	415217	4122711	2168	Sagebrush	27	19	6	14.45	0.3	85.8724	4.084044	10.04356
209	5/28/01	415286	4123073	1447	Peren. Riparian	9	5	4	38.8		84.19852	8.482759	7.318718
210	5/29/01	427169	4146438	1447	Piny-Junp	37	33	2	16.3		23.99201	41.83134	34.17665
212	5/30/01	404538	4114473	1932	Juniper	34	32	1	7.2	0.1	58.27137	17.90272	23.82591
211	5/29/01	426994	4146803	1932	Sagebrush	37	32	3	18.3		42.65982	21.33309	36.00709


USGS
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The National Institute of Invasive Species Science
Analysis Settings
Home
About Us
Gather Data
Field Methods
Field Tools
Browse Data
By Organization
By Location
By Species
By Project
By Map
Contribute Data
Survey Data
New Sightings
Data Standards
Analyze Data
Spreadsheets
GeoRasters
Download Data
Downloads
Contact Us
Help
My Profile
Logout
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
Back to spreadsheets

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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

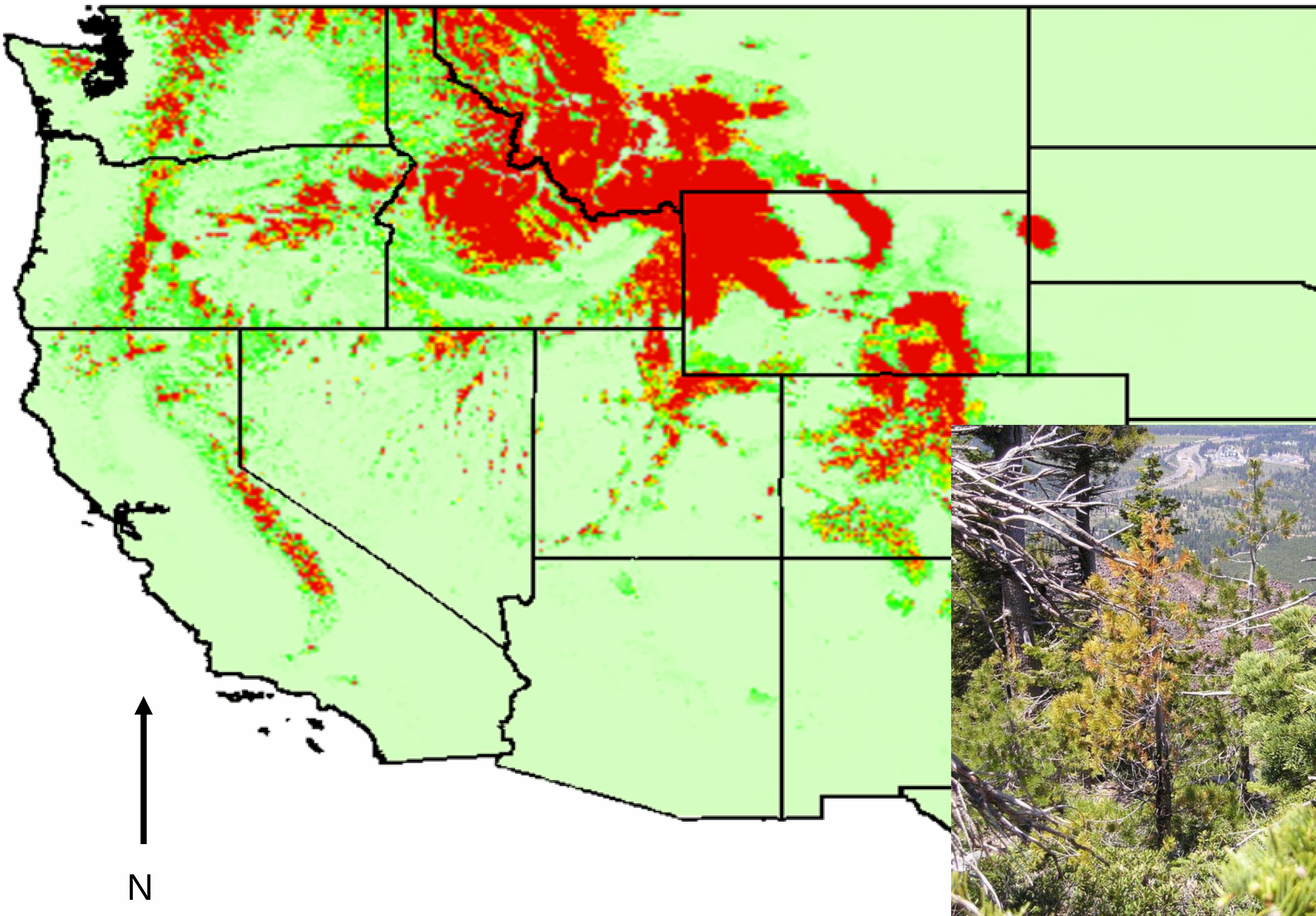
Null Deviance: 2787.353
Residual Deviance: 1012.422
Deviance explained: 0.637
AIC (Akaike's Information Criterion): 1026.422
AICc (AIC corrected for small sample size): 1026.473

Graphs of residuals verus fitted

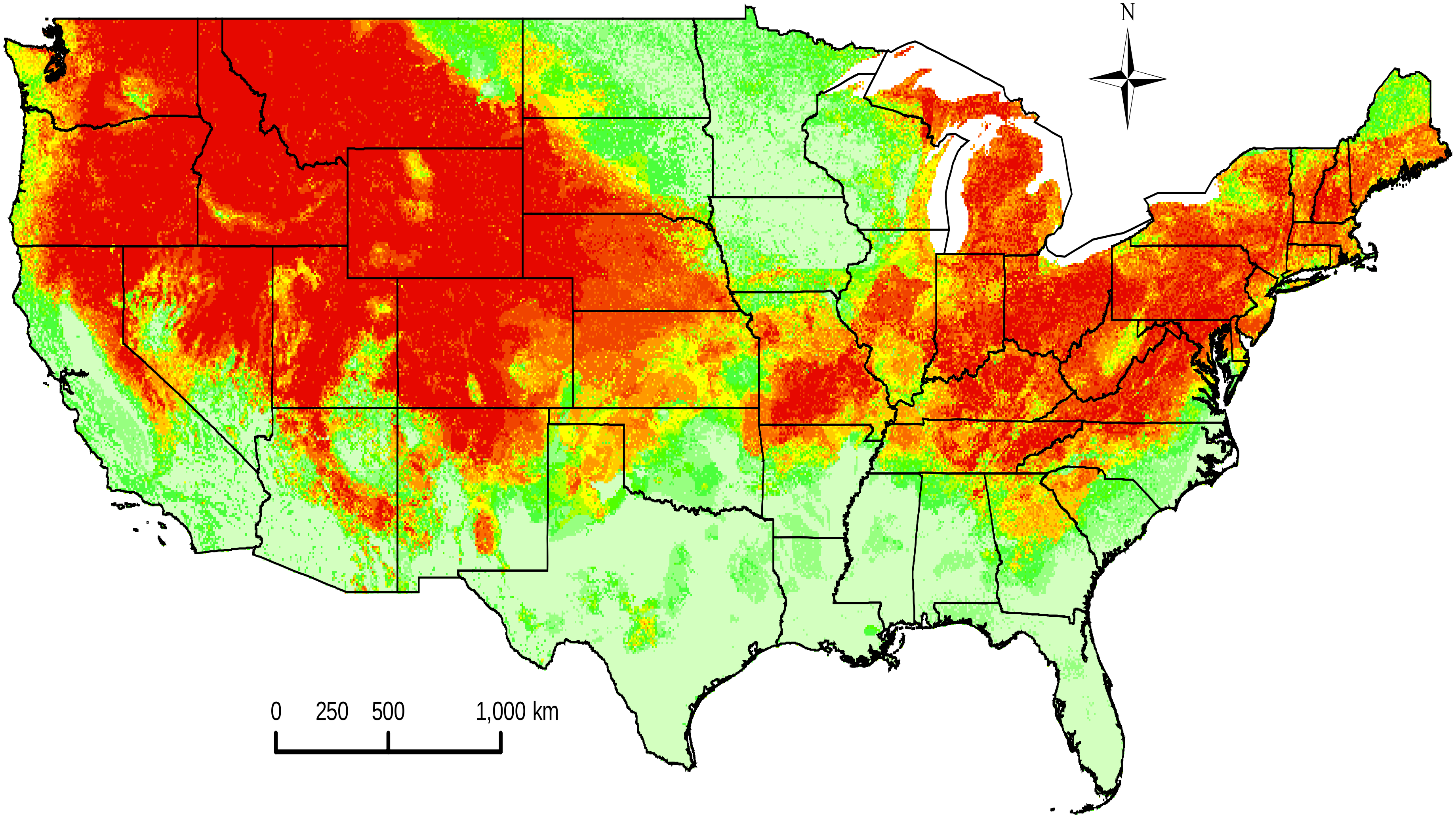
Predicted Surface

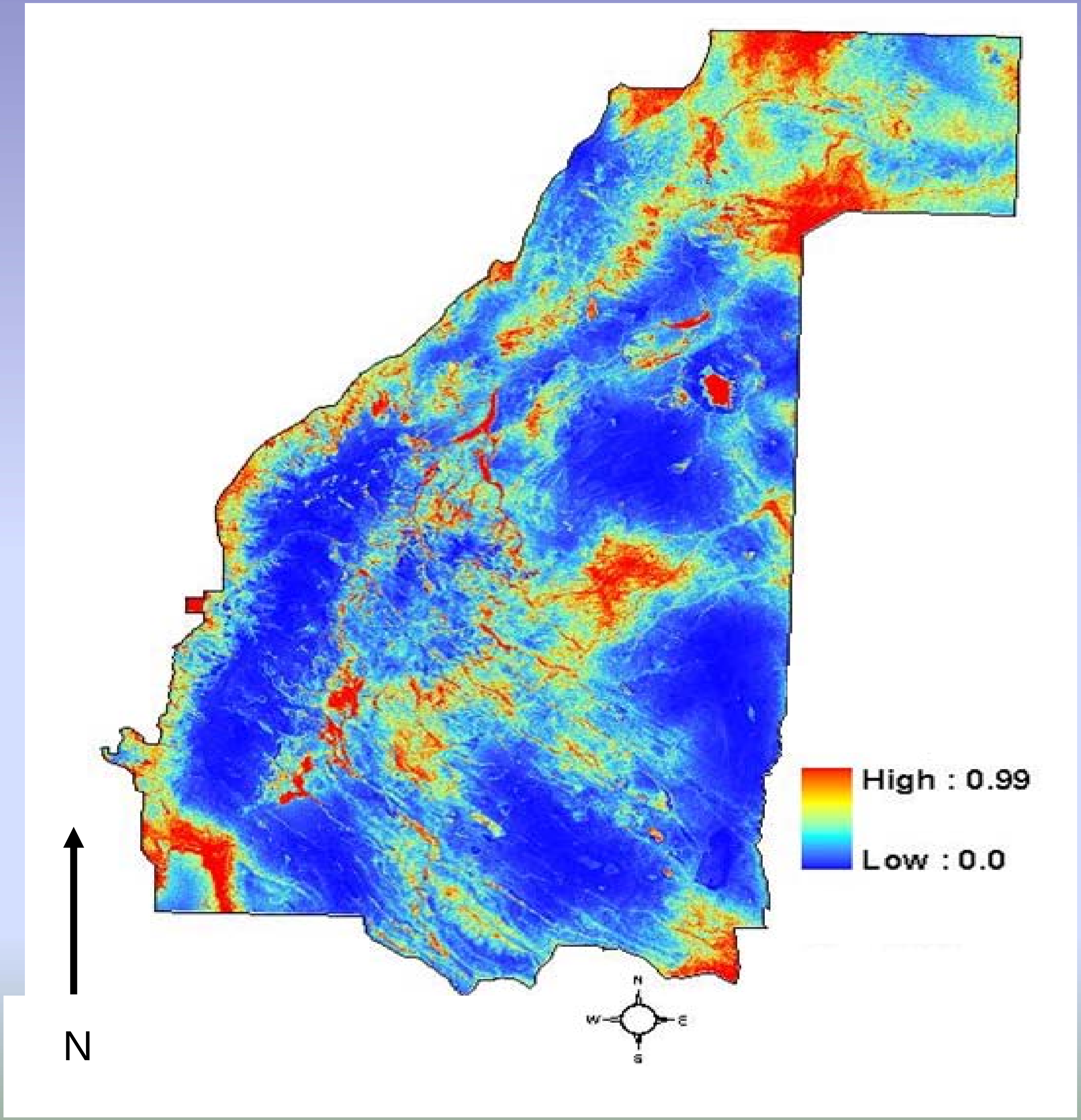
Back to spreadsheets

The Maxent Model was Tested on the Predicting White Pine Blister Rust Across Western USA Forests, Kumar *et al.* In Progress)



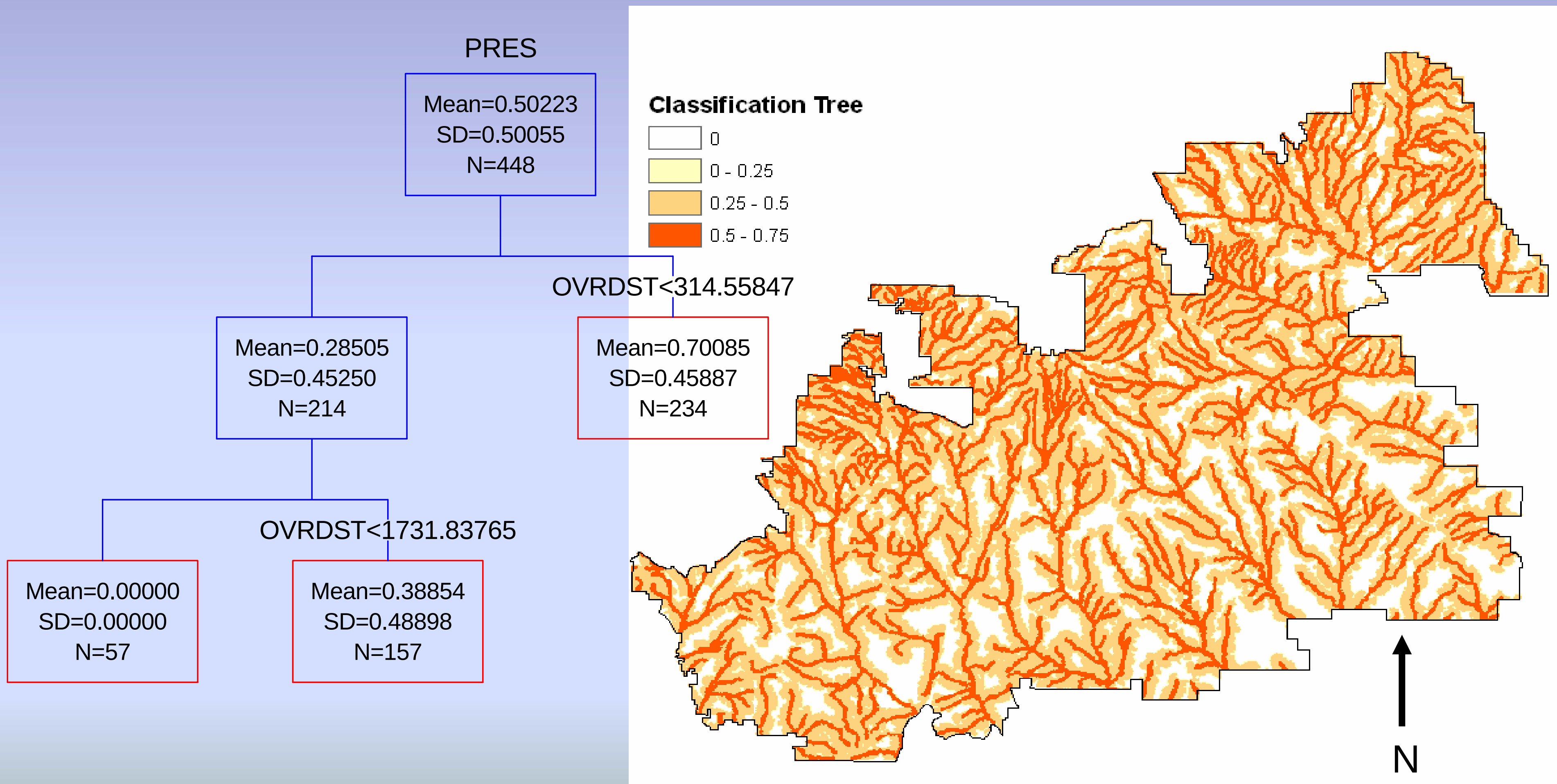
Diddymo, an invasive diatom infesting streams throughout the U.S., was modeled using GARP Model (Kumar *et al.* In Review).



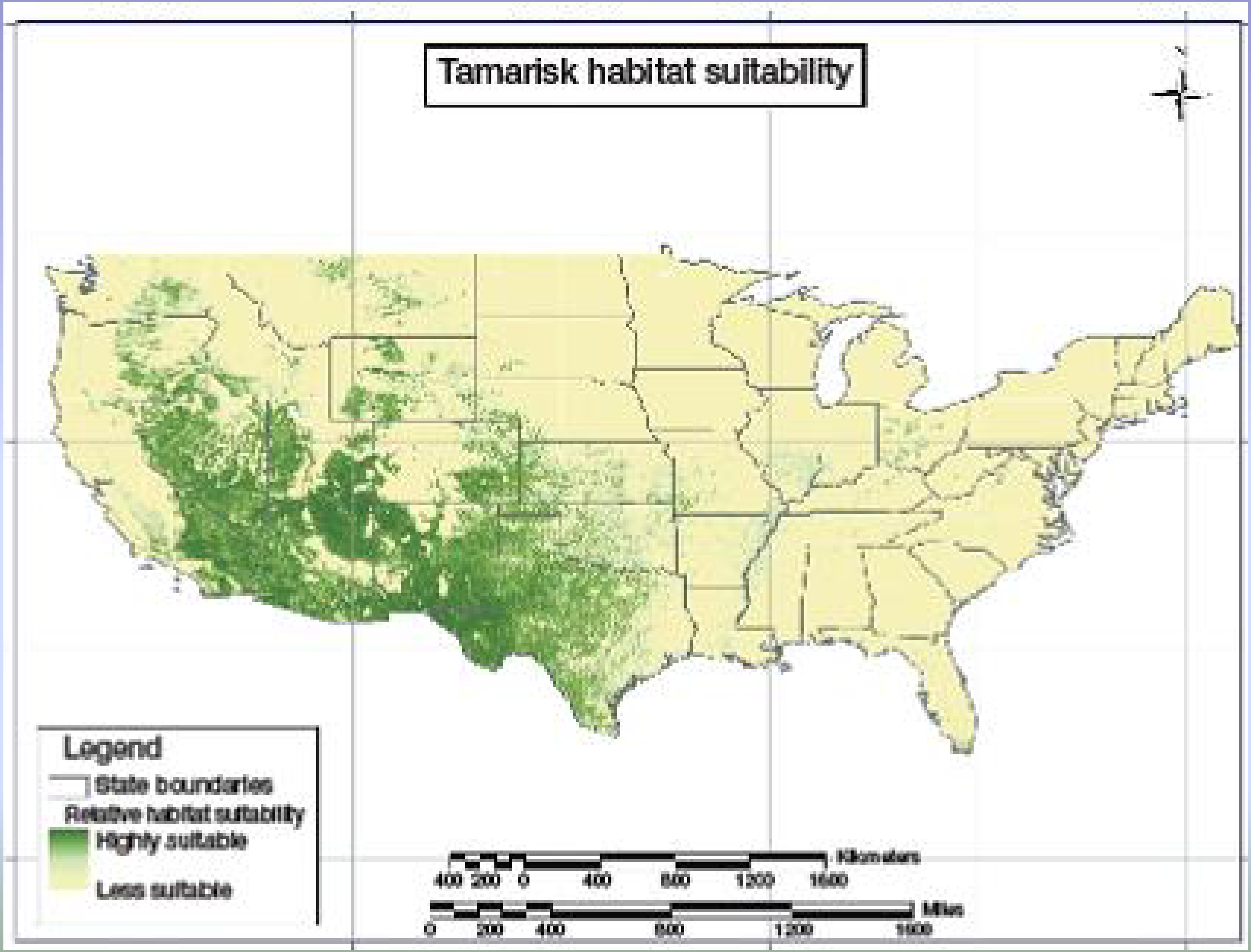


At Hart Mountain Wildlife Refuge Oregon, we tested logistic regression analyses to model areas at risk for white top infestation (Barnett *et al*. Work in Progress).

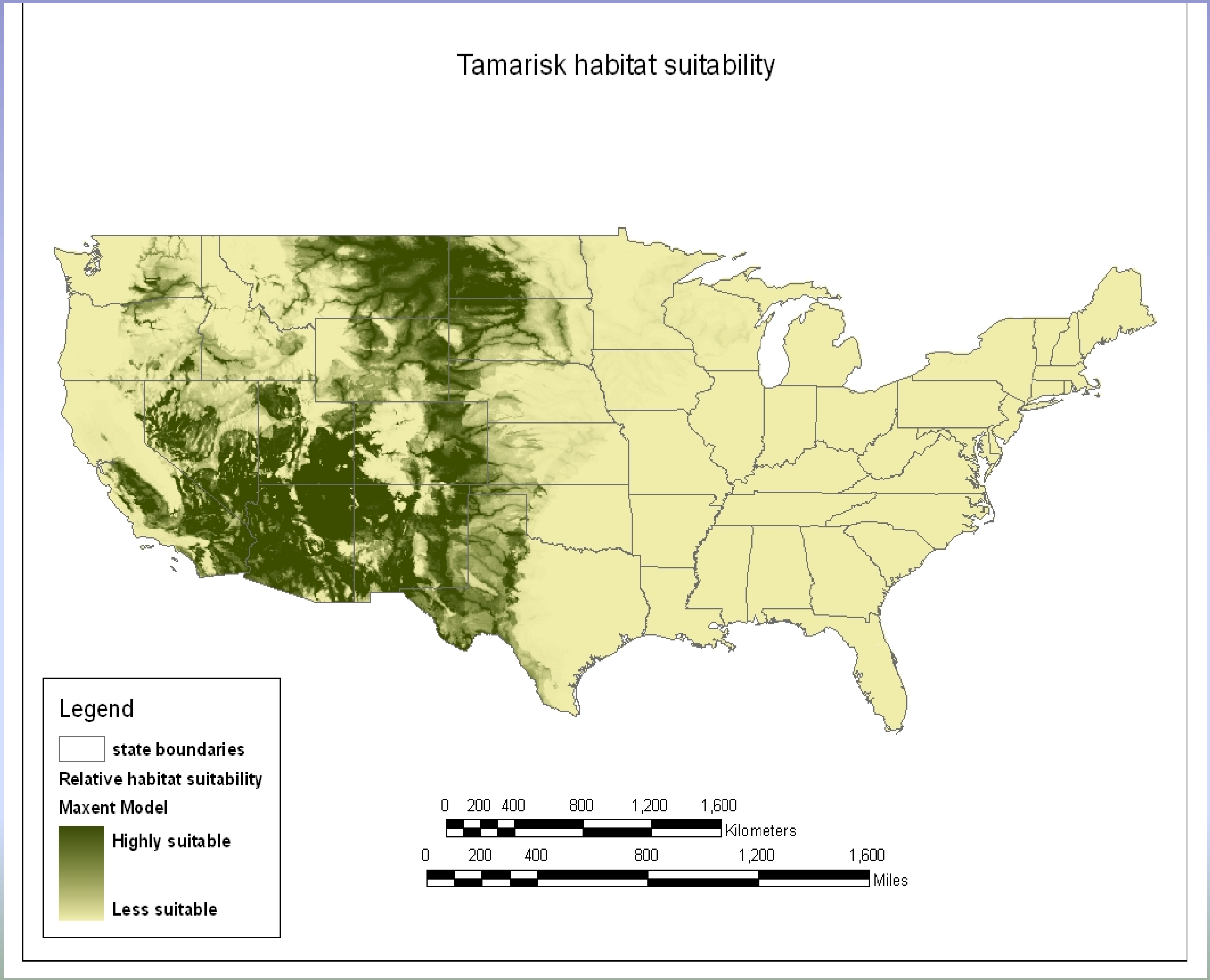
CART models statistically partition the dependent data into two homogenous groups, repeating the procedure for each group in a continuing process that forms a hierarchal tree based on the predictive strength of each environmental variable (Evangelista *et al.* In Press).



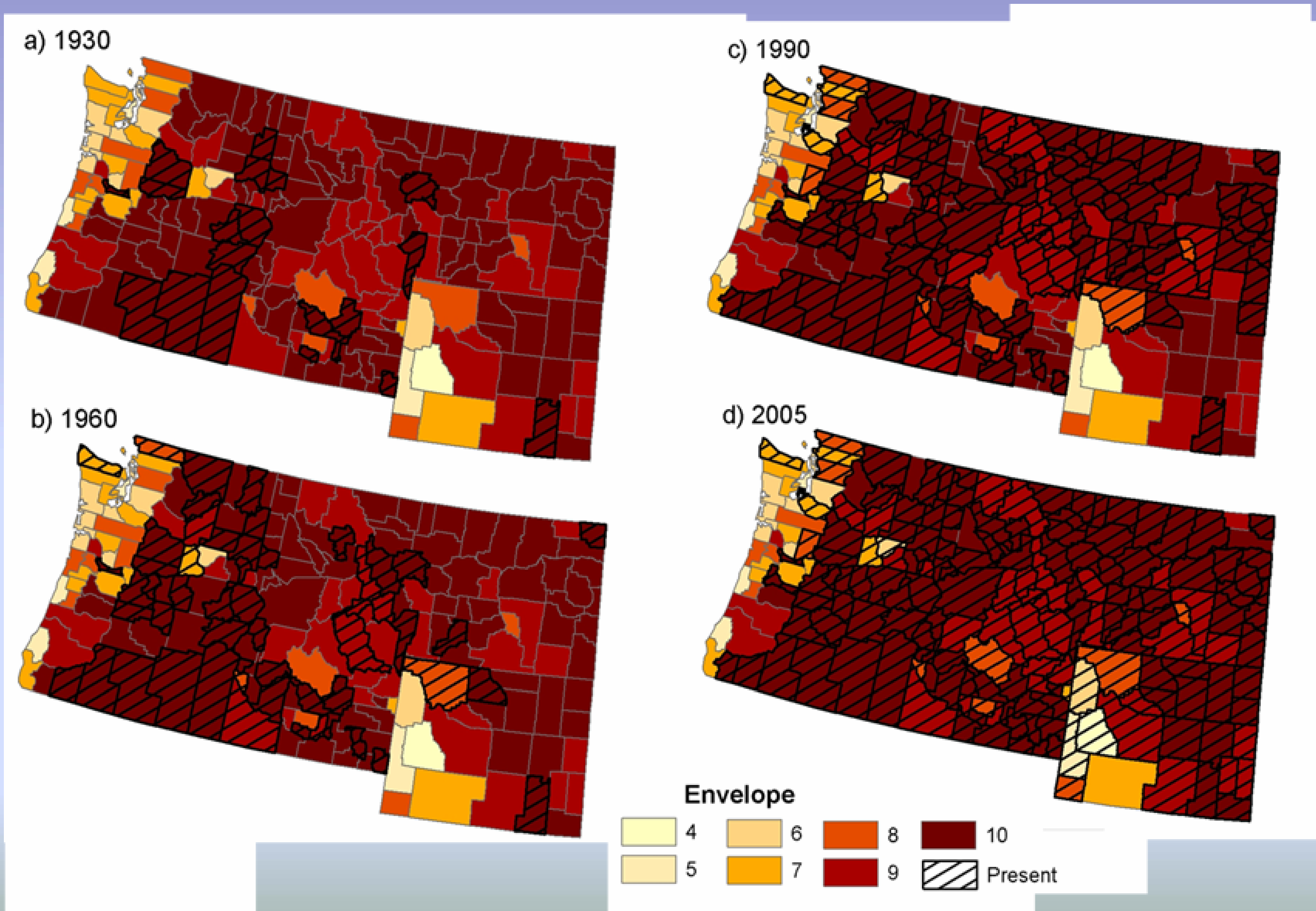
Tamarisk habitat suitability for the continental U.S. by Morisette *et al.* 2006.



Tamarisk Habitat Suitability for the Continental U.S. by Evangelista *et al.* Work in Progress.



Using the Envelope model, the number of non-native species was tracked over time in selected counties in Washington (Jarniviche *et al*. In Review).



The Geographic Setting

- Understanding the geography and topography of the continental U.S. helped set the stage for evaluating patterns of species diversity.
- Data from the 3,004 county centroids showed that as latitude increased from Mexico to Canada, mean annual temperature sharply declined ($r = -0.91$), and mean annual precipitation declined ($r = -0.42$) with exceptions no doubt in mountainous areas.
- Due to the shape and topography of the US, increasing latitudes coincided with increasing distance to coastlines ($r = 0.54$) and increasing mean elevation ($r = 0.48$)

Conclusions and Future Directions

- We are not yet satisfied that we achieved our objectives. Each of our data sets could be improved, as could the ancillary data layers used in geospatial modeling and the models themselves.

Conclusions and Future Directions

- This is the first attempt to evaluate patterns of native and non-indigenous vascular plants, birds, and fishes at multiple spatial scales relative to environmental factors, human population, and cross-correlations among the biological groups. Additional data on plant species richness are needed for many counties in the US (i.e., those with less than a few hundred native plant species seem suspiciously low).

Conclusions and Future Directions

- **Non-indigenous fish data have not all been refined to the 8-HUC (Hydolocgic Unit Code) drainage scale. Additional data at higher resolutions will be helpful in refining spatially predictive models of species richness and density.**

Conclusions and Future Directions

- **Need to more closely link richness and density to abundance, cover, and dominance, and to link species-level data to habitat quantity, quality, and connectedness by roads and waterways (i.e., corridors of invasion) and barriers to invasion.**

Conclusions and Future Directions

- **Caveats aside, we are gaining a much more robust general geospatial model –thematic maps of successful invasions by multiple biological groups. The general patterns observed here provide insights into changes needed for prevention, early detection and rapid response, research, control, and monitoring.**


Questions,
Comments,
!!!!!!!!!!!!!!!
Thank you