Approach and Progress on Species Modeling for Clark County Covered Species Analysis Support

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Clark County
Goals for this project …

- Clark County has a need to amend its MSHCP to update its incidental take permit

  - Revising/updating the covered species list

    - Updated species accounts

    - Wants to use species distribution models to aid in identifying potential footprint for covered species

    - Recognizes that some models exist – but want an evaluation of their quality/utility

Project Deliverables

56 Species of Plants and Animals

- Species Accounts
  - Review and Update 18 Existing Accounts
  - Create 28 New Species Accounts
- Species Distribution Models (SDM)
  - Review 25 Existing Models
  - Create 31 New SDMs

Species addressed

Common Name	Scientific Name	Common Name	Scientific Name	Common Name	Scientific Name
Golden eagle	Aquila chrysaetos	western red bat	Lasiurus blossevillii	alkali mariposa lily	Calochortus striatus
Bell's Sparrow	Artemisiospiza belli	hoary bat	Lasiurus cinereus	Blue Diamond cholla	Cylindropuntia multigeniculata
Western burrowing owl	Athene cunicularia hypugea	California leaf-nosed bat	Macrotus californicus	Gold Butte moss	Didymodon nevadensis
Costa's hummingbird	Calypte costae	Mexican free-tailed bat	Tadarida brasiliensis	silverleaf sunray	Enceliopsis argophylla
Yellow-billed cuckoo	Coccyzus americanus	Botta's pocket gopher	Thomomys bottae	Pahrump Valley buckwheat	Eriogonum bifurcatum
Gilded Flicker	Colaptes chrysoides	Mojave shovel-nosed snake	Chionactis occipitalis	Las Vegas buckwheat	Eriogonum corymbosum var. nilesii
Southwestern willow flycatcher	Empidonax traillii extimus	sidewinder	Crotalus cerastes	sticky buckwheat	Eriogonum viscidulum
Loggerhead shrike	Lanius ludovicianus	Regal ringneck snake	Diadophis punctatus	catchfly gentian	Eustoma exaltatum
Phainopepla	Phainopepla nitens	Desert iguana	Dipsosaurus dorsalis	polished blazingstar	Mentzelia polita
Ridgway's rail	Rallus obsoletus yumanensis	desert tortoise	Gopherus agassizii	Beaver Dam breadroot	Pediomelum castoreum
Bendire's thrasher	Toxostoma bendirei	banded Gila monster	Heloderma suspectum cinctum	white margined beardtongue	Penstemon albomarginatus
Le Conte's thrasher	Toxostoma lecontei	spotted leaf-nosed snake	Phyllorhynchus decurtatus	yellow twotone beardtongue	Penstemon bicolor ssp. bicolor
Arizona Bell's Vireo	Vireo bellii arizonae	MacNeill's Saltbush Sootywing	Hesperopsis gracielae	rosy twotone beardtongue	Penstemon bicolor ssp. roseus
Pallid bat	Antrozous pallidus	sticky ringstem	Anulocaulis leiosolenus	Death Valley beardtongue	Penstemon fruticiformis ssp. amargosae
desert pocket mouse	Chaetodipus penicillatus	Las Vegas bearpoppy	Arctomecon californica	Clarke phacelia	Phacelia filiae
Townsend's big-eared bat	Corynorhinus townsendii	white bearpoppy	Arctomecon merriamii	Parish phacelia	Phacelia parishii
desert kangaroo rat	Dipodomys deserti	threecorner milkvetch	Astragalus geyeri var. triquetrus	St. George blue-eyed grass	Sisyrinchium radicatum
Spotted bat	Euderma maculatum	straw milkvetch	Astragalus lentiginosus var. stramineus		
silver-haired bat	Lasionycteris noctivagans	halfring milkvetch	Astragalus mohavensis		

Species Addressed

Type	Count
Plant	23
Bird	13
Bat	8
Snake	4
Mammal	3
Lizard	2
Cactus	1
Moss	1
Tortoise	1
Grand Total	**56**

Species Account

- Species Status
  - IUCN, ESA, NDOW
- Range Description
- Population Trends
- Distribution and Habitat Use within Clark County
- Ecosystem Level Threats
- Threats to Species
- Existing Conservation Areas/Management Actions
- Summary of Direct Impacts

Conceptual Model

Create Conceptual model from the information in the Species Account

- Identifies appropriate scale and resolution for analysis
- Identifies key drivers for habitat/distribution
- Drives use and development of habitat layers needed as GIS, and expected statistical relationships

Conceptual Models

Phyllorhynchus decurtatus is a broadly occurring species throughout the Mojave and Sonoran Deserts, yet due to its nocturnal activity and secretive nature, little is know about its biology. It is active April through July, lays 3-5 eggs, and typically inhabits **sandy or gravelly habitats**, and has been associated with **Creosote bush habitats typical of Mojave desert scrub, and mixed Mojave desert scrub** (Brattstrom 1953, Goldberg 1996, Stebbins 2003). It is usually found in **bajadas and valley bottoms** and is **rare in sandy flats**, although in some areas it occupies sand dunes (Cowles 1941). They **are not found in mountainous areas**. Its diet consists predominantly of the eggs of lizards (Gardner and Mendelson 2003). It is a small snake, less than 510 mm total length, and burrows underground, and hides in surface debris (Frost et al. 2007).

Spotted Leaf Nose Snake

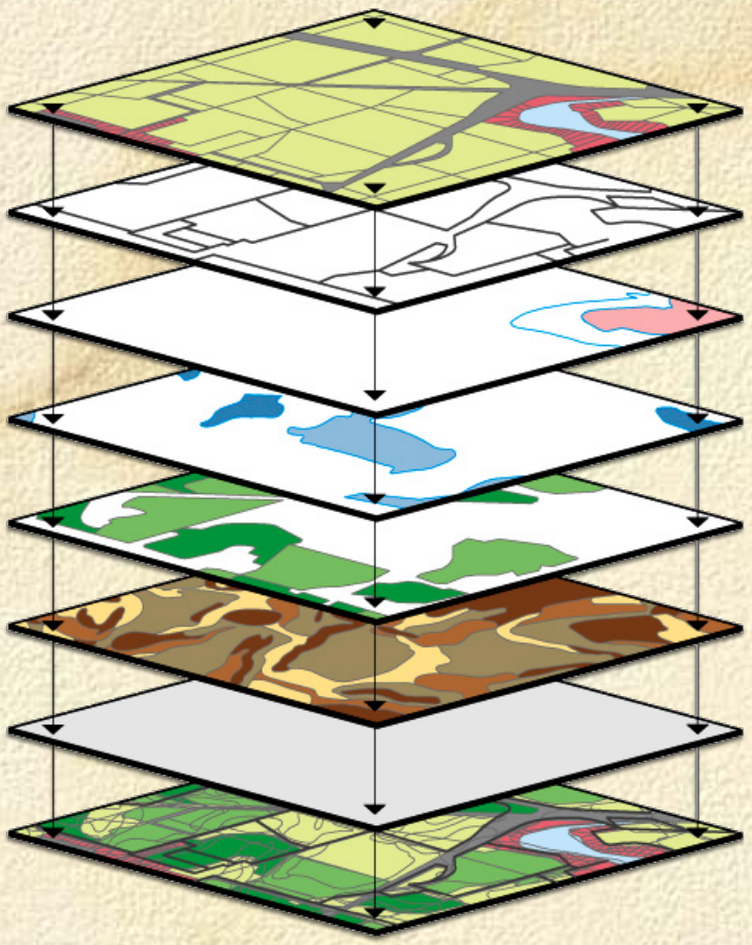
Surface Texture

Slope Terrain Roughness

Topographic Position

Temperature Precipitation

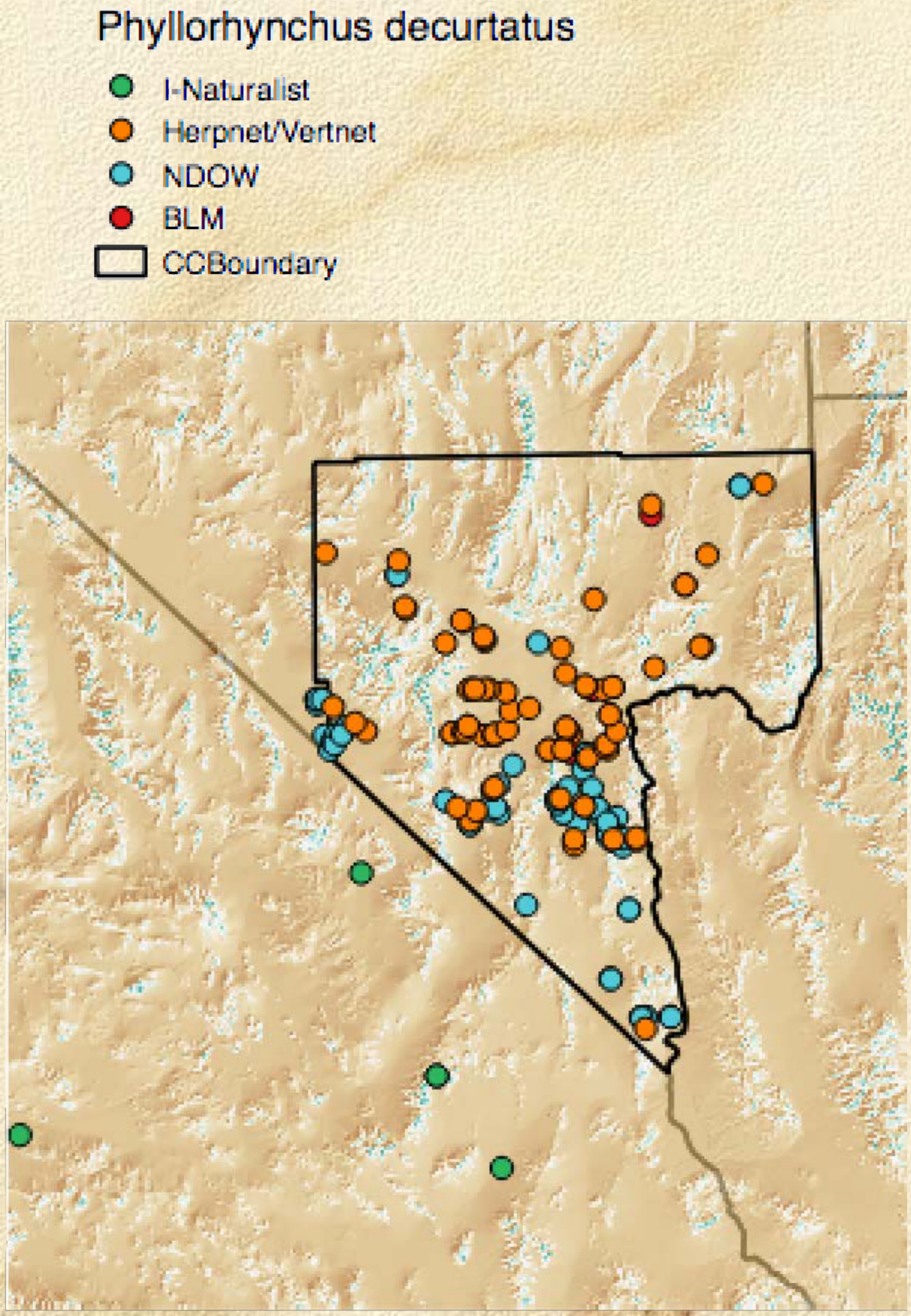
Environmental Layers



Acquire, and Assess environmental layers

- County provided layers
- Layers that we have developed from previous efforts
- Searches of online sources (DataBasin, ESRI, etc.)
- Generation of new layers if needed

Locality Data



- County provided sources
- Searches of online sources (herpnet, vertnet, i-naturalist, and other museum sources)
- Colleagues and scientific literature with species specific information

Assess Data Quality

QAQC Species and Environmental Data

Evaluate spatial accuracy and precision of input data relative to species modeling goals (e.g. resolution)

Evaluate patchiness of species data

Evaluate completeness of data relative to range that species will be modeled over

Modeling

Models Available… among many

Presence/Absence

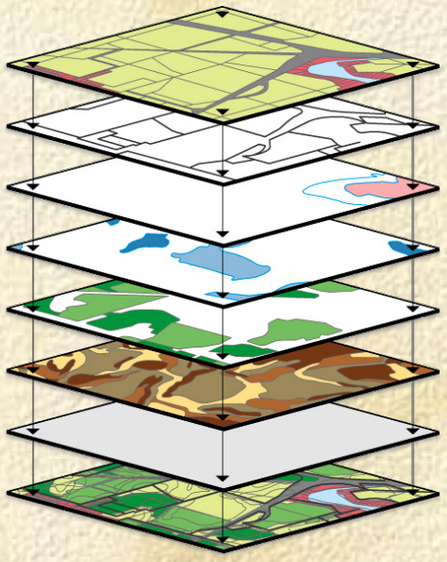
- Resource Selection Function (a.k.a Logistic regression… GLM)
- General Additive Models (GAM)
- Bayesian approaches
- Random Forest/CART

Presence Only

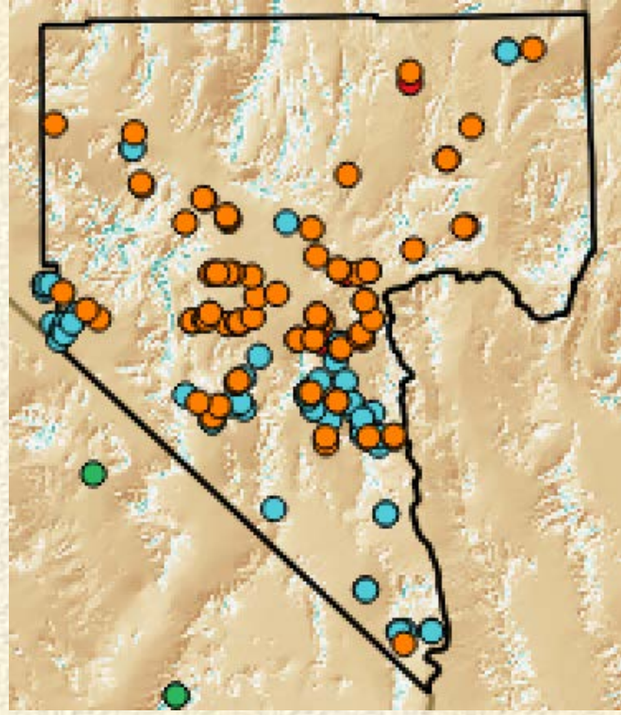
- Ecological Niche Factor Analysis (a.k.a. principle components)
- Maxent/GARP
- Poisson Point Process
- Use Pseudo - absences OR random background points

Study

- General Additive Models GAM (PA)
- Random Forest (PA)
- Maxent (Background)



Modeling



- Model Selection
- Cross-validation using 50 samples of localities
- Model combinations of up to 5 environmental layers
- Rank Models using AIC, AUC, BI, TSS

Average top 10 Models to Create and Ensemble model for each Algorithm

WinterPrecip + Diurnal_TempRng + Slope

WinterPrecip + Tmax + Diurnal_TempRng + Slope

WinterPrecip + Diurnal_TempRng + MaxNDVI + Slope

WinterPrecip + Diurnal_TempRng + Slope + SurfText

WinterPrecip + Diurnal_TempRng + Slope + Roughness

WinterPrecip + Tmax + Diurnal_TempRng + Slope + SurfText

WinterPrecip + Tmax + Tmin + Diurnal_TempRng + Slope

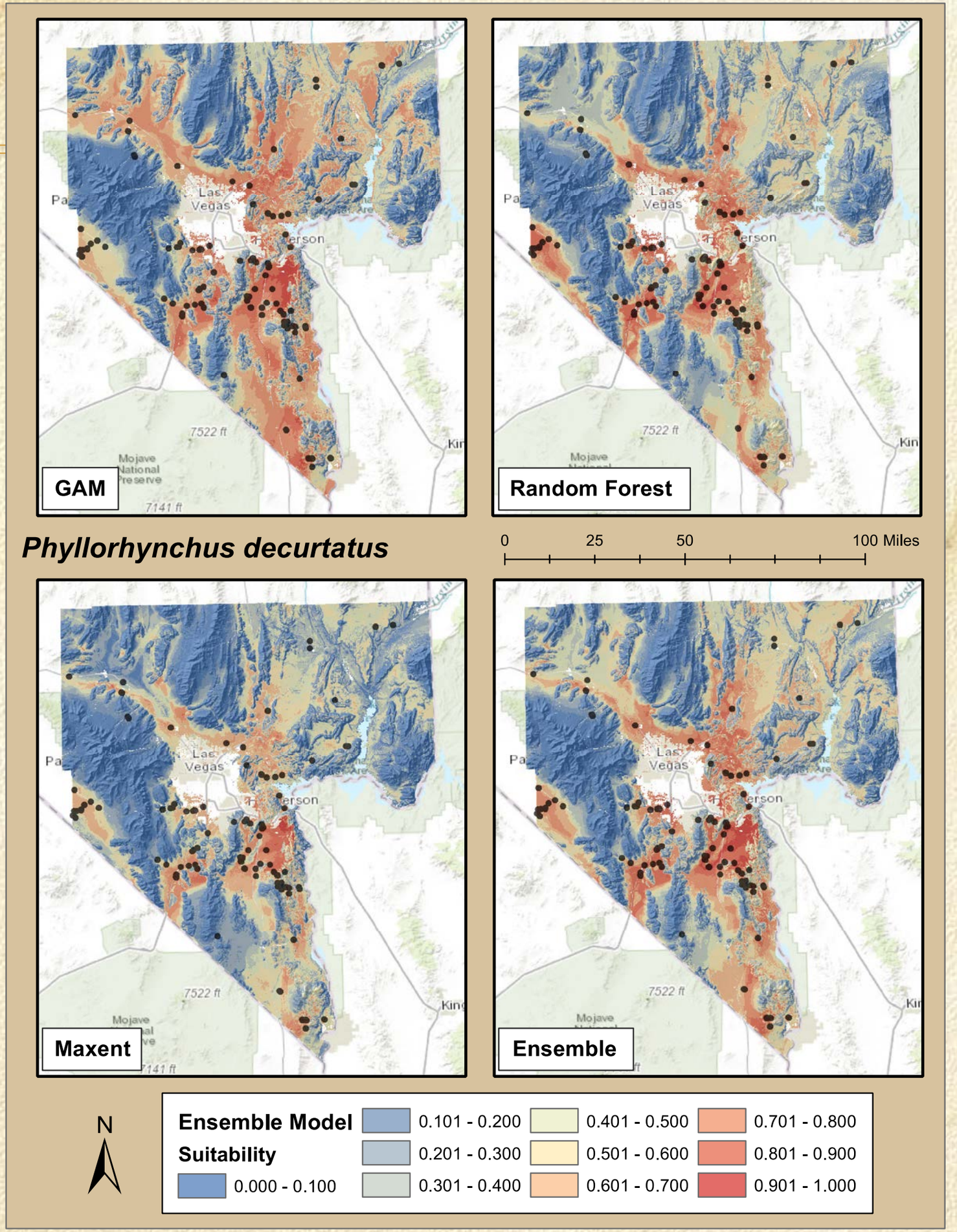
WinterPrecip + Tmax + Tmin + AvNDVI + Slope

WinterPrecip + Tmax + Tmin + Diurnal_TempRng + AvNDVI + Slope

WinterPrecip + Tmax + Tmin + Diurnal_TempRng + MaxNDVI + Slope

WinterPrecip + Tmax + Tmin + Diurnal_TempRng + Slope + Roughness

Individual Ensemble Models averaged to create Overall Ensemble Model



Model Assessment

- Evaluate model performance using multiple metrics, e.g. AUC, BI, TSS, r, etc.

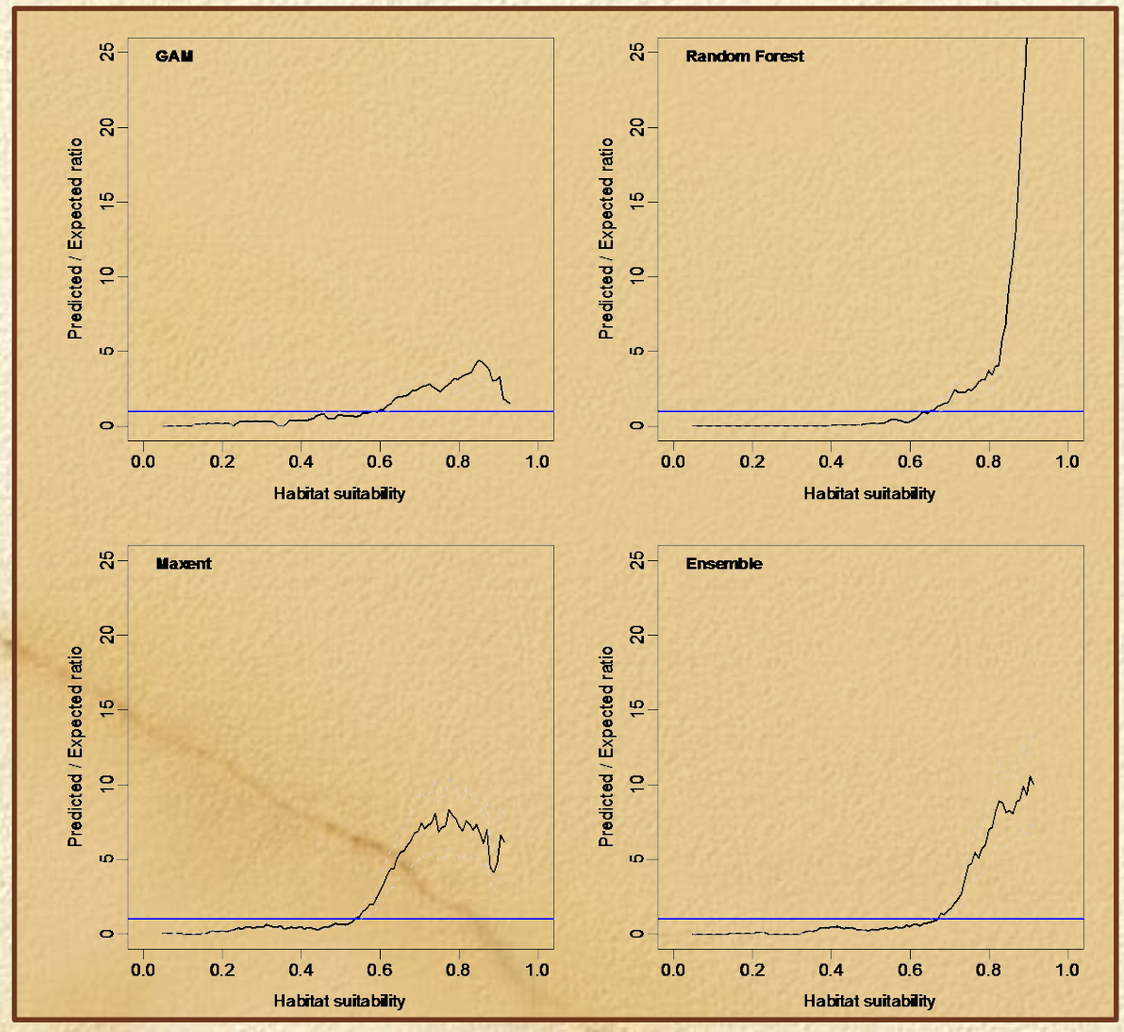
Table 10. Model performance values for *Phyllorhynchus decurtatus* models

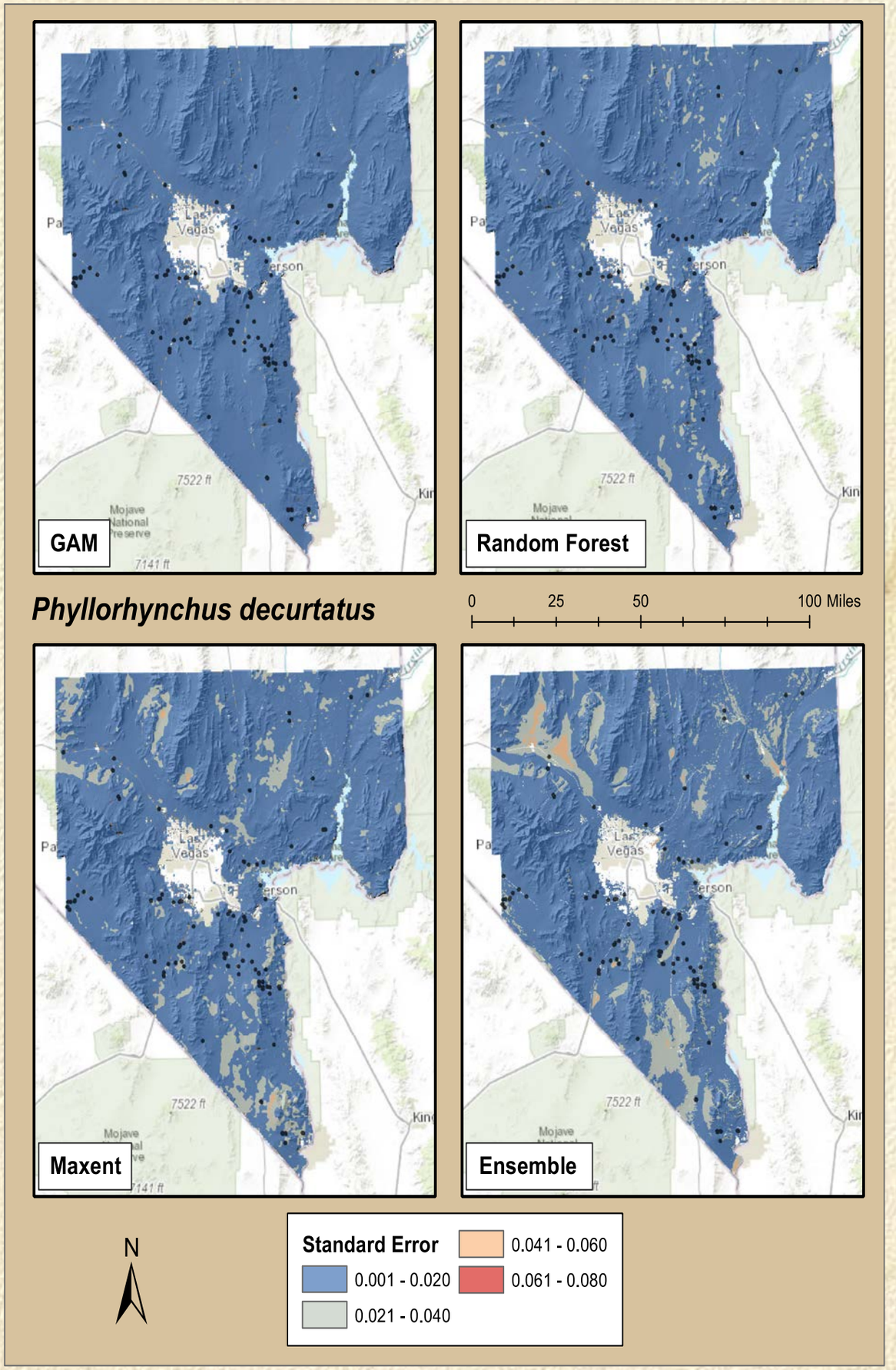
Performance	GAM	RF	Maxent	Ensemble
AUC	0.78	0.96	0.88	0.91
BI	0.72	0.76	0.73	0.76
TSS	0.53	0.76	0.70	0.73
Correlation	0.51	0.79	0.66	0.70
Cut-off*	0.54	0.65	0.51	0.70

*threshold at which sum of sensitivity (true positive rate) and specificity (true negative rate) is highest

Model Assessment

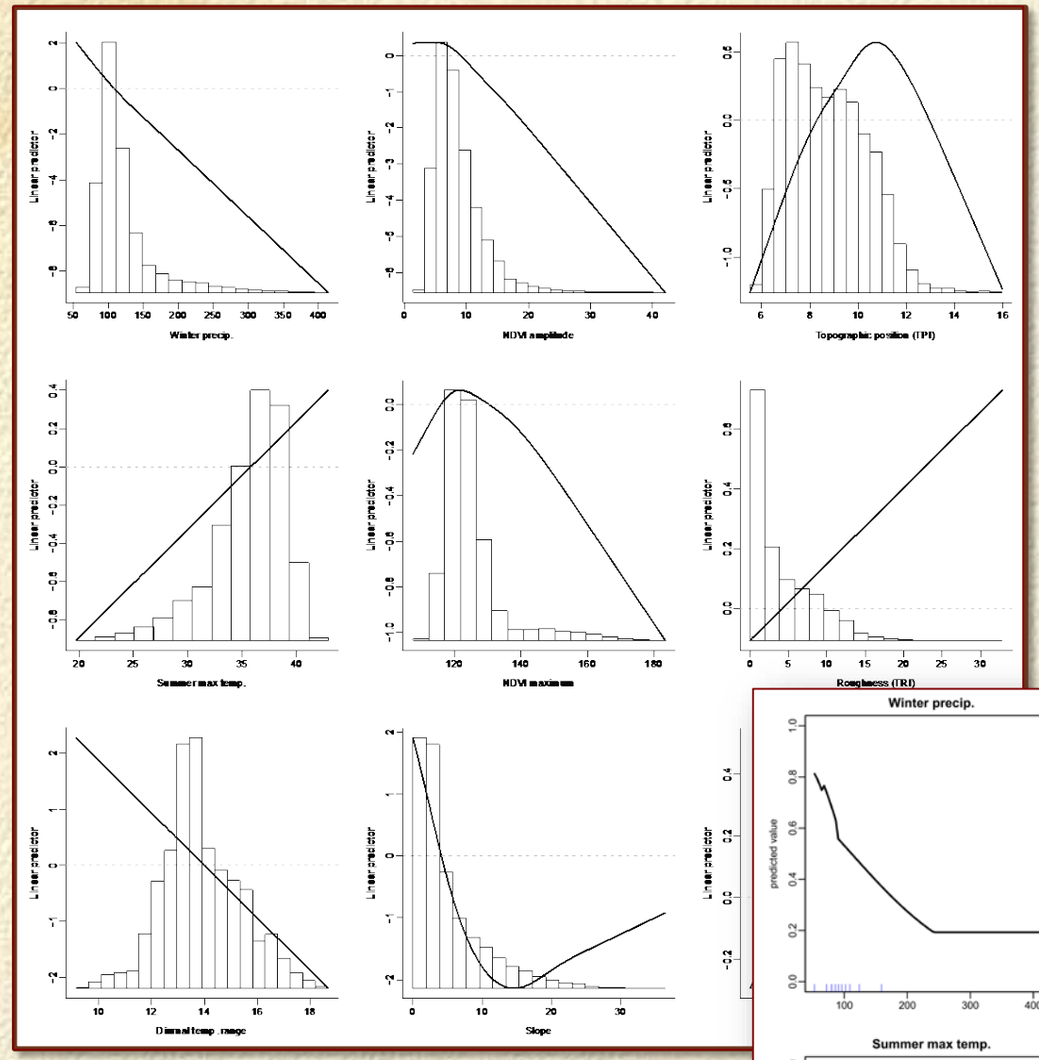
Evaluate spatial accuracy and precision of model predictions with Standard Error Maps, and Continuous Boyce Indices

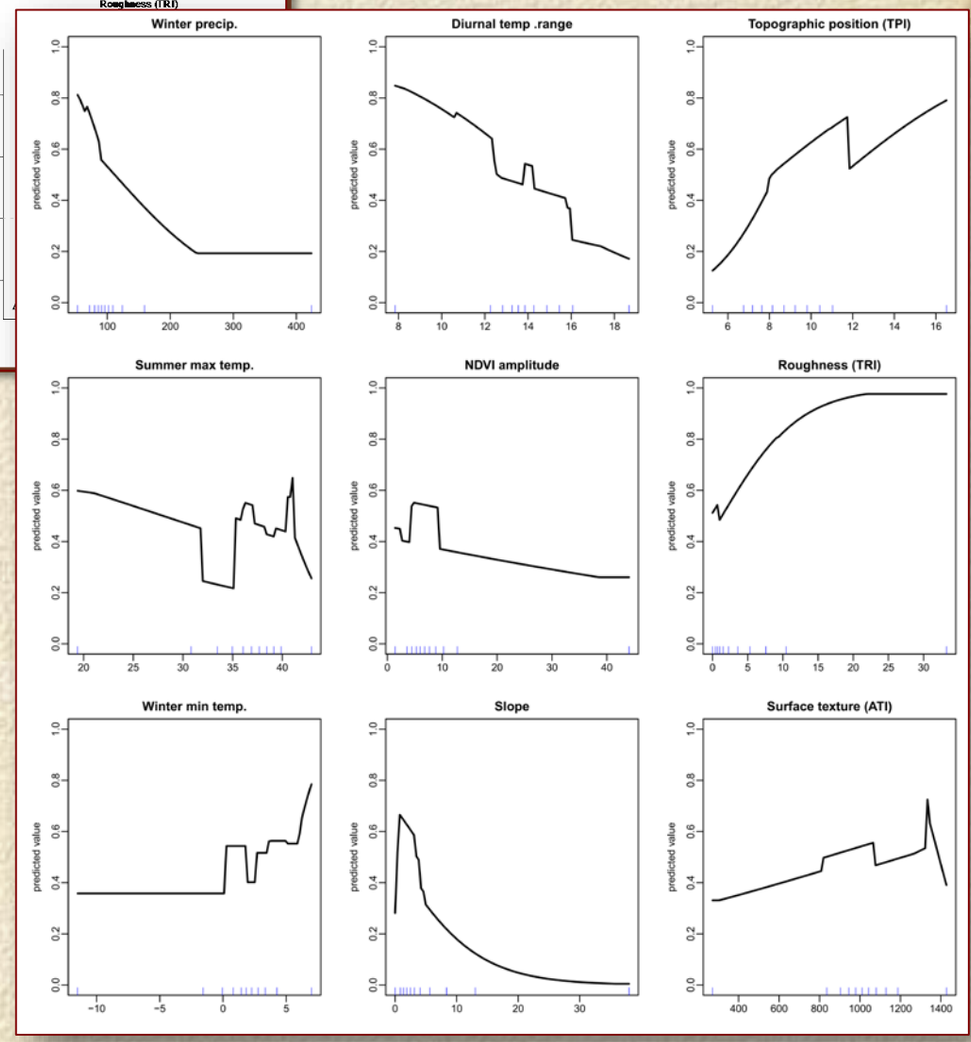


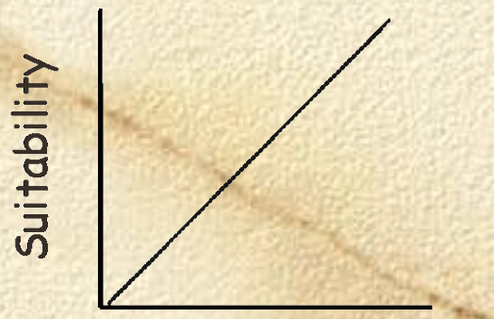


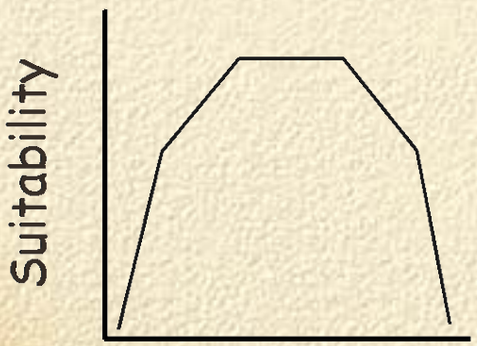
Model Assessment

- Evaluate realism model responses relative to hypothesized species responses





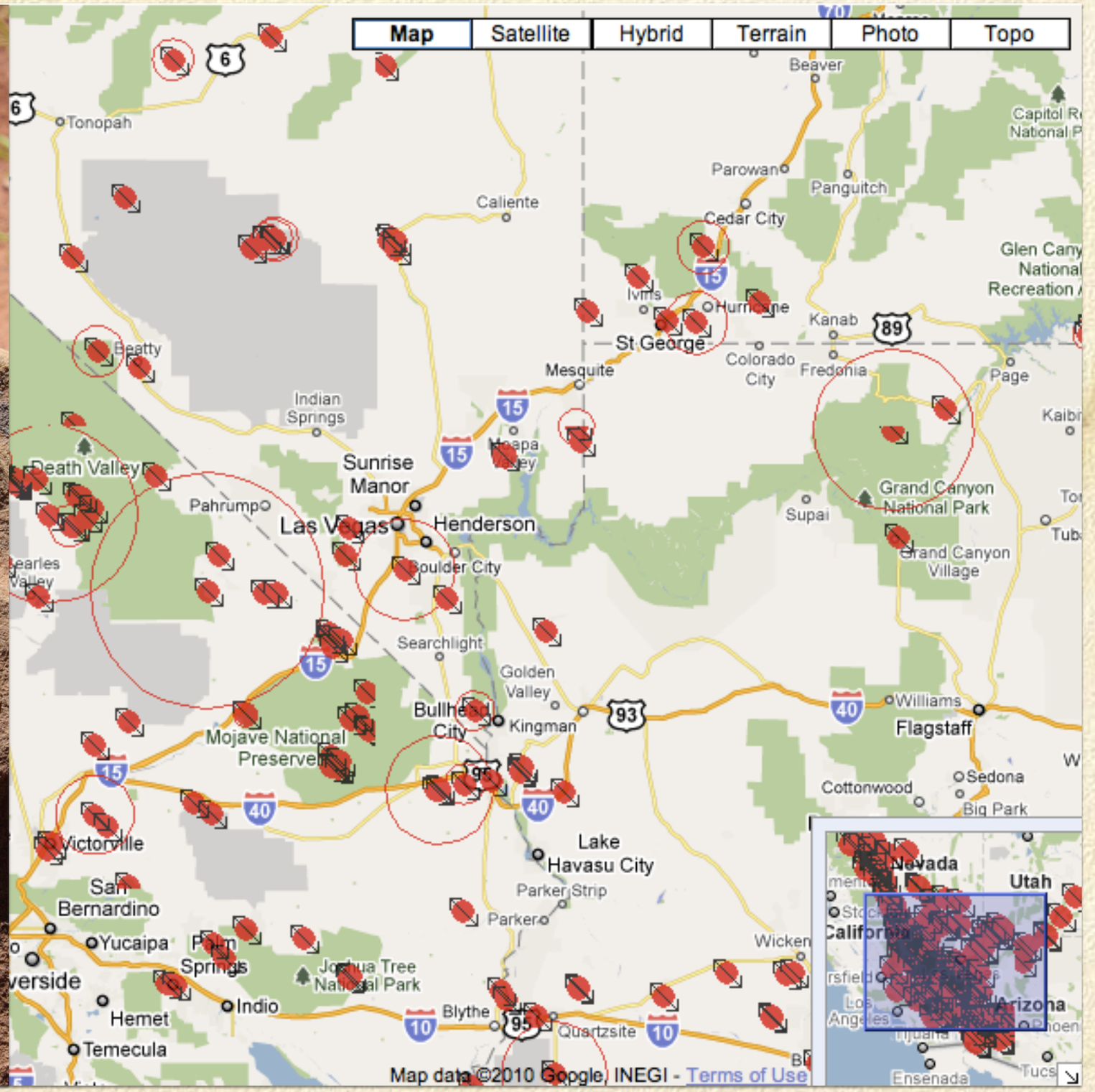




Progress 1st 6 Months

Type	Count	Account	SDM
Plant	23	4*	
Bird	13	5	5
Bat	8	8*	3
Snake	4	4	4
Mammal	3	2	2
Lizard	2	2	2
Cactus	1		
Moss	1		
Tortoise	1	1	1
Grand Total	**56**	**26**	**19**

Accuracy and Precision



Spatial Clustering and Accuracy

- Spatially clustered relative to known range
- Data with mixed precision
- Data

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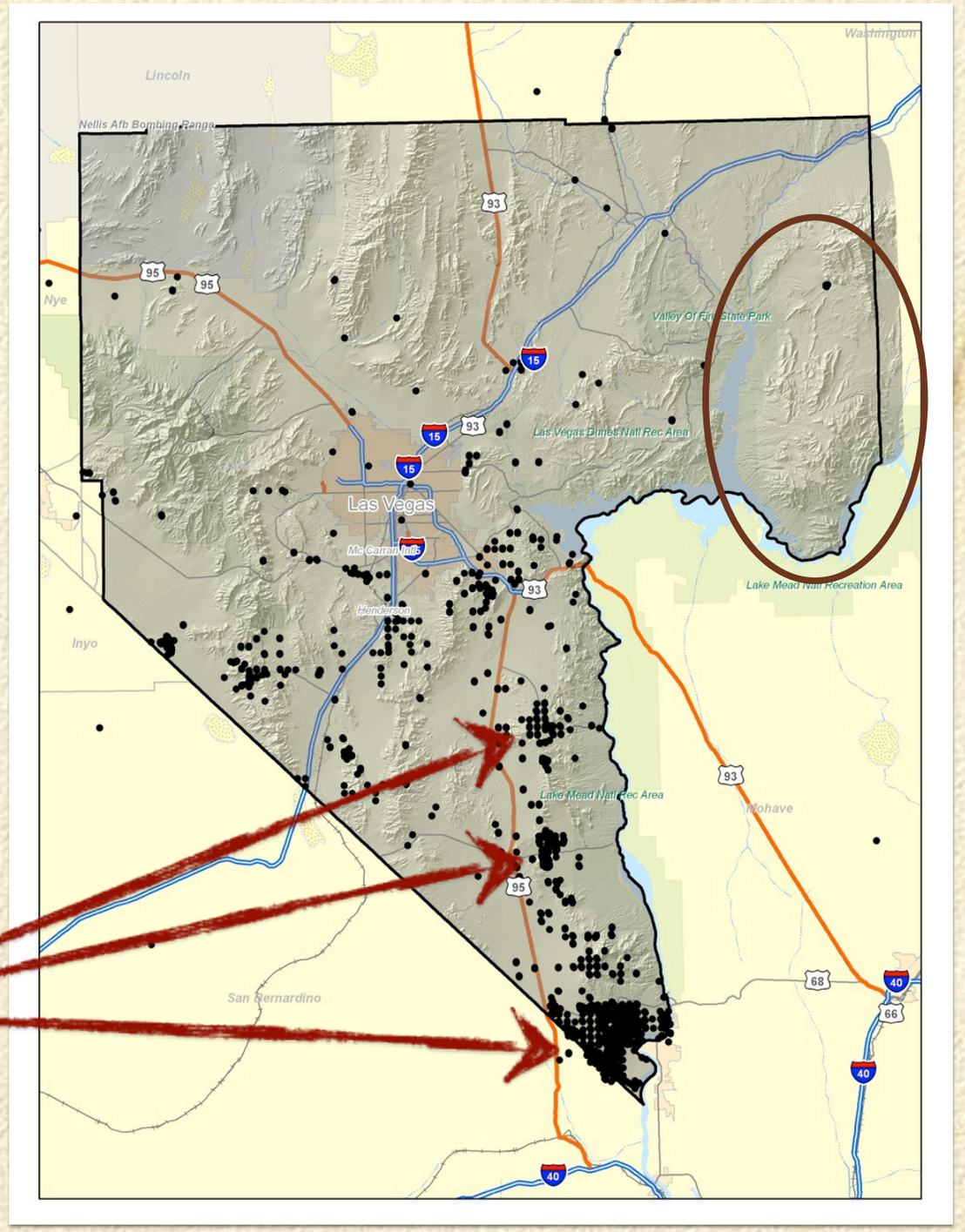
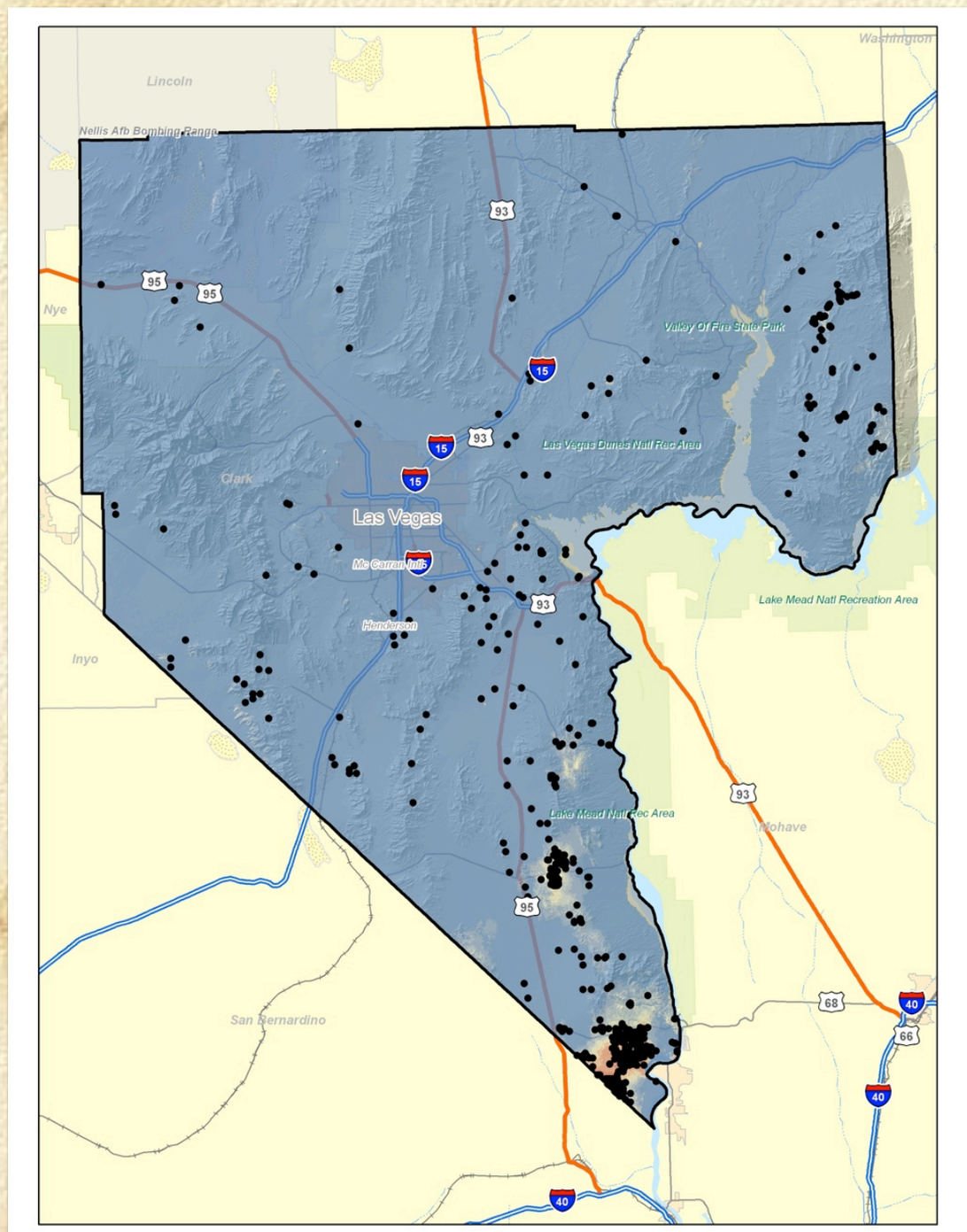


Clustering and Covariate Space

AUC - 0.91
Boyce Index - 0.16



AUC - 0.75
Boyce Index - 0.38