Meeting of the Sagebrush Ecosystem Council

December 11, 2015

Agenda Item 10

State Management Category Map Update and Approval

Peter S. Coates, USGS

USGS science for a changing world

NEVADA SAGEBRUSH ECOSYSTEM PROGRAM

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

NEVADA DIVISION OF WILDLIFE

Presentation Topics

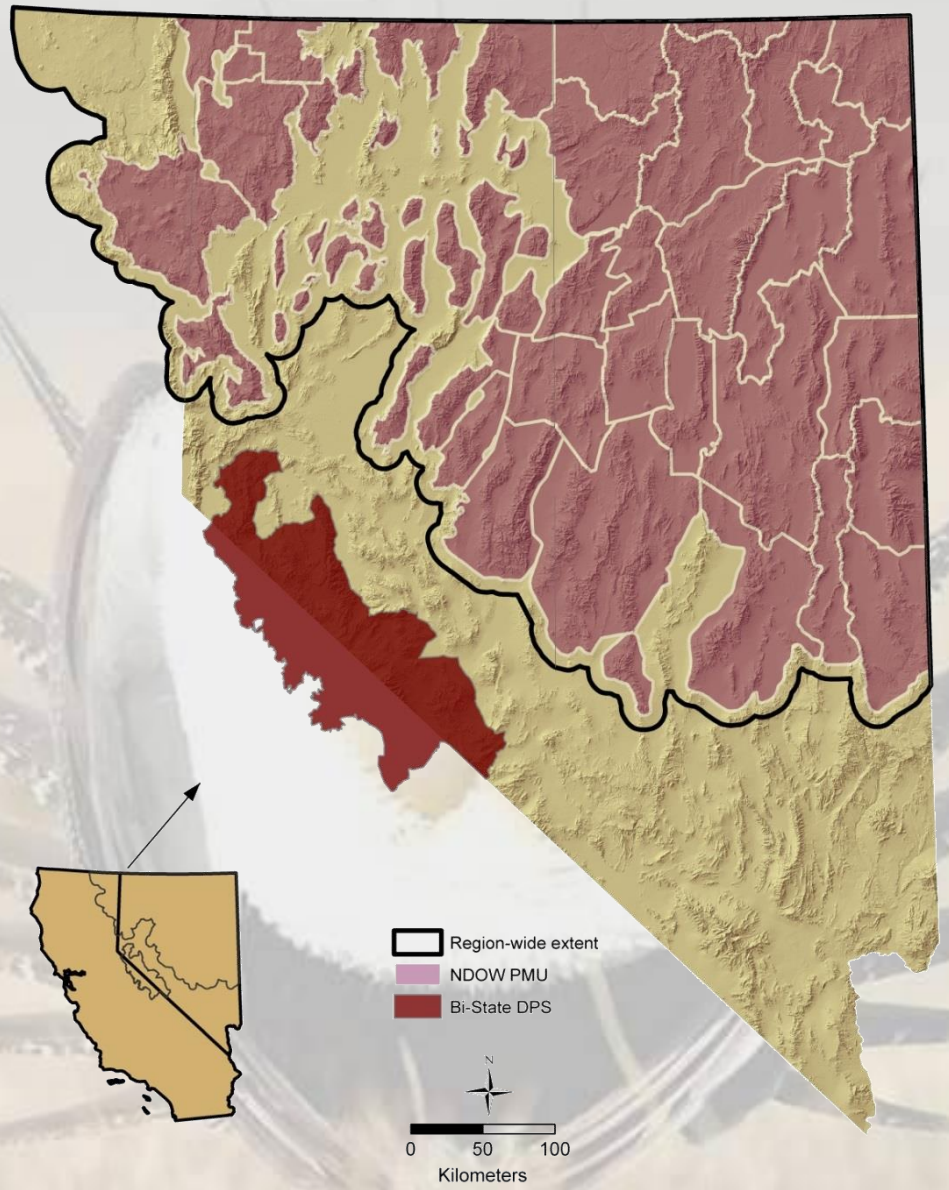
1) **Habitat Model Process (Improvements)**

2) **Updated Habitat Selection Models (Annual and Seasonal)**

3) **Space Use and Abundance Model**

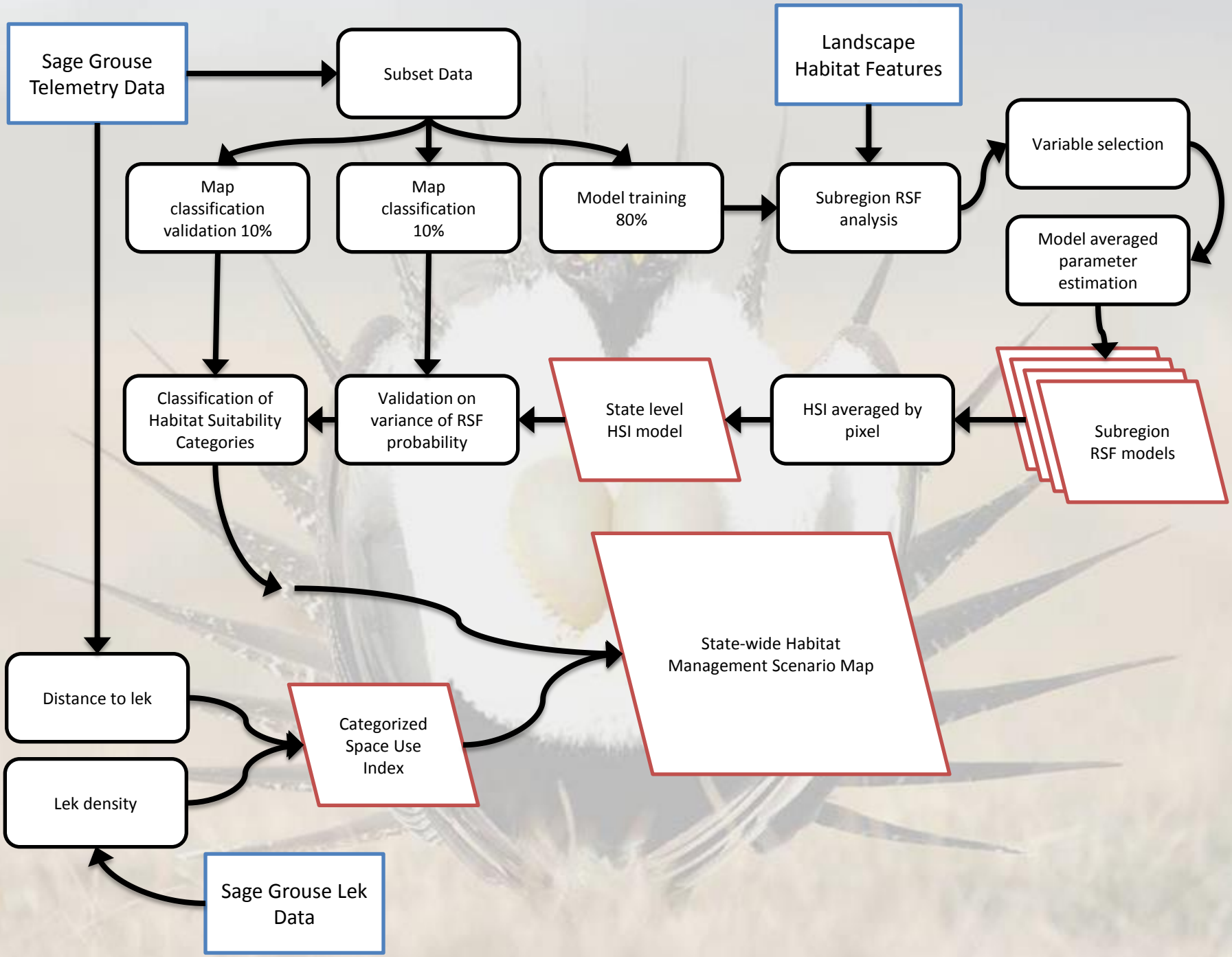
4) **Habitat Management Categories**

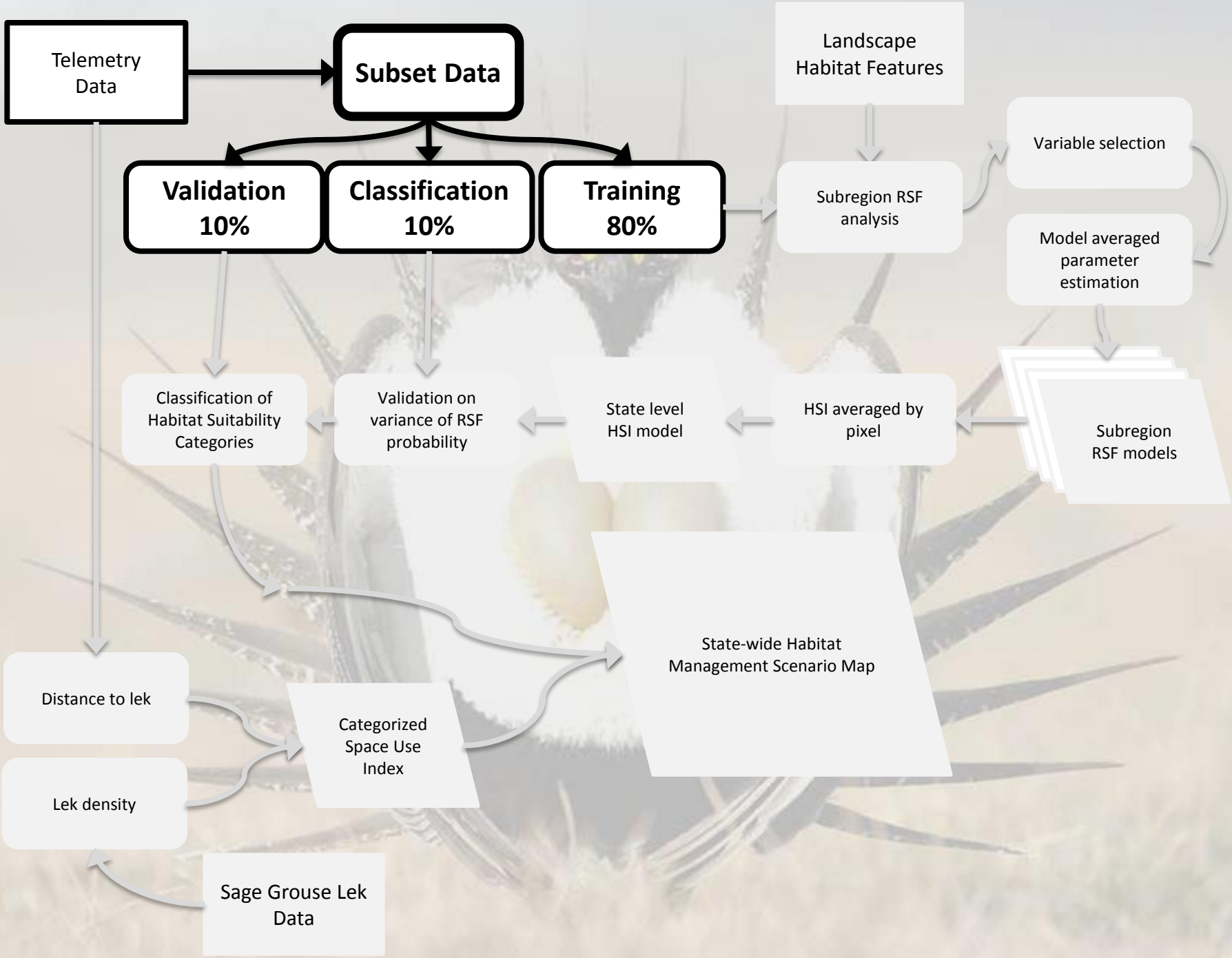
Defining the Modeling Area



Used existing PMU boundaries (10 km)

Approximated potential sage-grouse range


Sage Grouse Telemetry Data
Subset Data
Landscape Habitat Features
Map classification validation 10%
Map classification 10%
Model training 80%
Subregion RSF analysis
Variable selection
Model averaged parameter estimation
Classification of Habitat Suitability Categories
Validation on variance of RSF probability
State level HSI model
HSI averaged by pixel
Subregion RSF models
State-wide Habitat Management Scenario Map
Distance to lek
Lek density
Categorized Space Use Index
Sage Grouse Lek Data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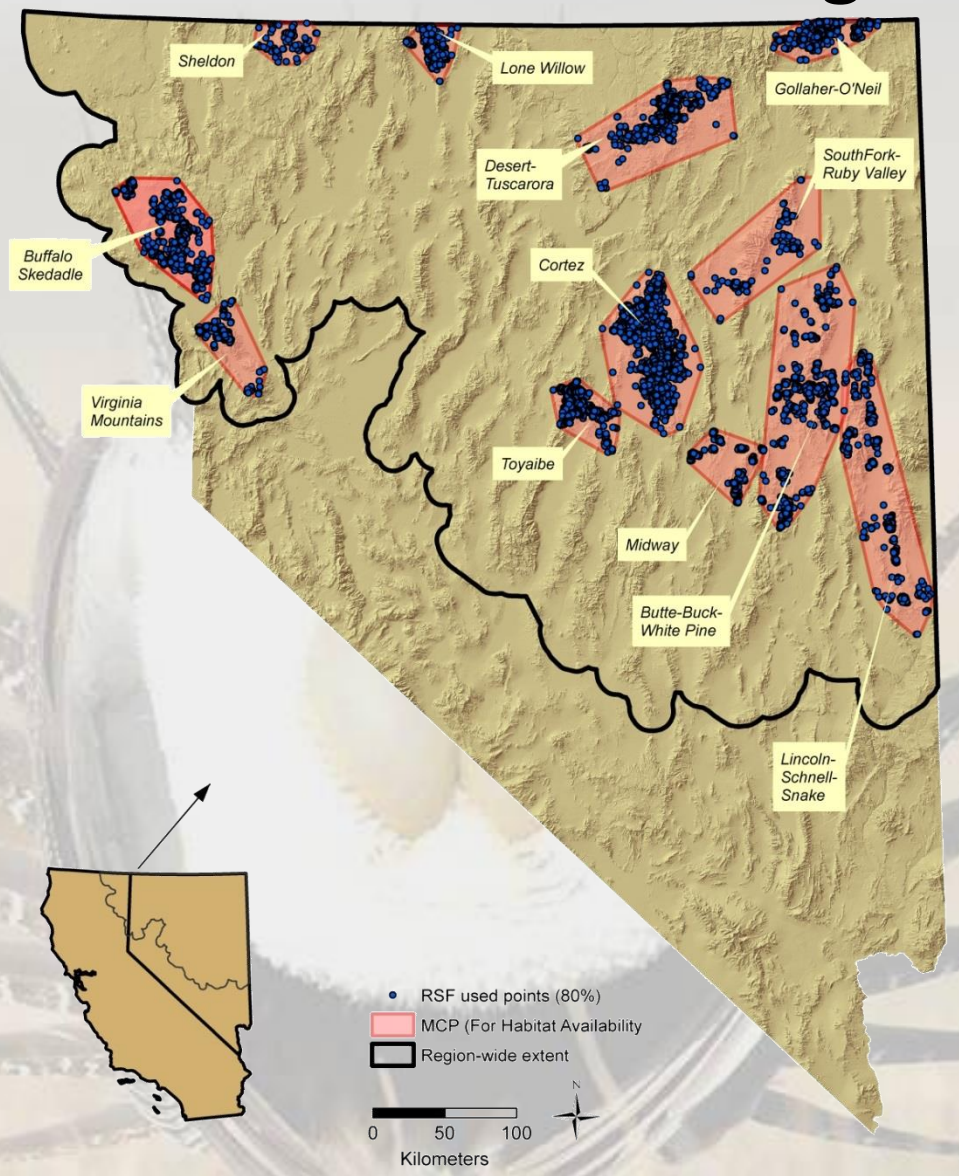
Statewide Modeling

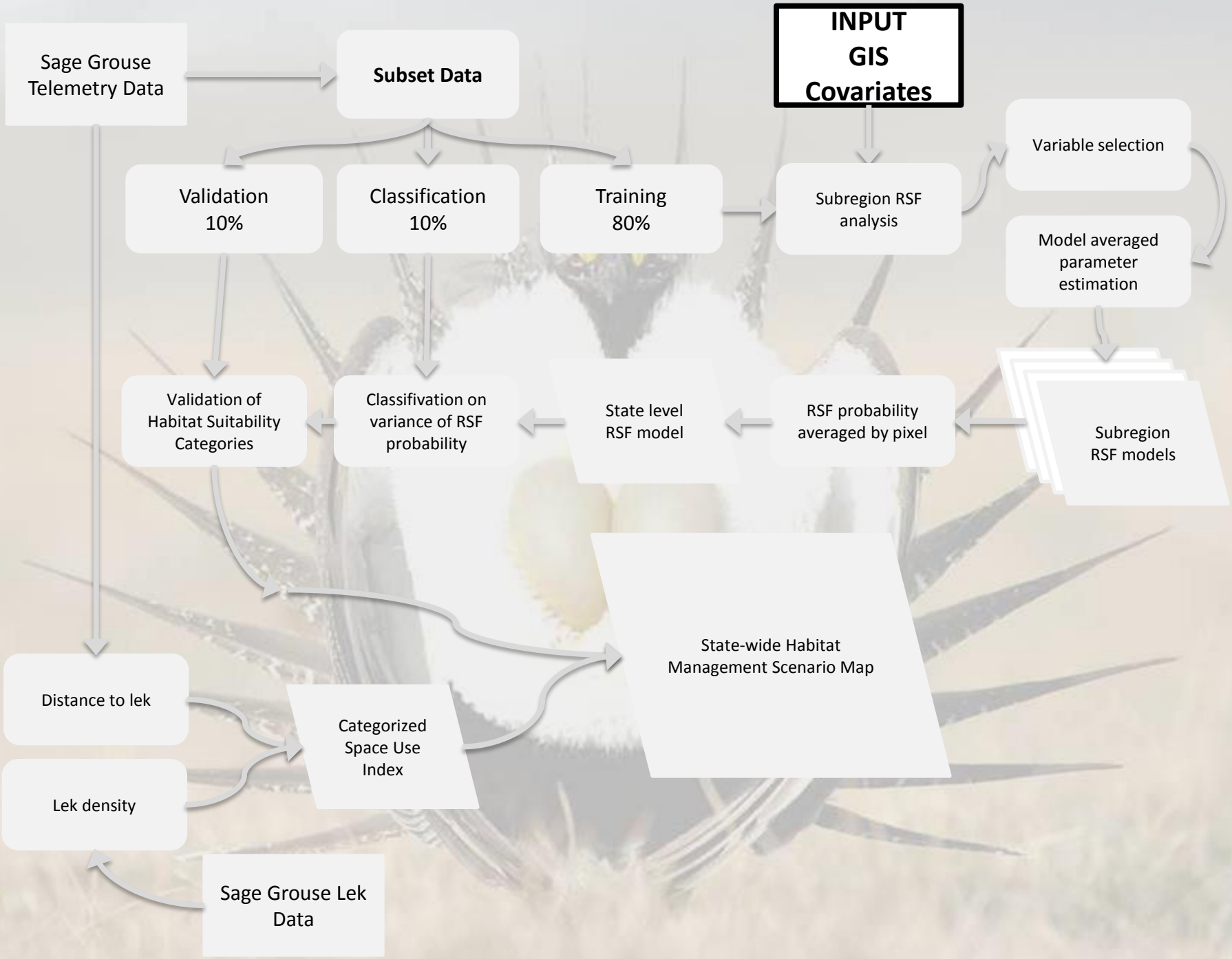


Three independent datasets:

- **Model Training**
- **Category Training**
- **Validation**

- **12 sub-regions**
- **3 seasons (nesting, brood-rearing, wintering)**
- **24 site/sub-region Resource Section Function (RSF) maps**
- **> 16 years of data**
- **> 37,000 location**
- **> 1,700 grouse**

Preliminary Information—Subject to Revision. Not for Citation or Distribution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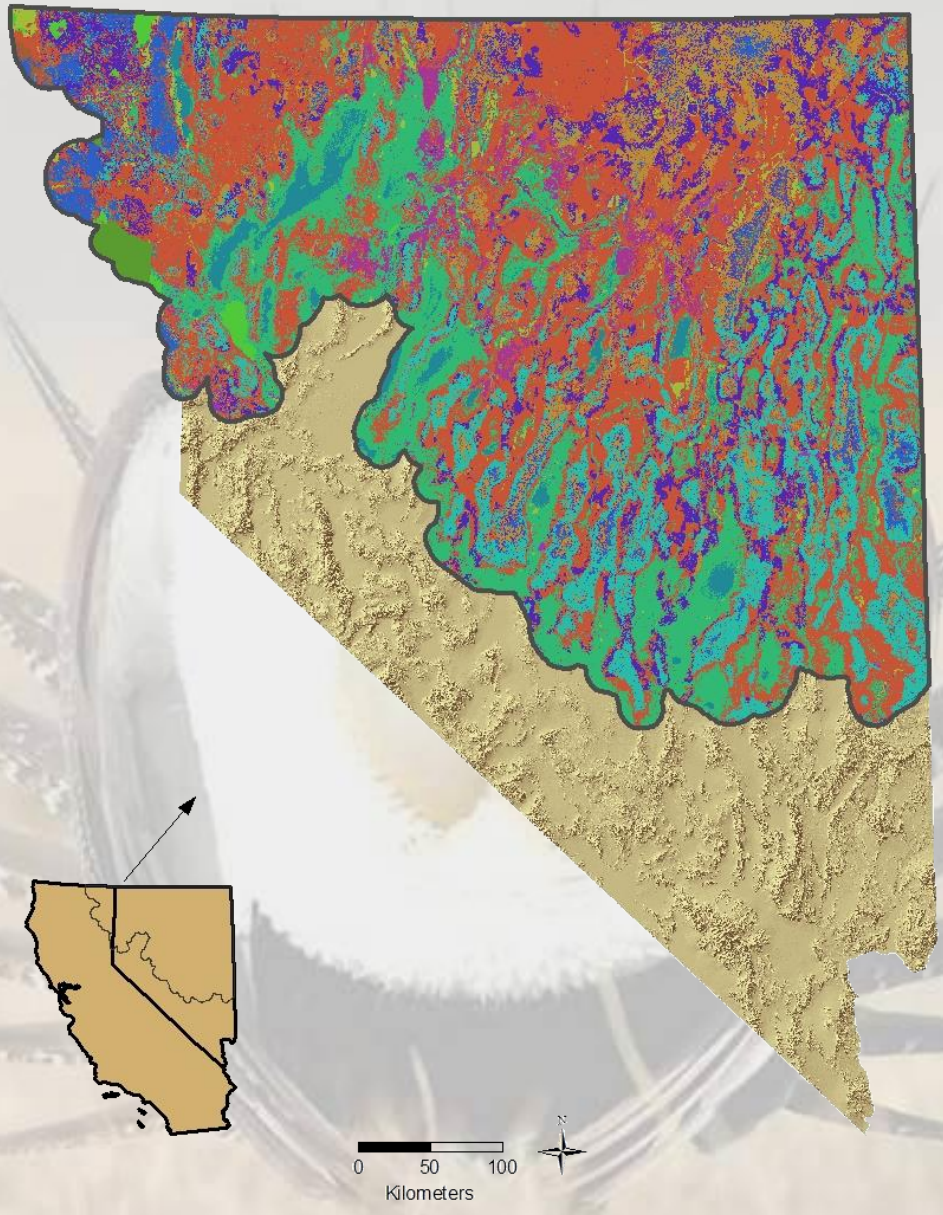
Land Cover Maps



Model Covariates

Vegetation Communities

Agricultural Areas

Topographic Indices

Elevation Model

Anthropogenic Attributes

- Urbanization

- Recreational Indices

- *Power Lines**

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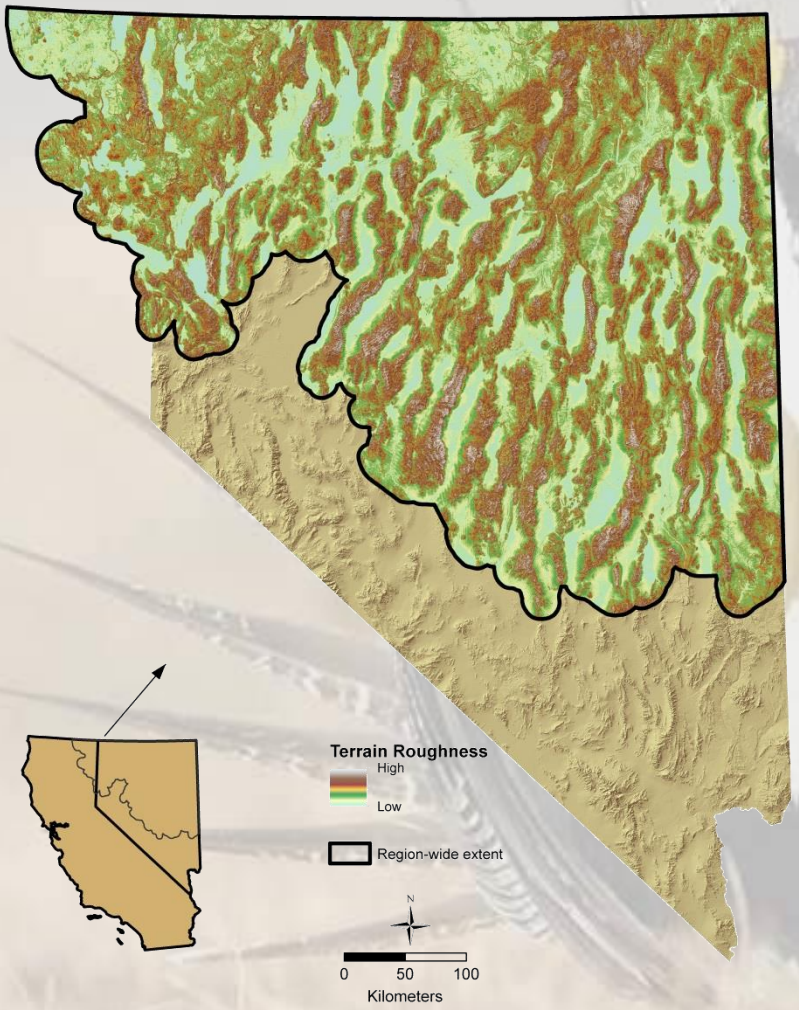
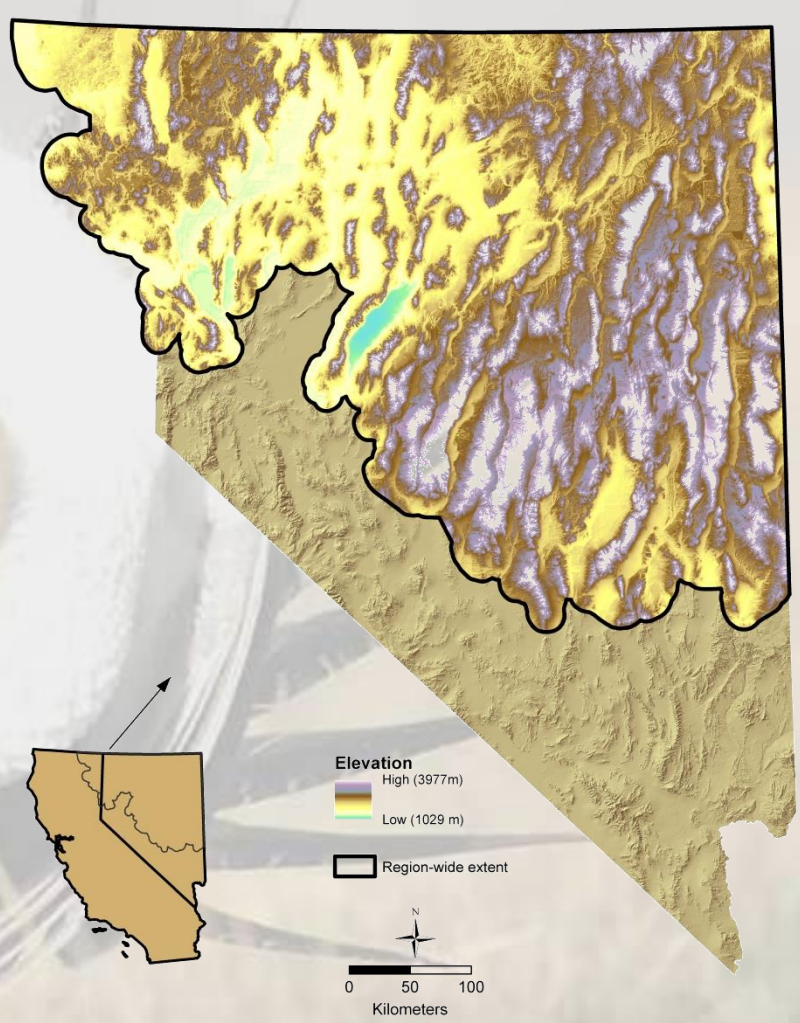
Physiographic Variables

Ruggedness Index



Elevation



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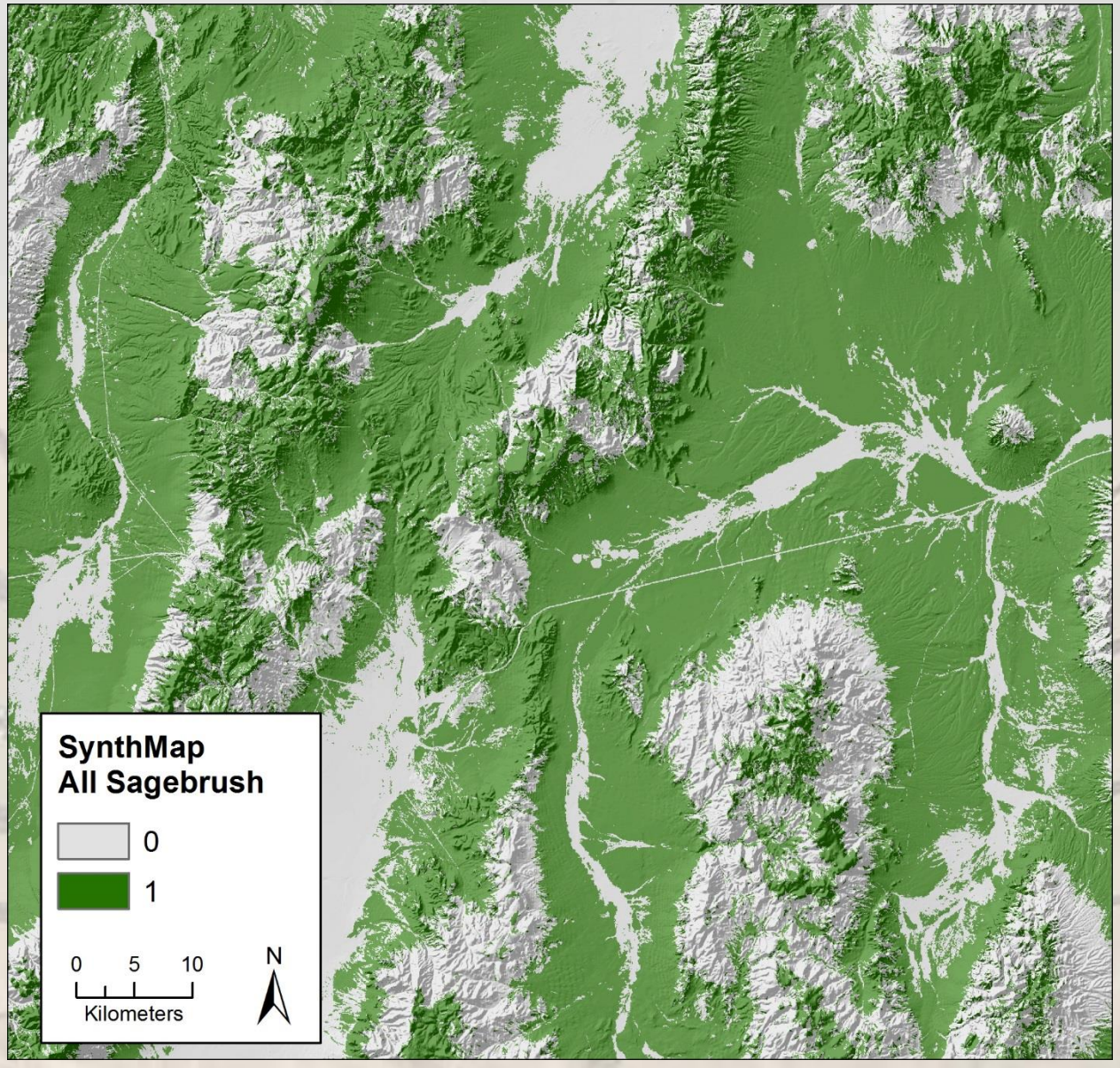
Improvement on Land Cover Inputs

- **Sagebrush Ecosystem Quantification Products for the Great Basin**
  - **USGS-Earth Resources Observation Sciences Lab (C. Homer)**
  - **Integrates high-resolution Quickbird (< 2-m) satellite imagery with larger scenes of Landsat 8 (30-m) imagery**
  - **Model output = 30-m pixels with land cover expressed as percent cover (0 – 100%)**
- **In contrast, Landsat-based Nevada SYNTH map expresses land cover as a binary (0 or 1) value at 30-m resolution**

Sagebrush Land Cover Types



Previous version (Coates et al. 2014) was based on 30-m classification (NV Synthmap)

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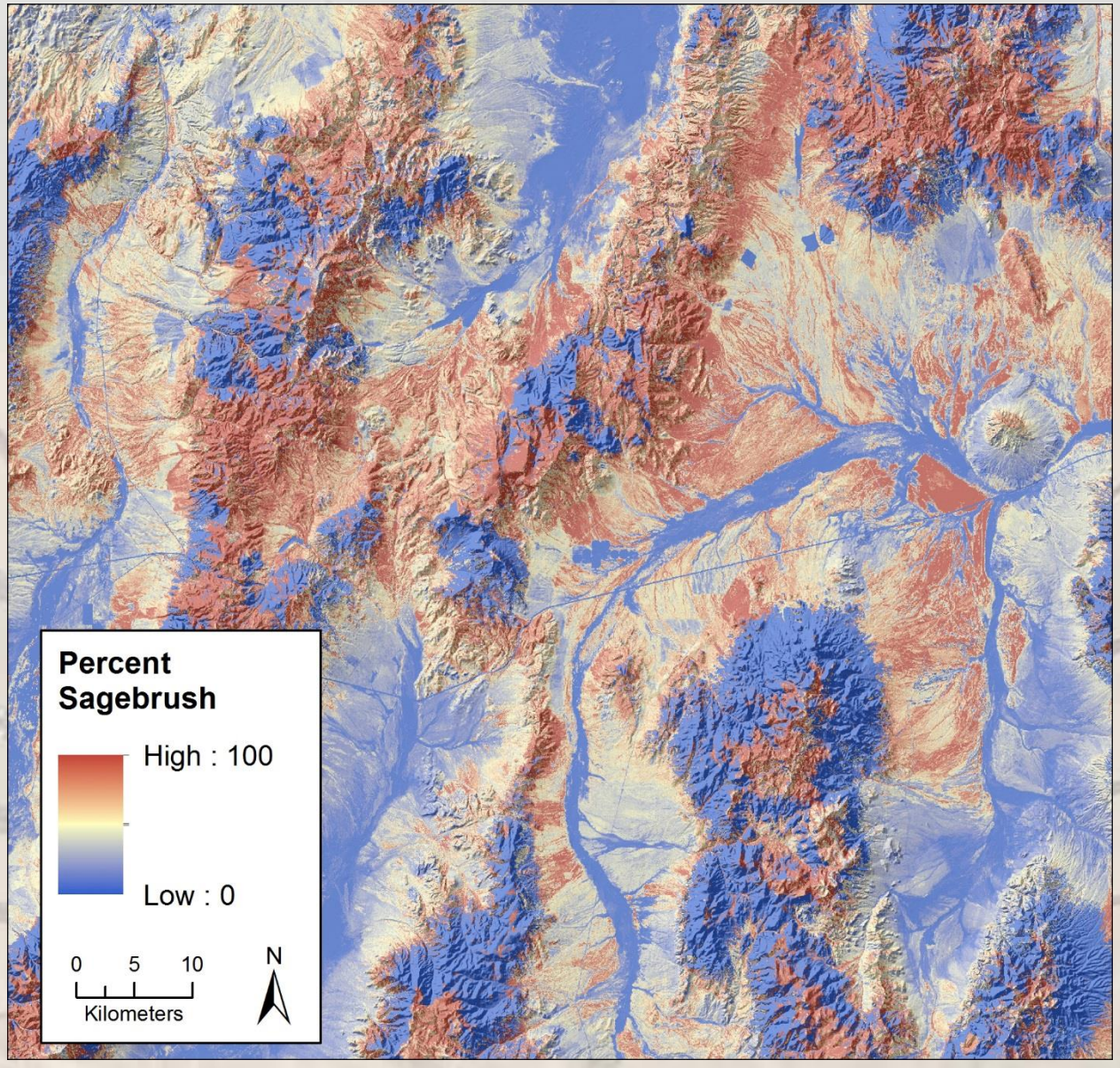

Recent version is based on <2-m resolution (Homer et al., In Prep)

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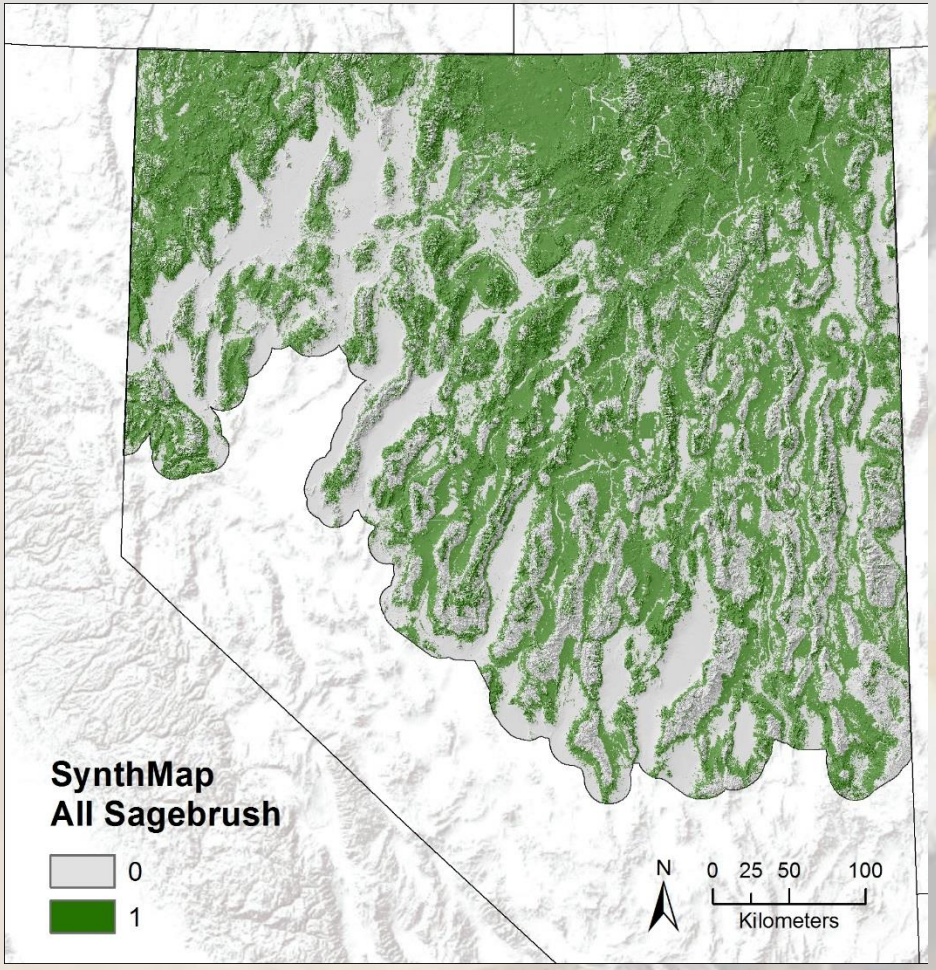
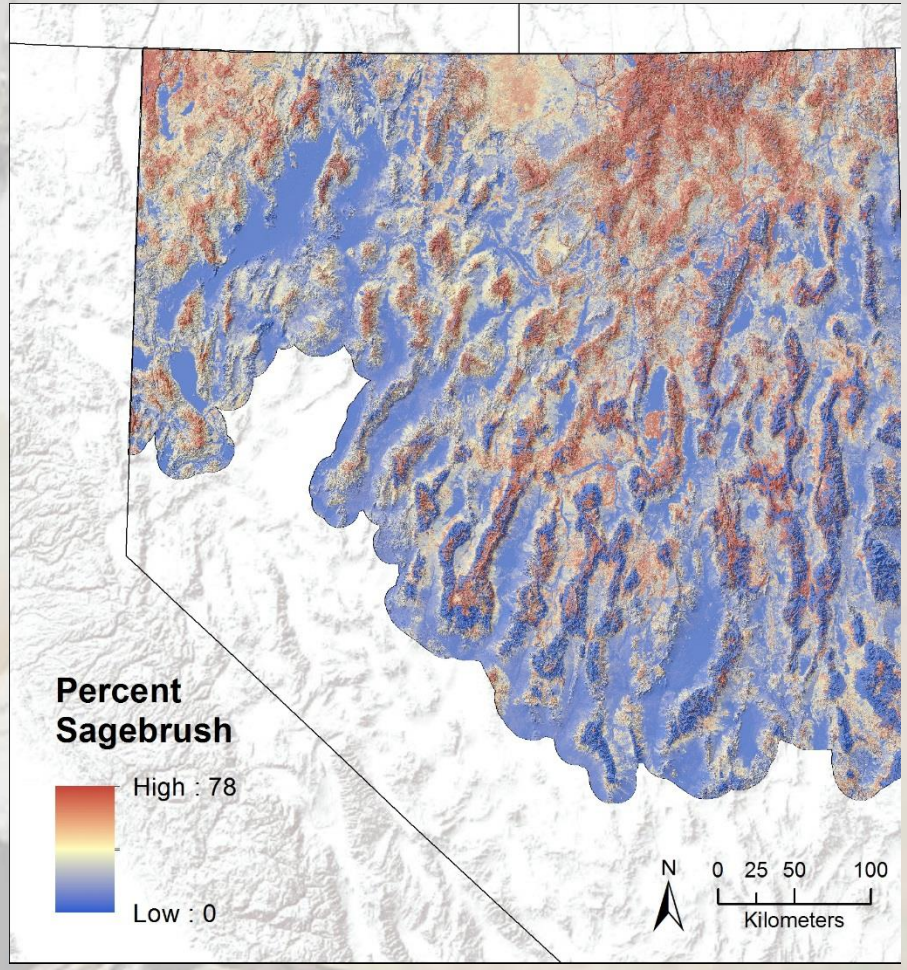
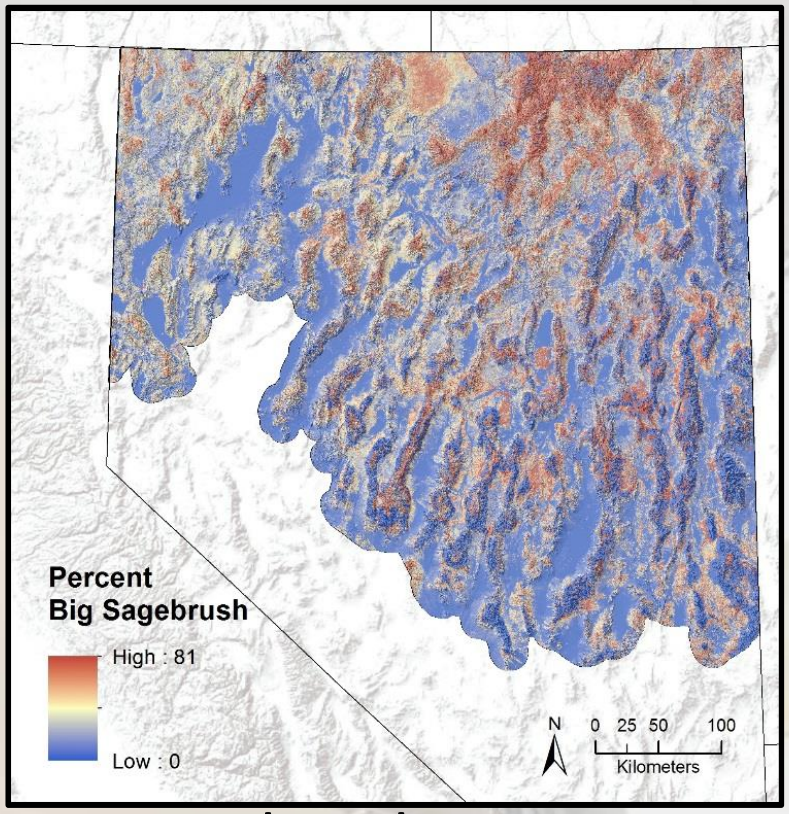


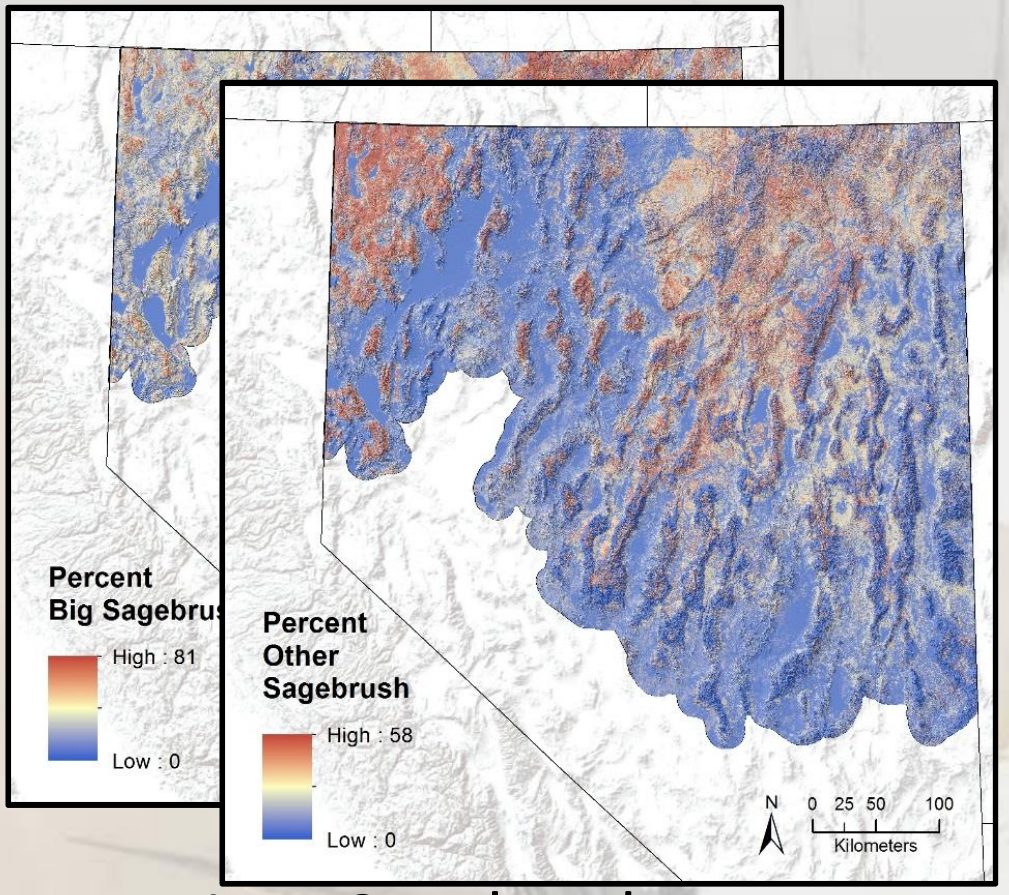


Improved Land Cover Types



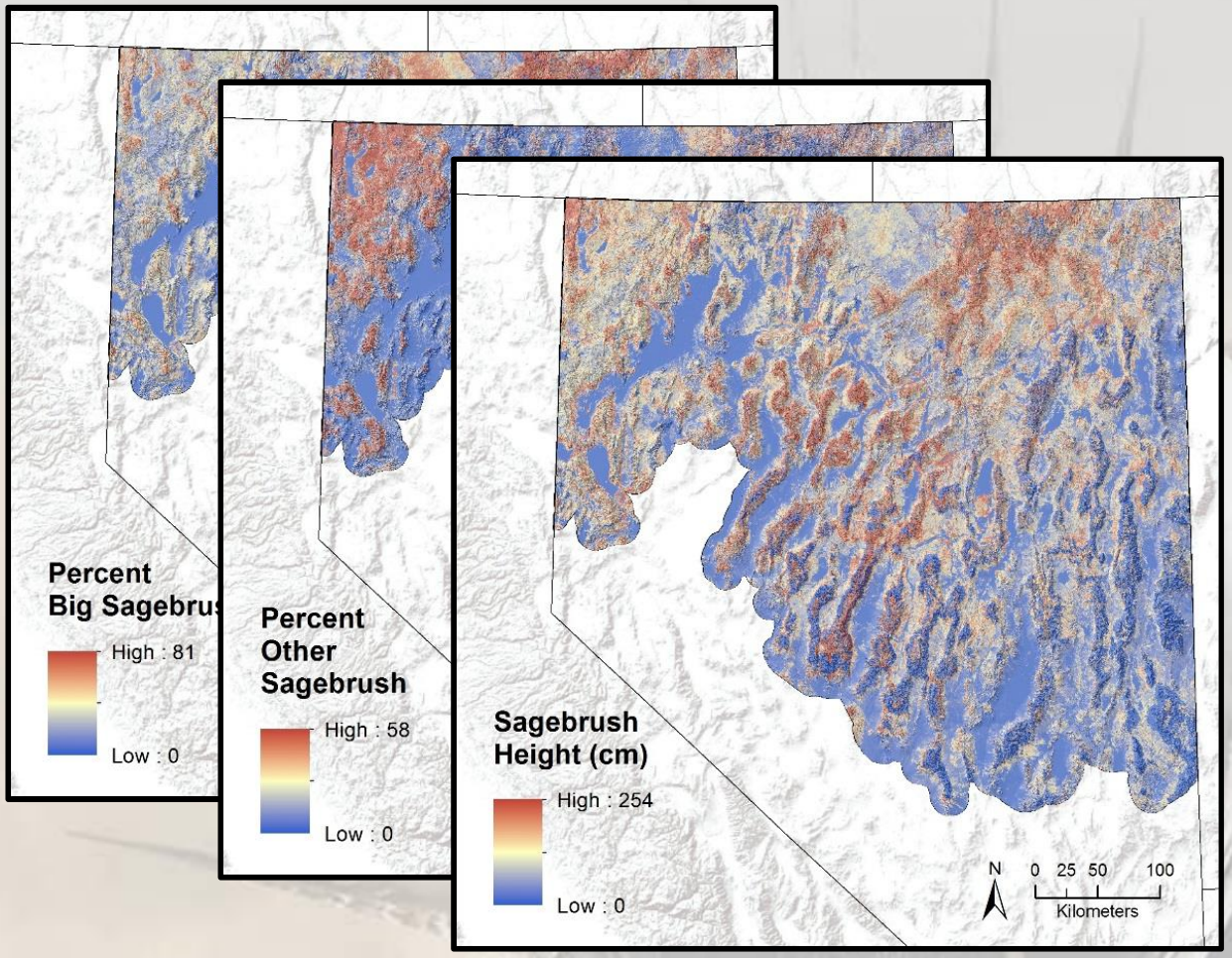
Big Sagebrush

Improved Land Cover Types



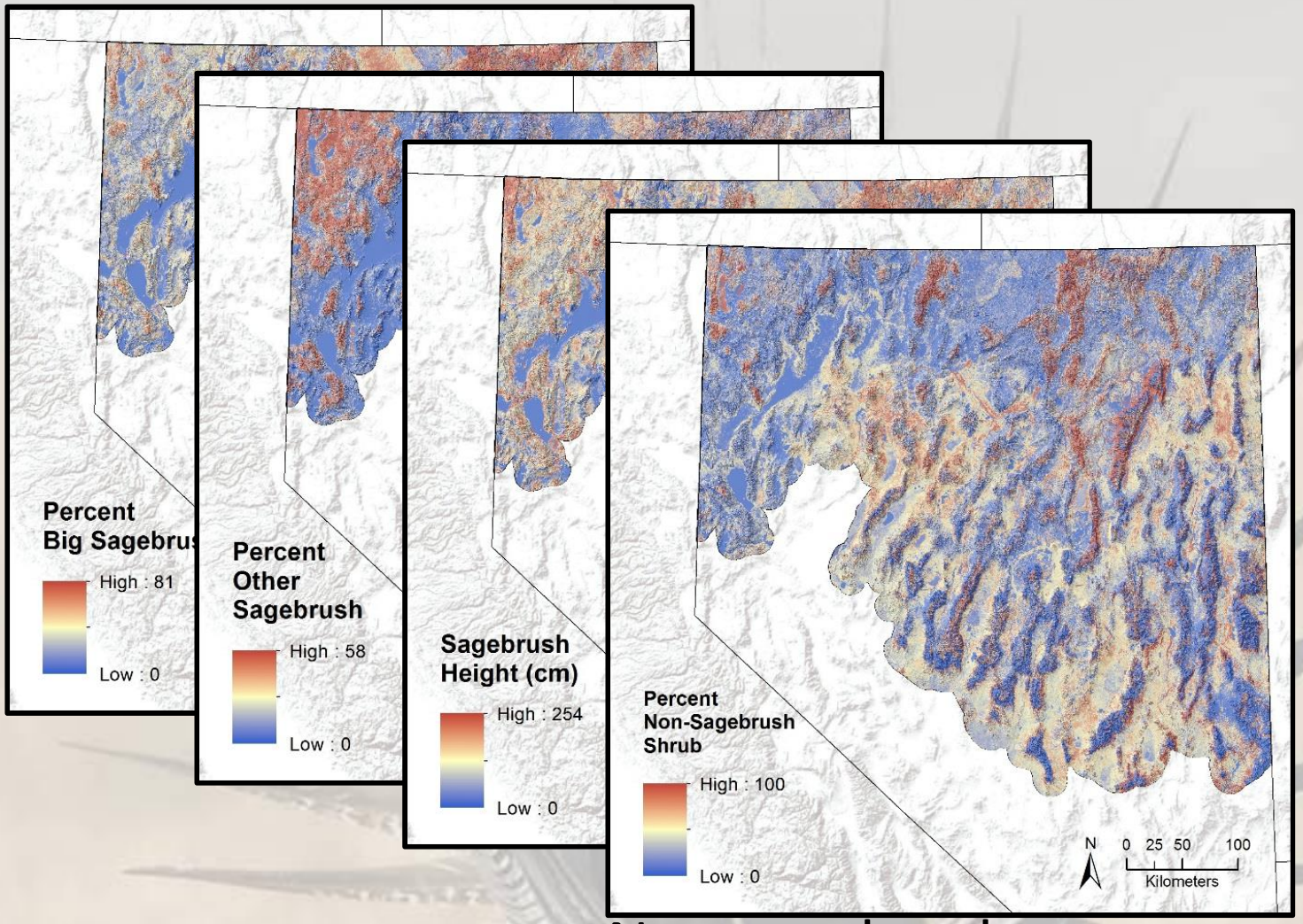
Low Sagebrush

Improved Land Cover Types



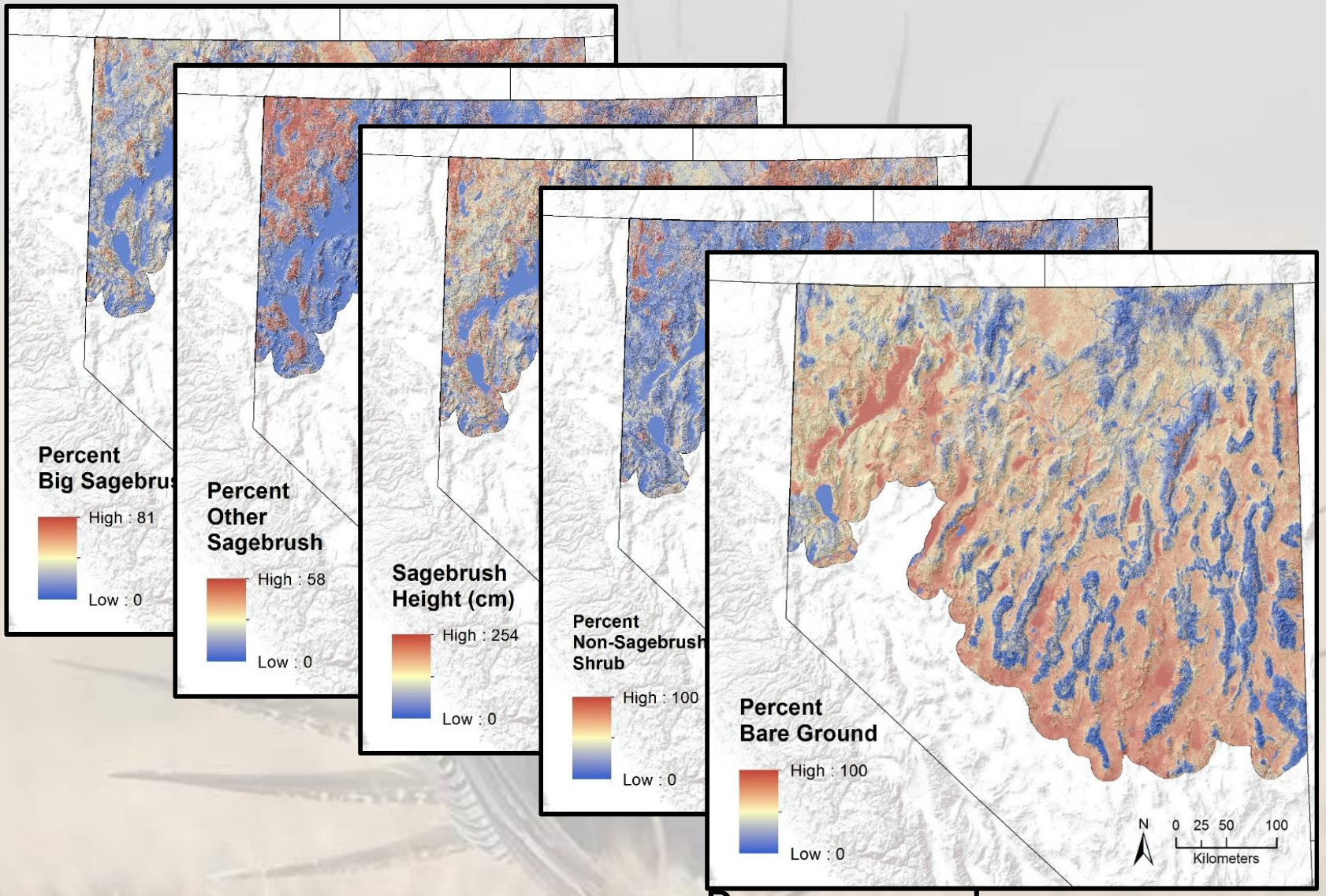
Sagebrush Height

Improved Land Cover Types



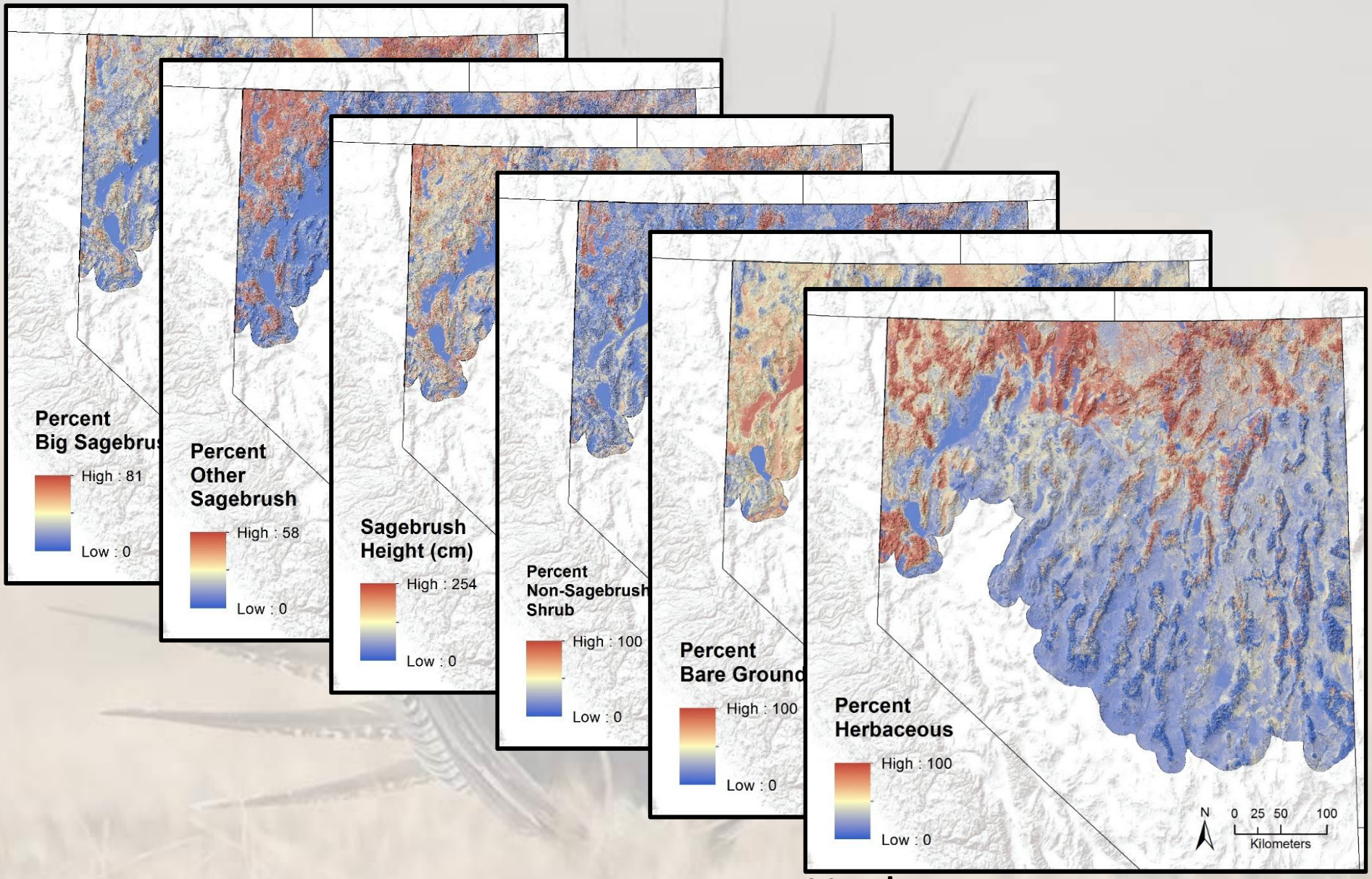
Non-sagebrush

Improved Land Cover Types



Bareground

Improved Land Cover Types

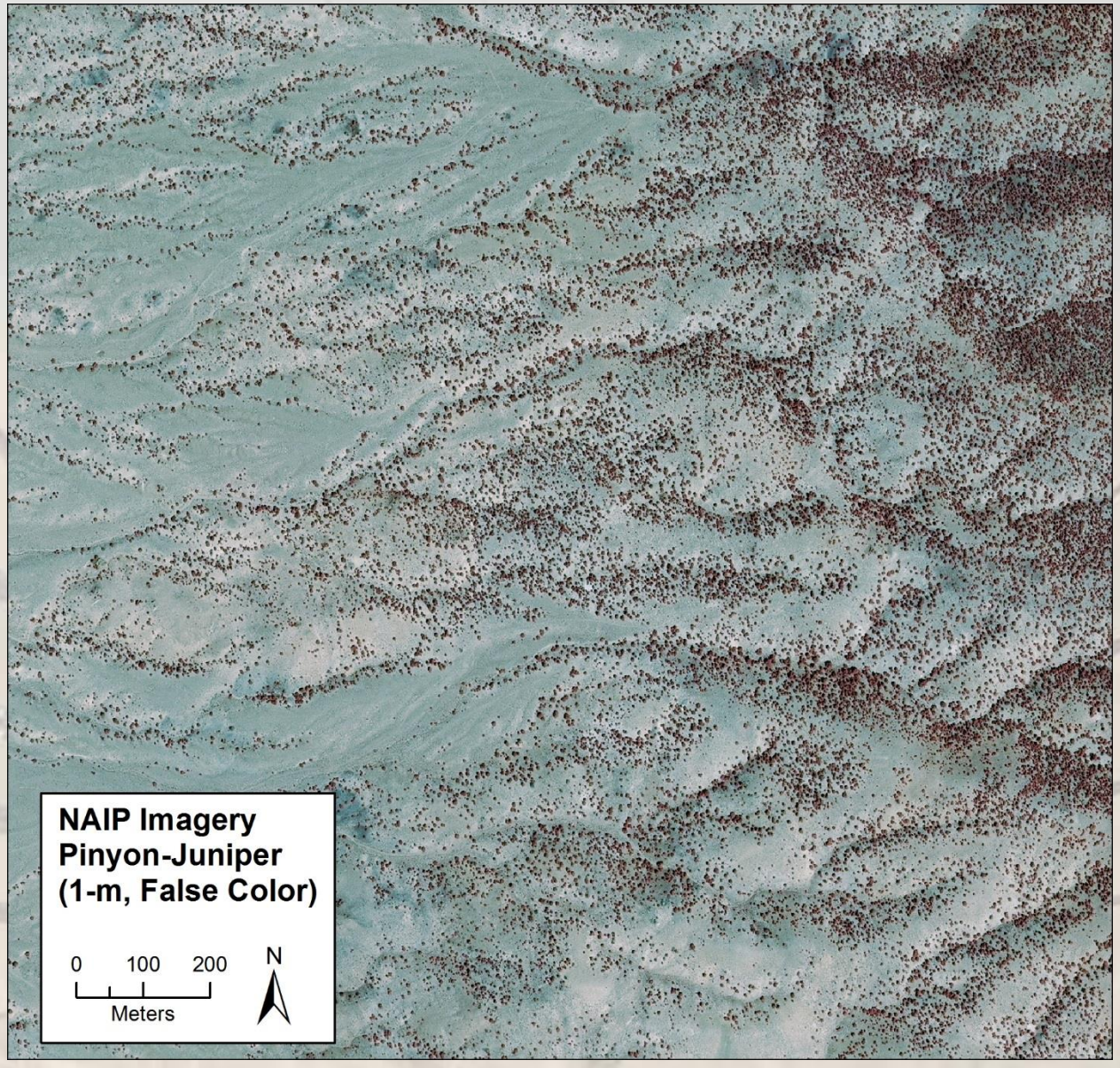


Herbaceous

Improvement on PJ Inputs

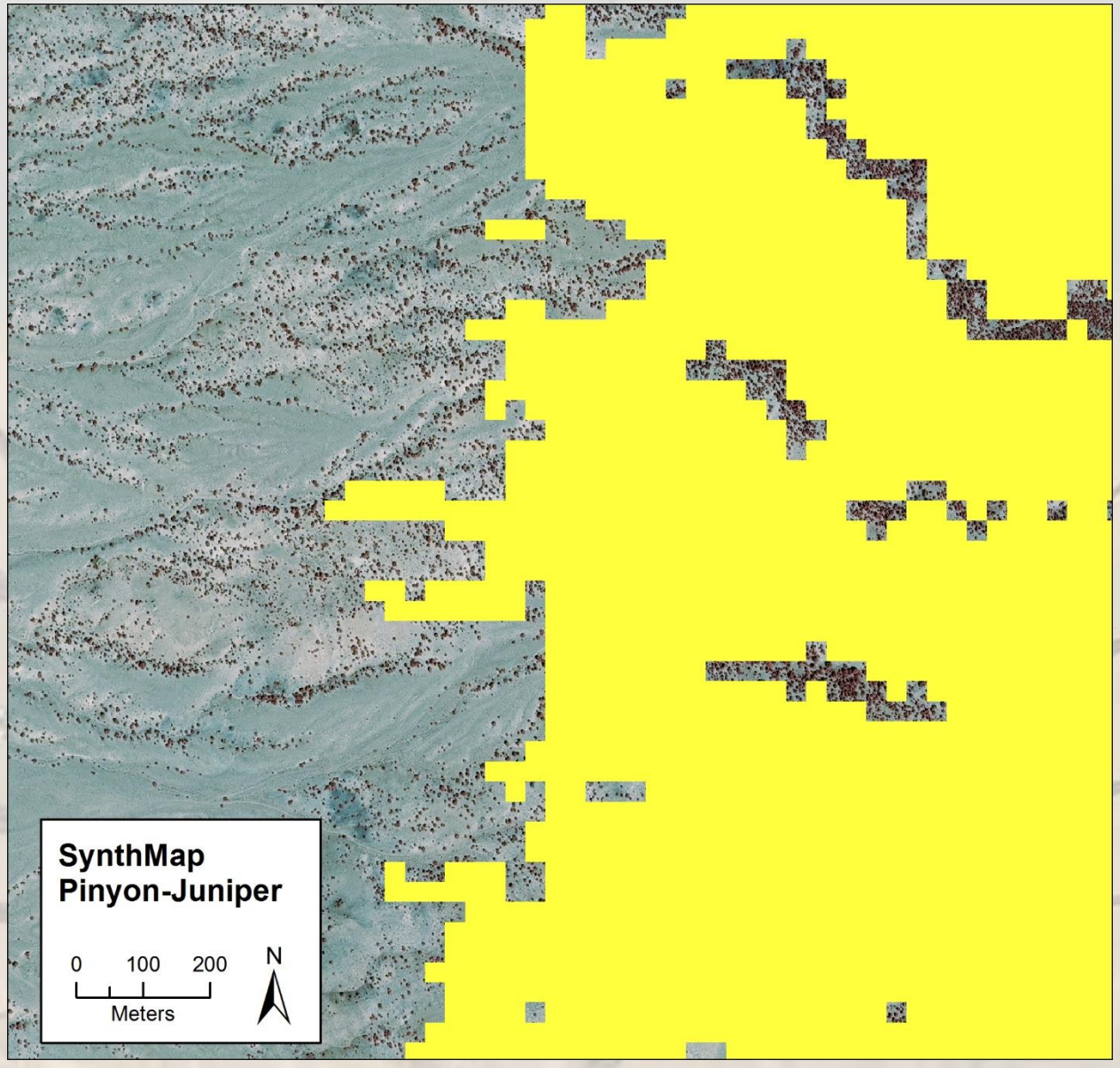
- **Existing 30-m resolution PJ not ideal for habitat mapping**
- **Sage-grouse show strong avoidance of PJ**
- **Low cover of PJ over sagebrush can greatly diminish value of otherwise high quality habitat**
- **‘In house’ and multi-year effort-map to PJ at 1-m resolution to greatly improve habitat models.**

Conifer Land Cover Types



NAIP imagery (black dots are trees)

Conifer Land Cover Types



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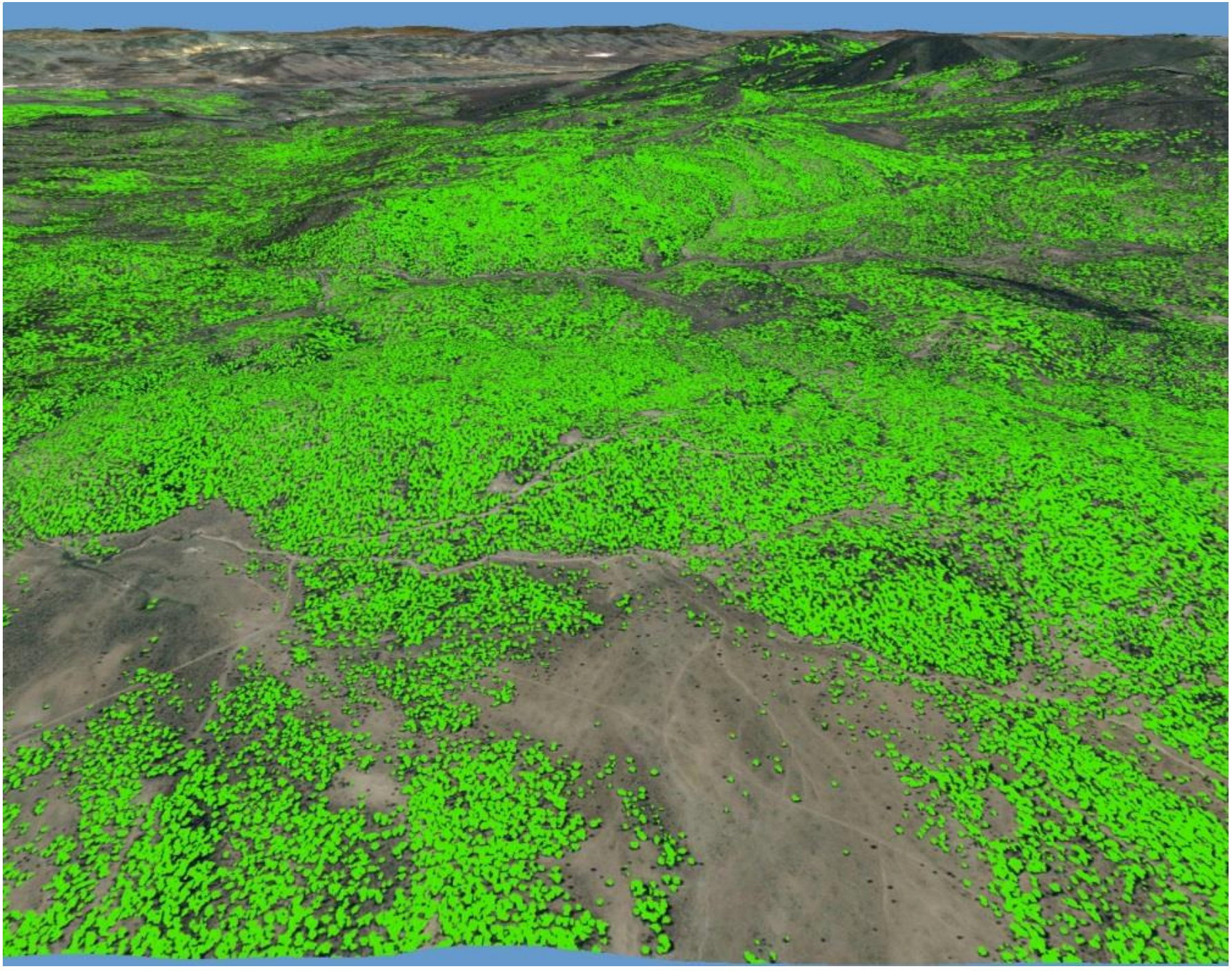

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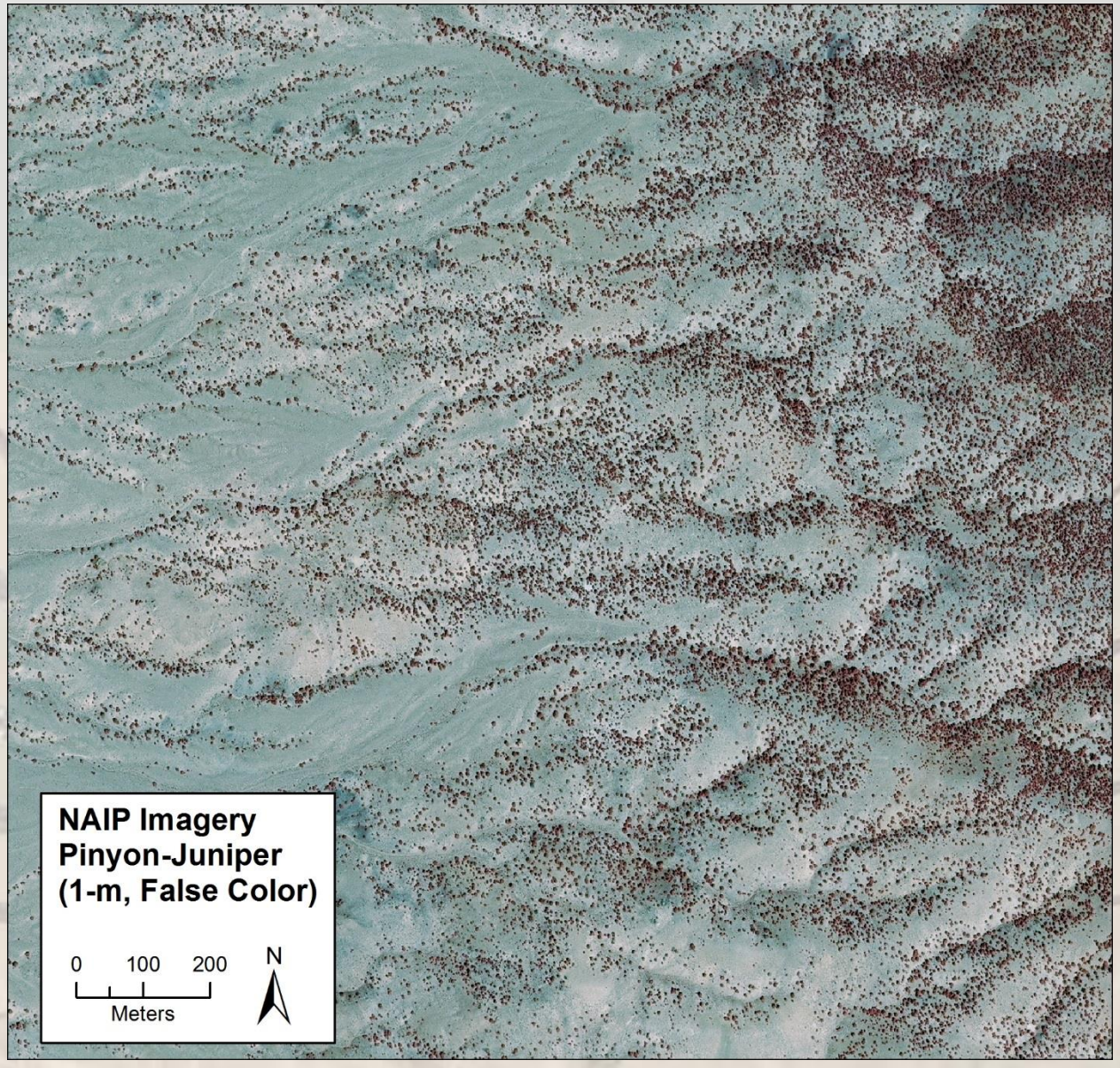

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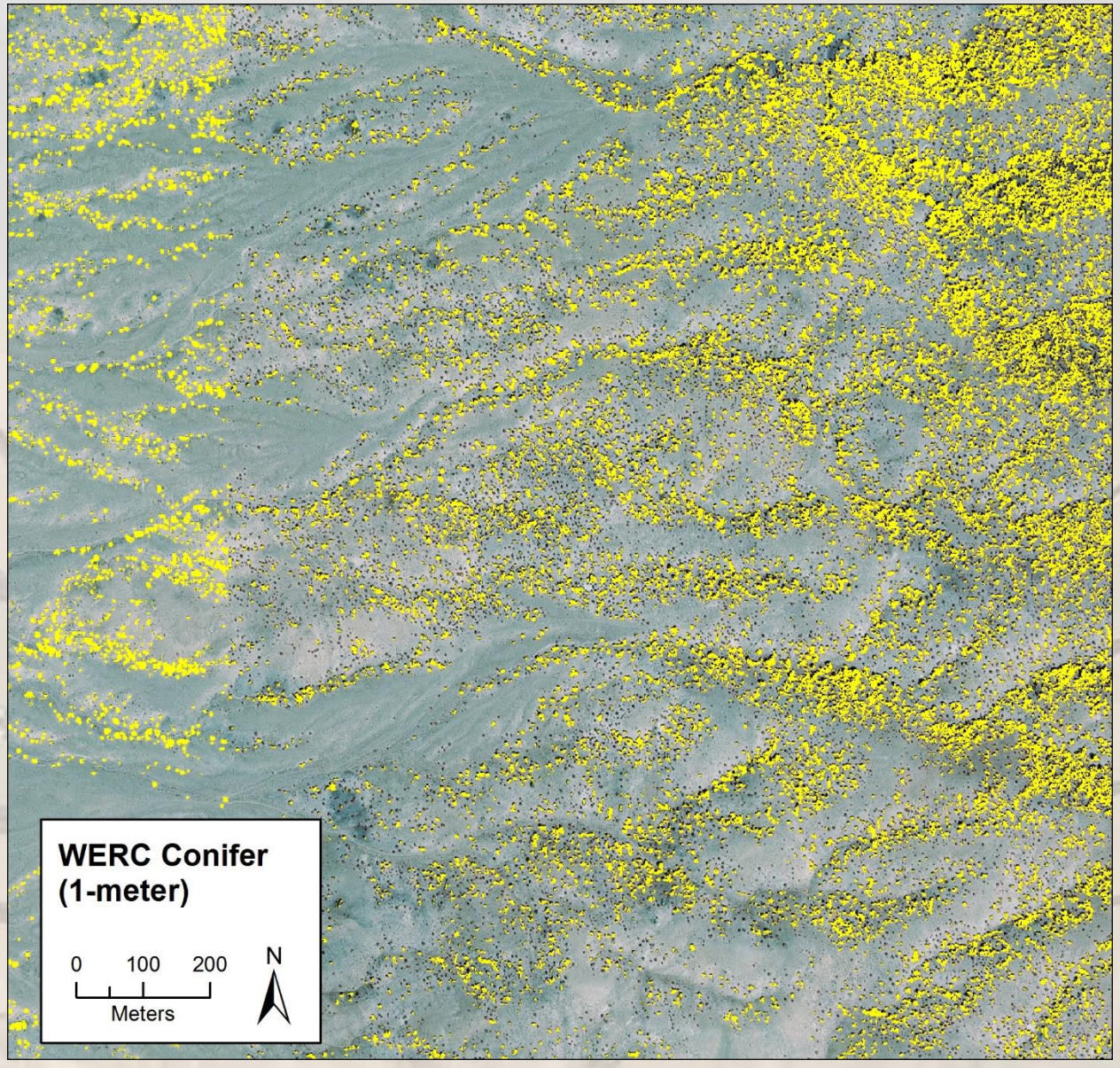
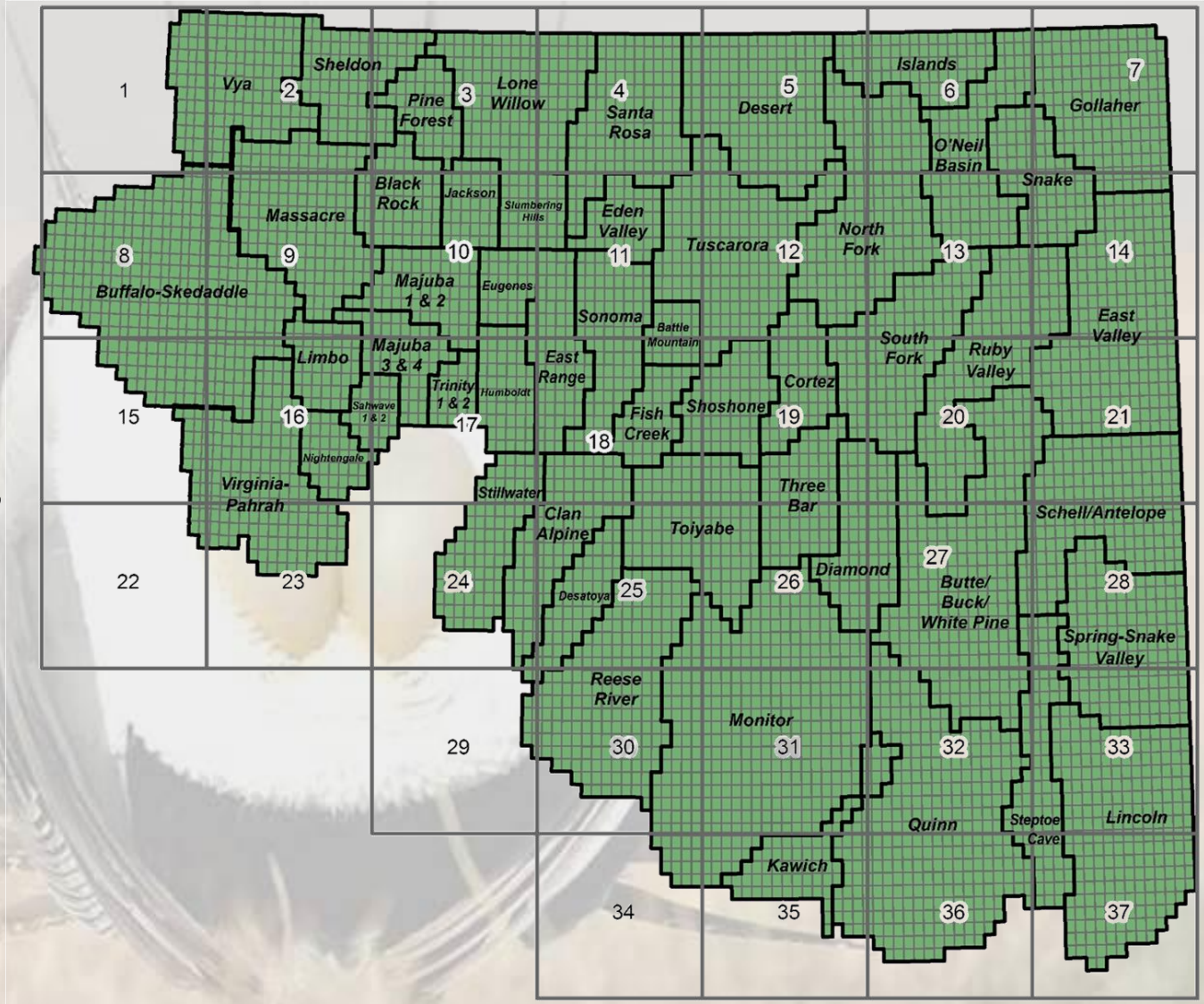
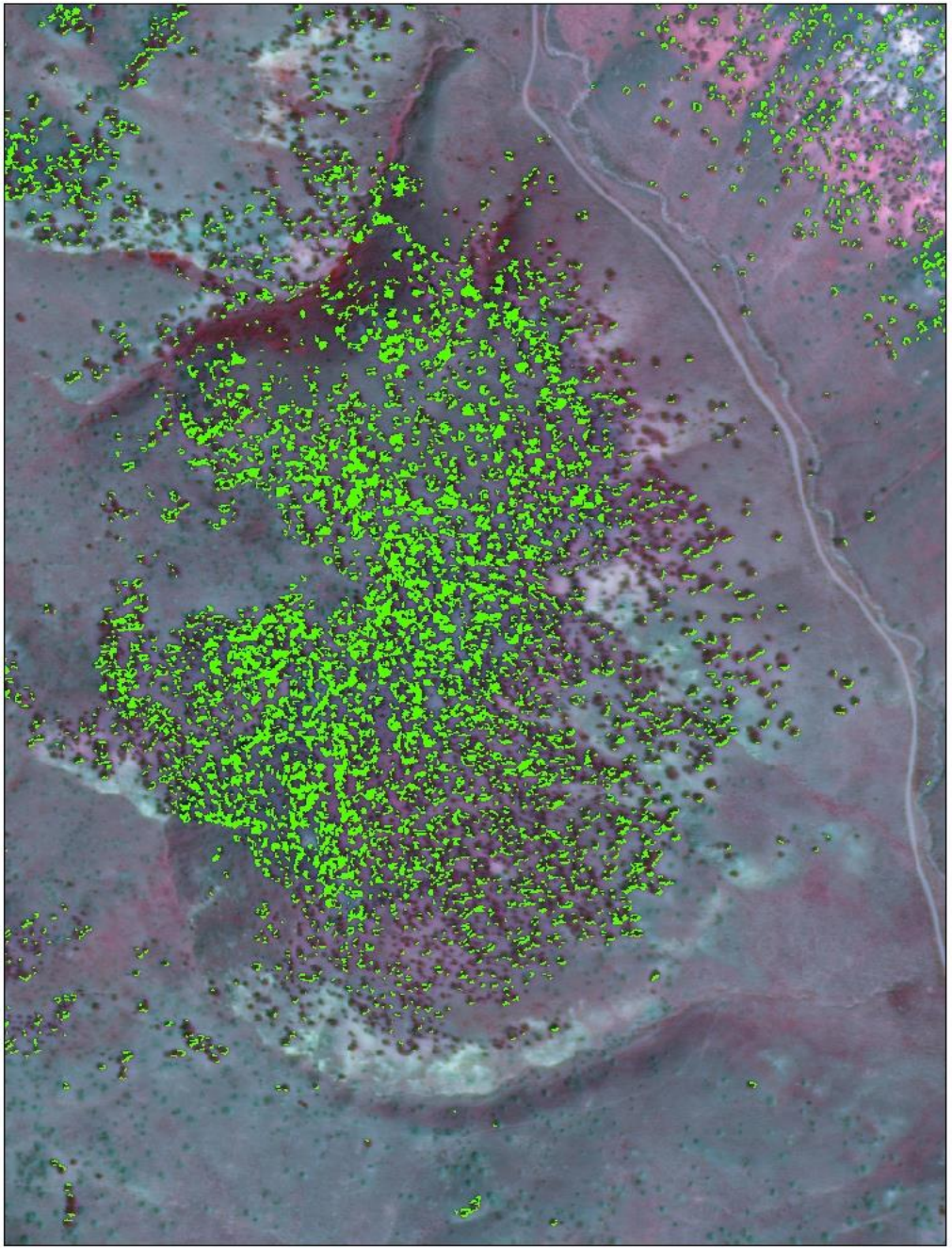

WERC Conifer
(1-meter)
0
100
200
Meters
N

- **> 7,000 tiles state-wide analyzed**
- **Time and computationally intensive process**





Continuous surface that can be modeled as a percentage

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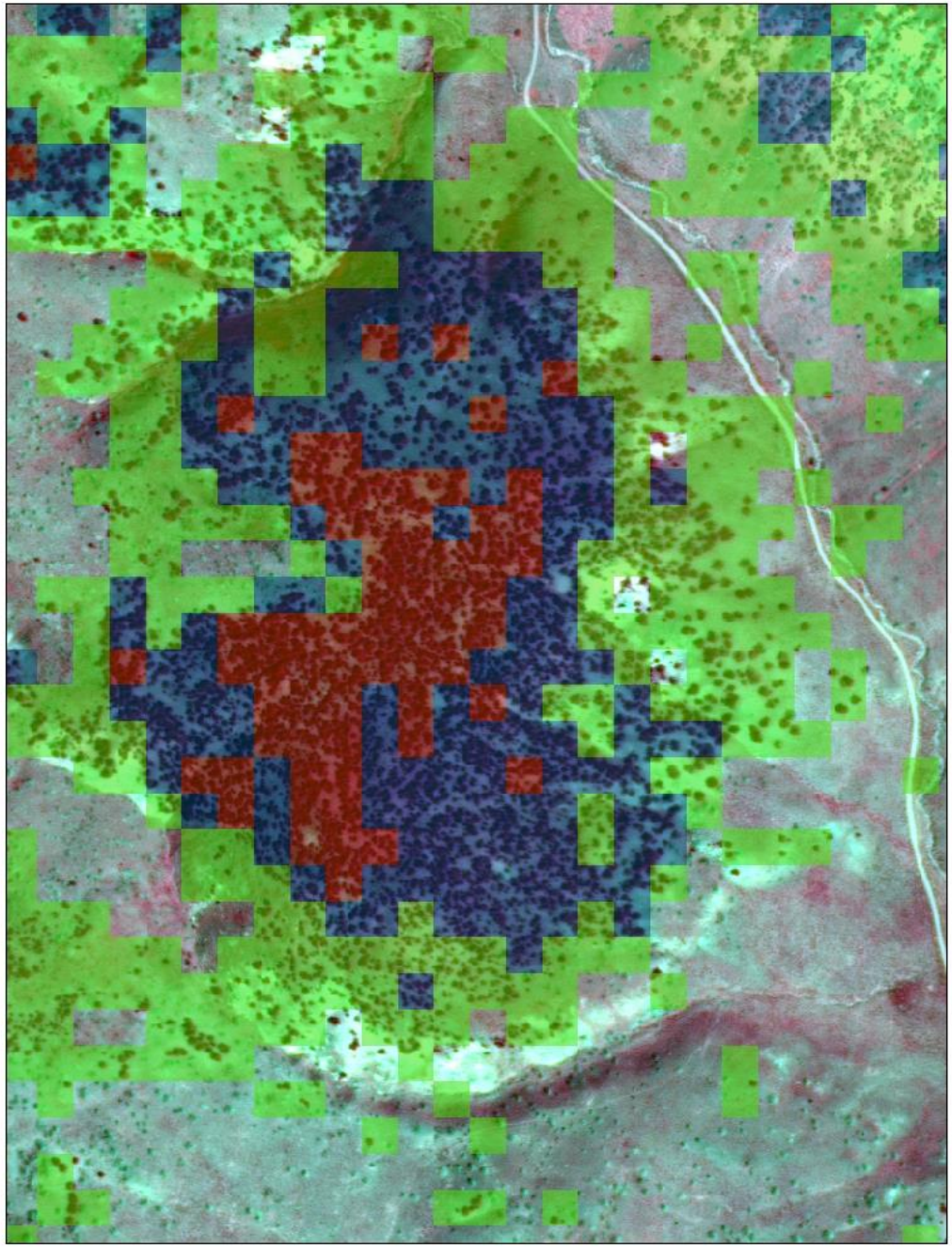
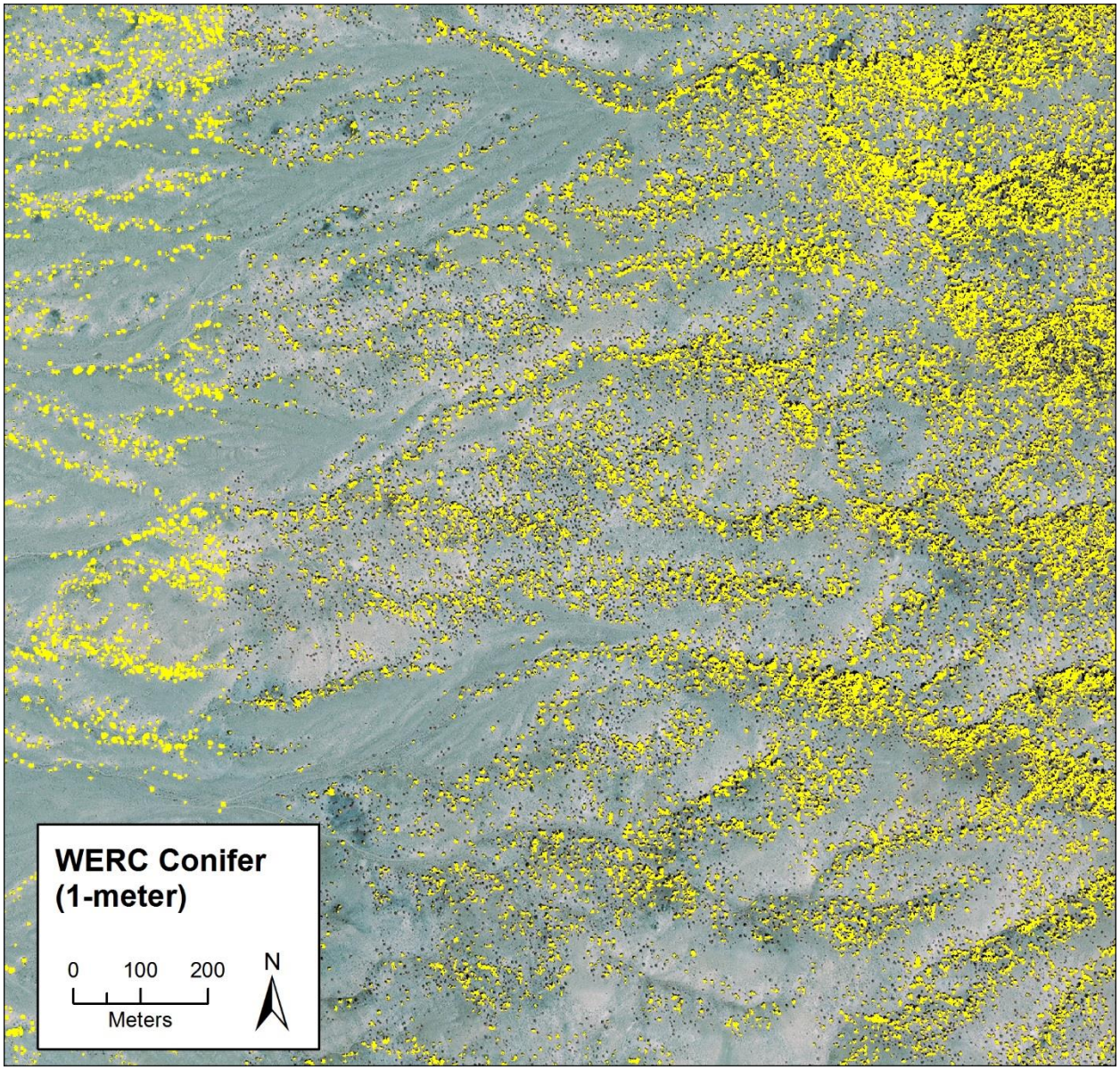
Conifer Cover Classes

Green
Class 1

Blue
Class 2

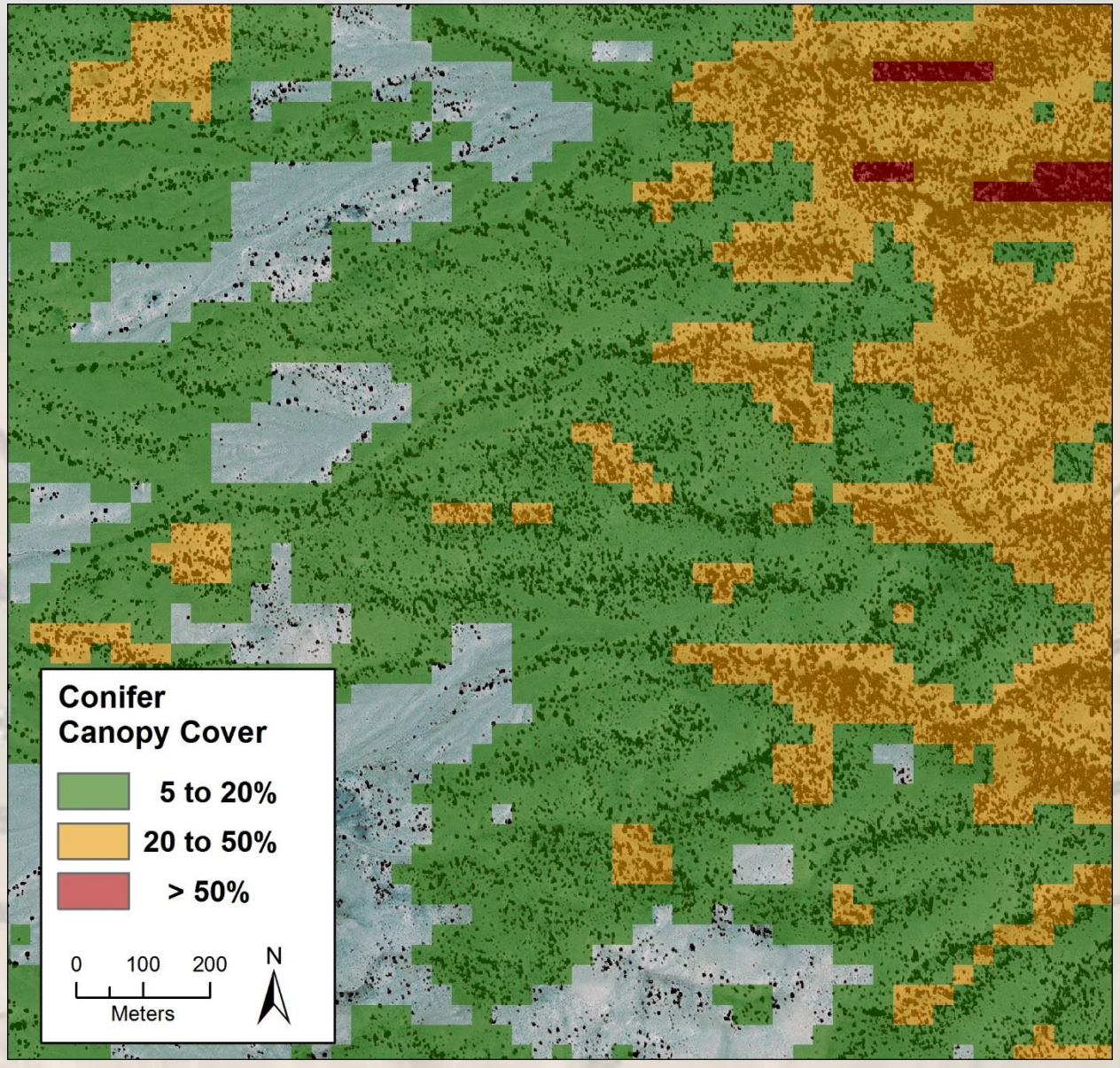
Red
Class 3





Use object recognition software

Continuous surface that can be modeled as a percentage



Can also be reclassified into ecologically relevant cover classes for a wide range of management applications.

Locations of sage-grouse using GPS and VHF telemetry

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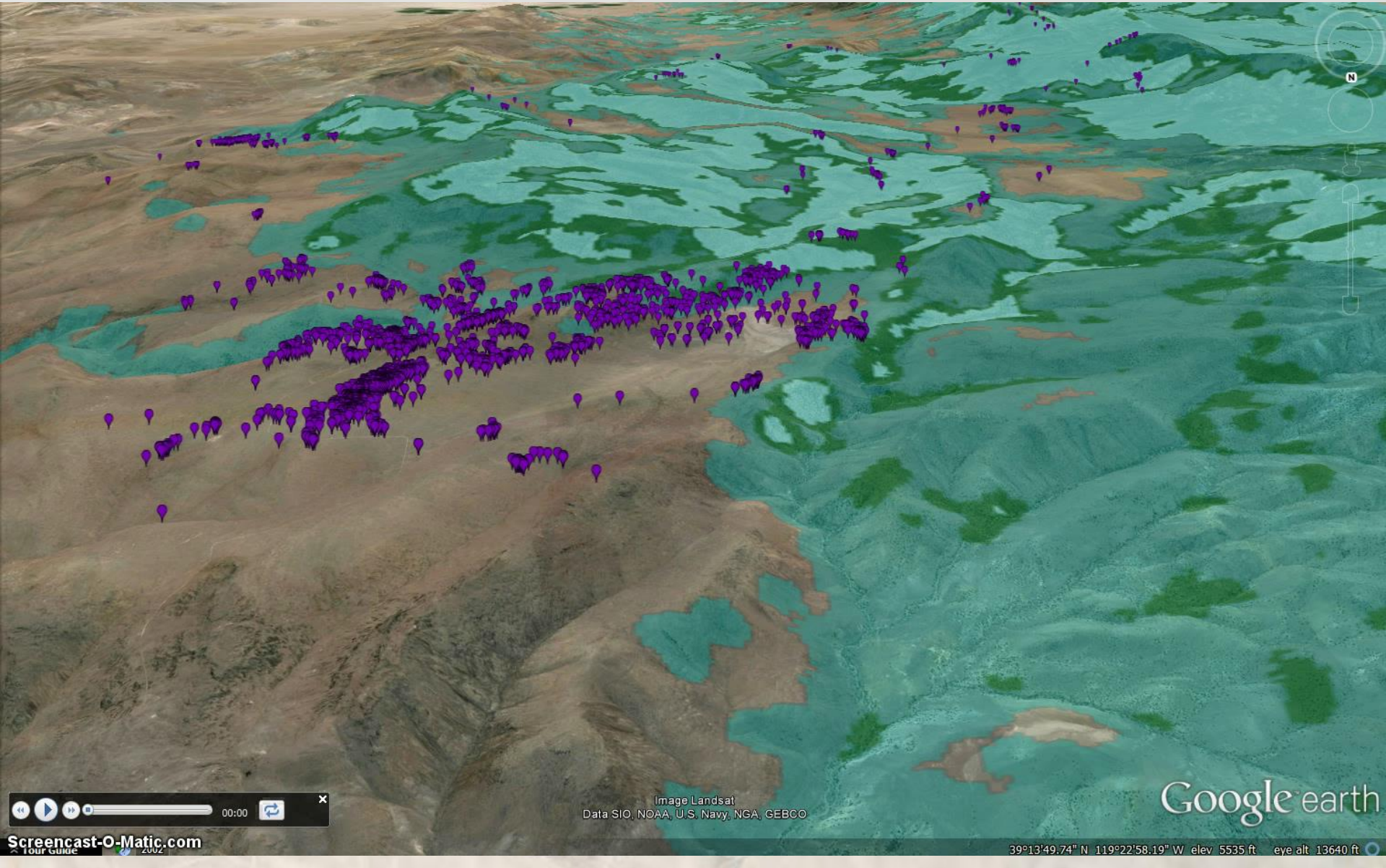
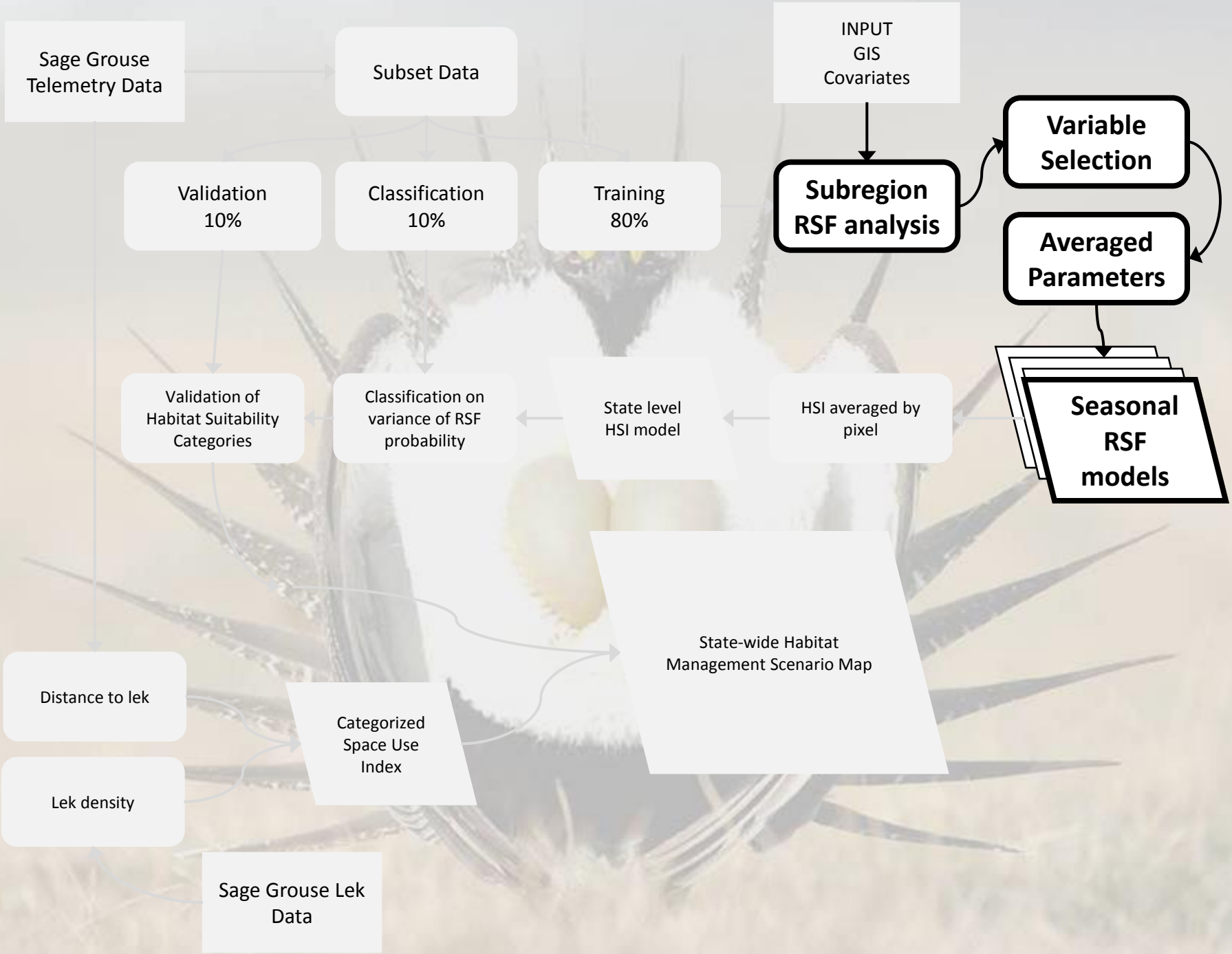


Landcover Update Summary

Previous (30-m based)	Updated (< 2-m based)
Bare ground	% Bare ground
All sagebrush	% Big sagebrush
	% Low sagebrush
Lowland shrub	% Non-sagebrush
Upland shrub	% Non-sagebrush
Pinyon Juniper	% Pinyon Juniper
none	% Pinyon Juniper Understory
none	% Herbaceous (interspace)
none	Urban masked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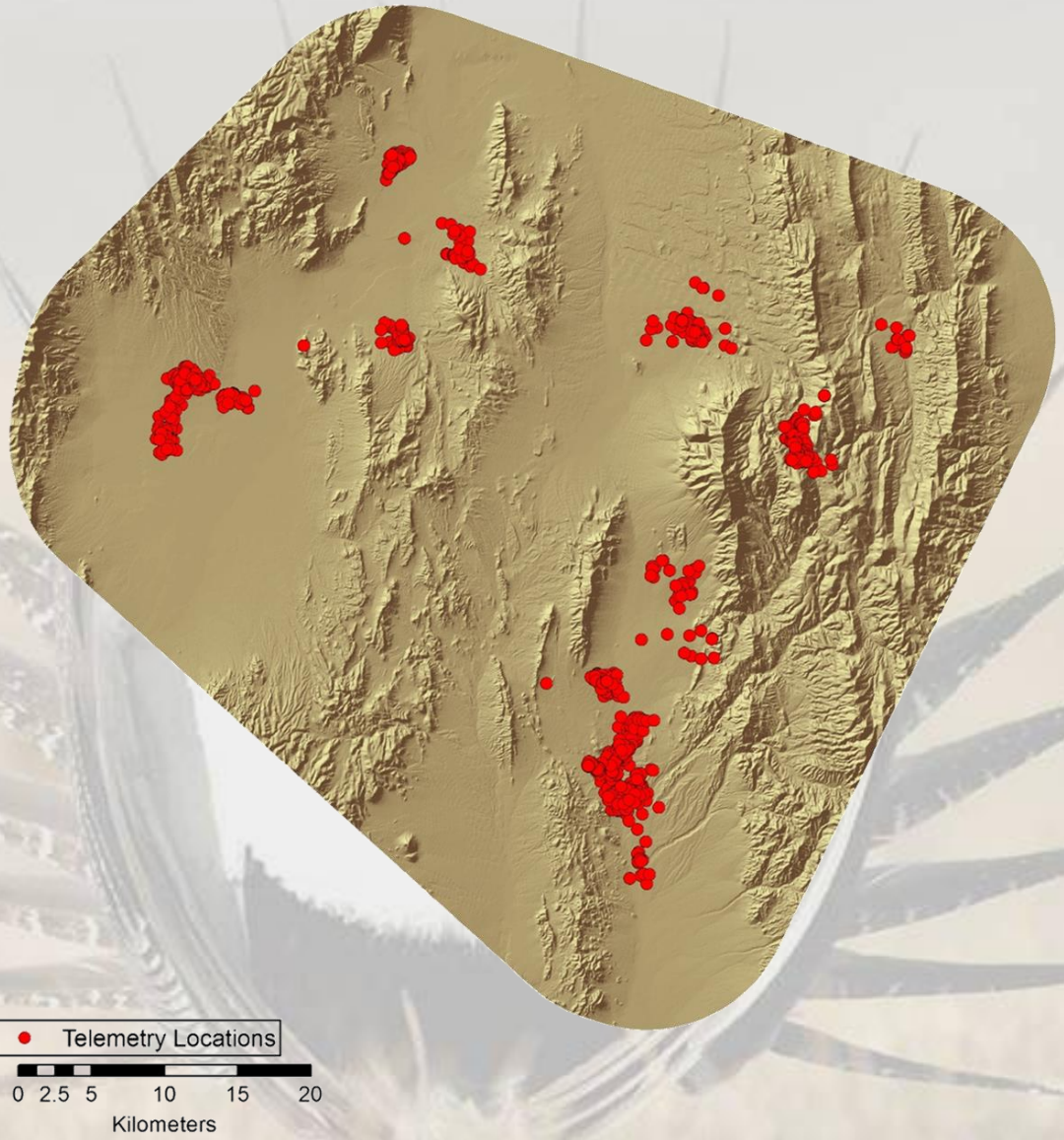
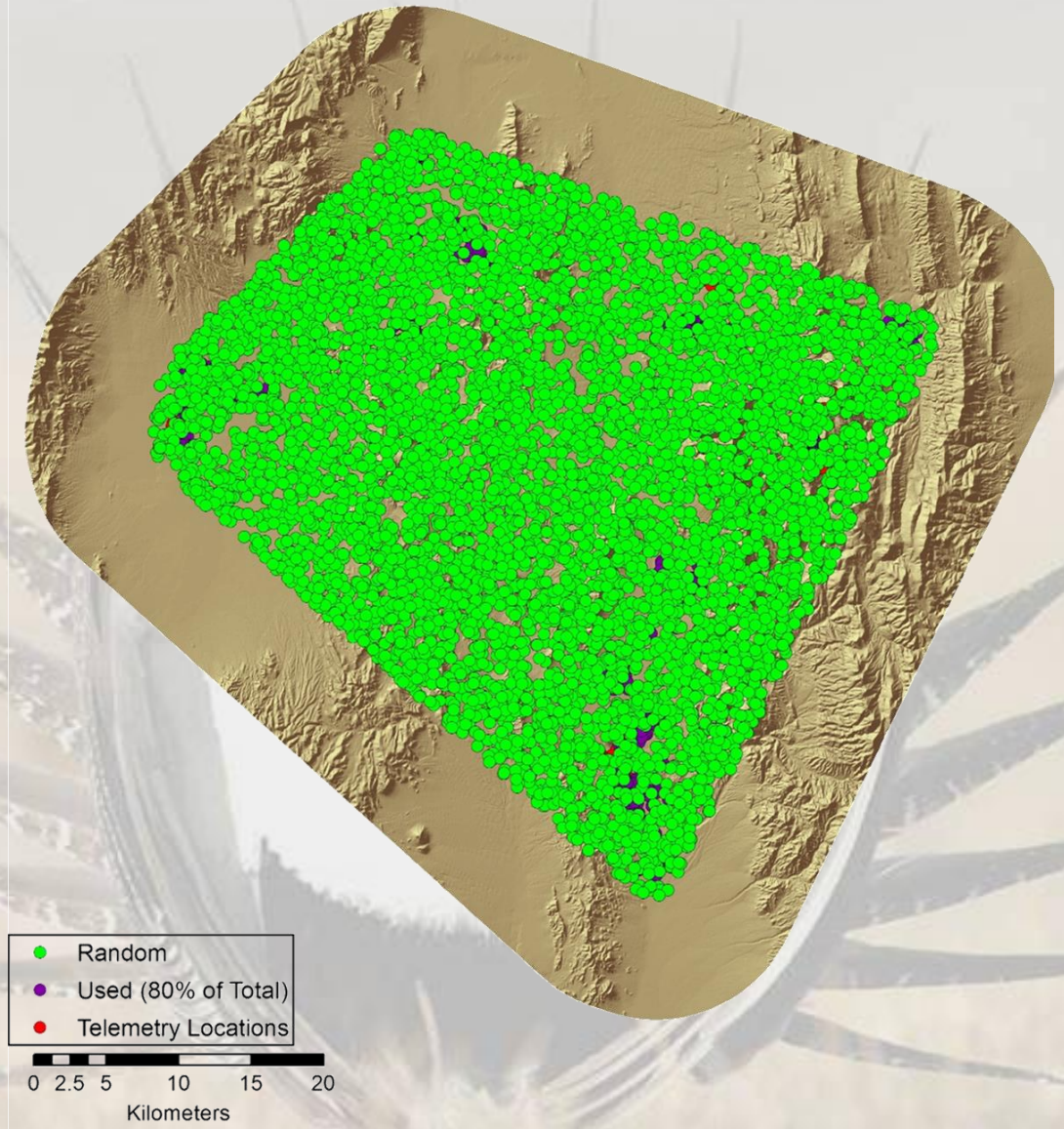
RSF Example (Telemetry Points)



RSF Example (Random Points)



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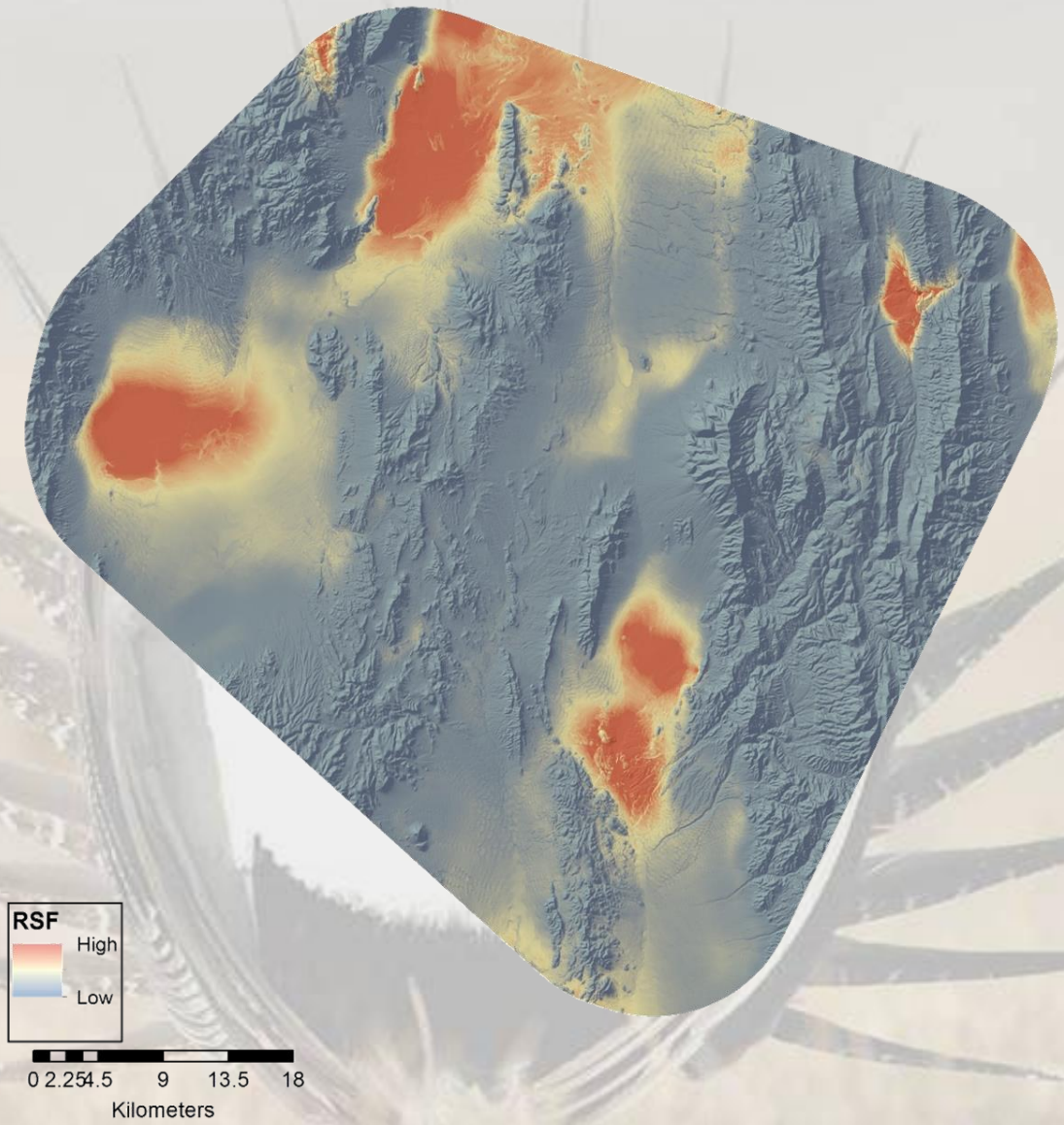
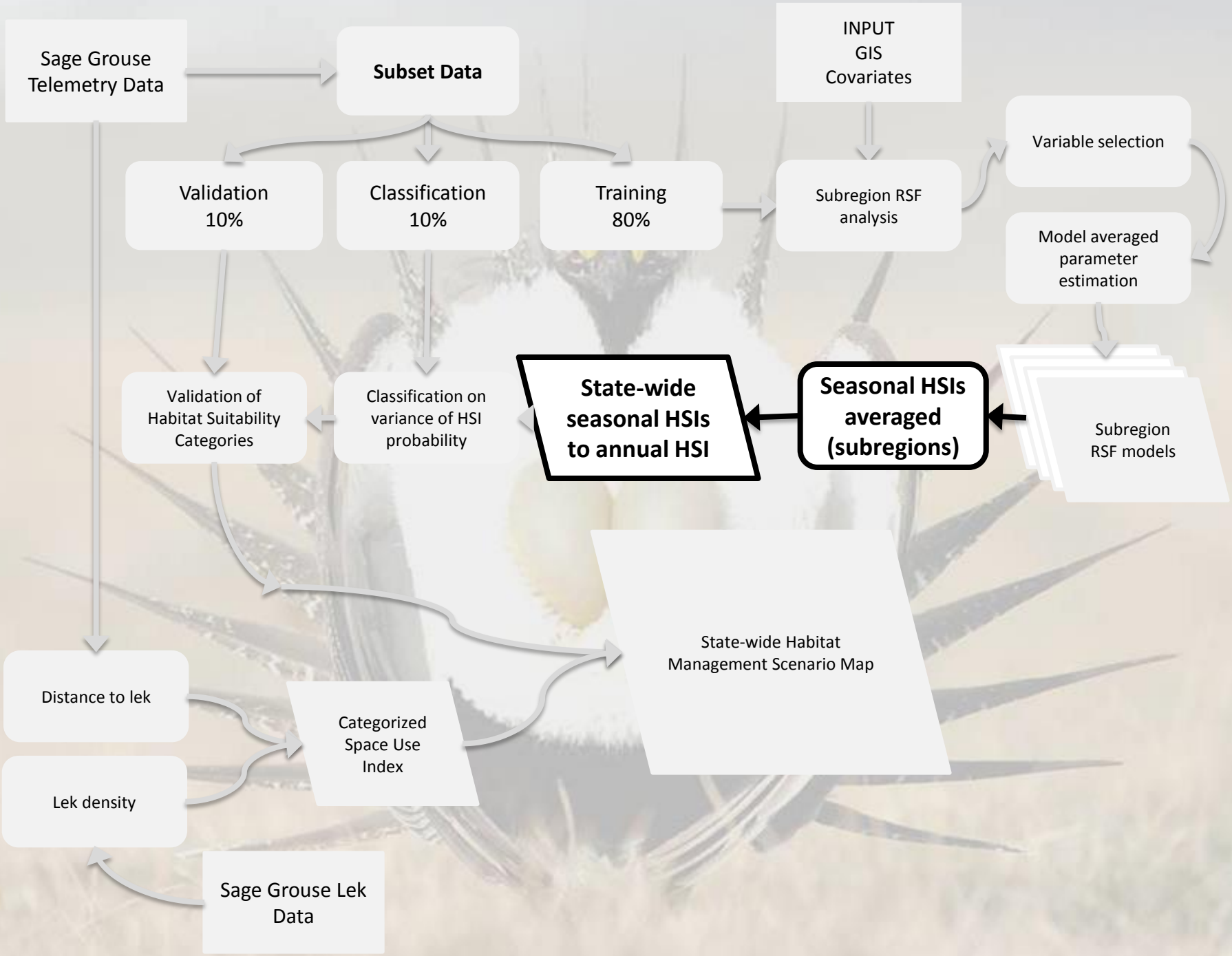
RSF Example (Resource Selection Function)

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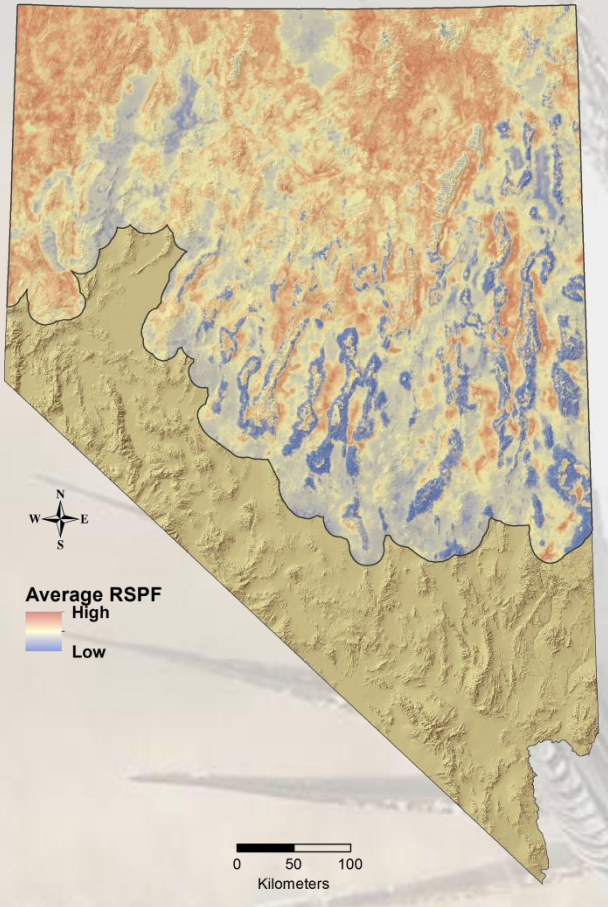
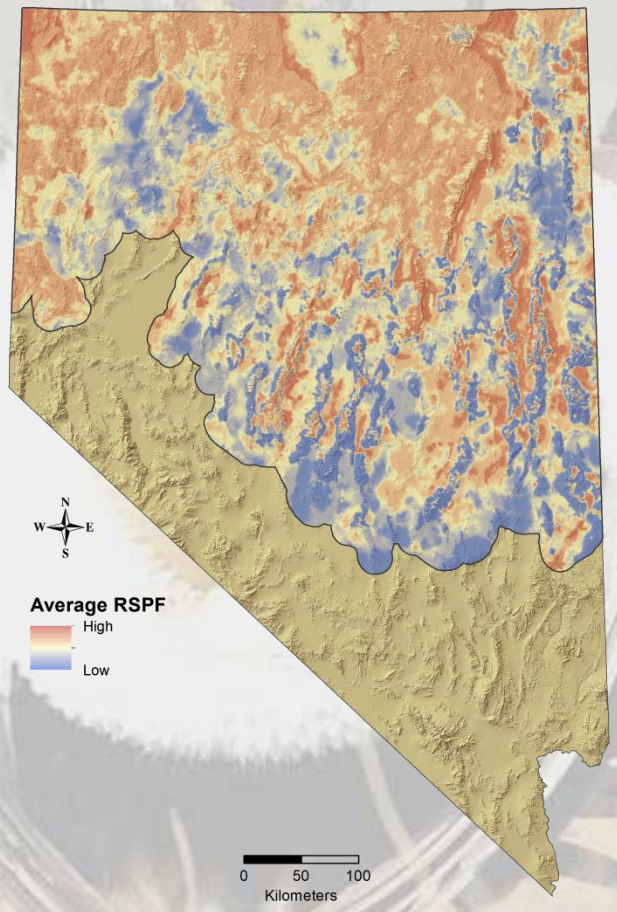
Seasonal HSIs

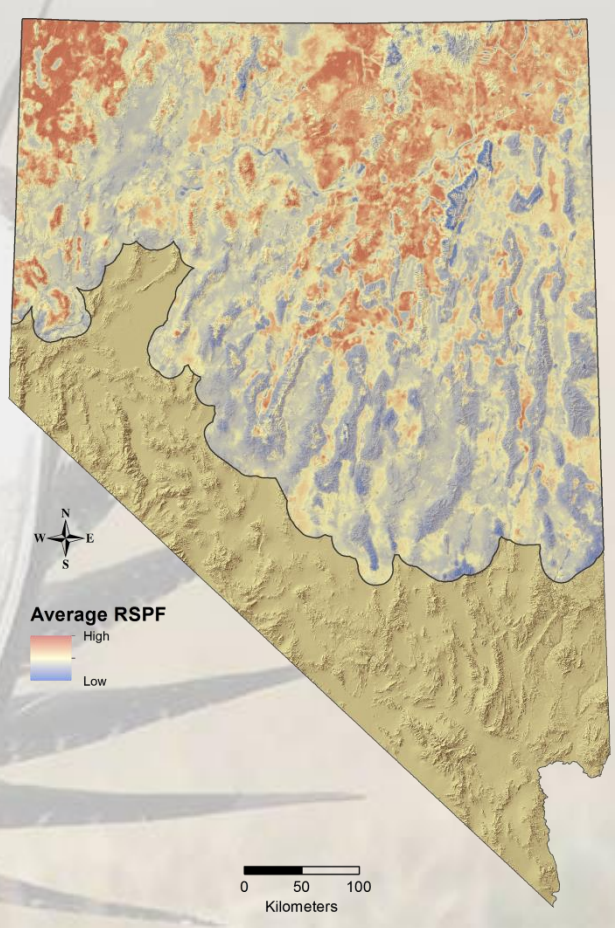
Breeding



Brood



Winter



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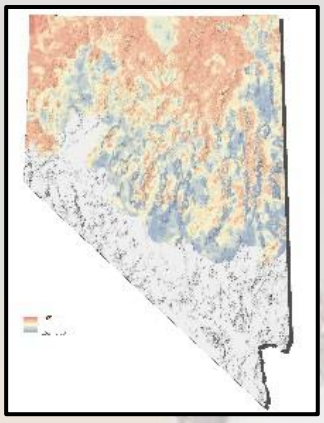
Modeling Seasons / composite to annual

Breed



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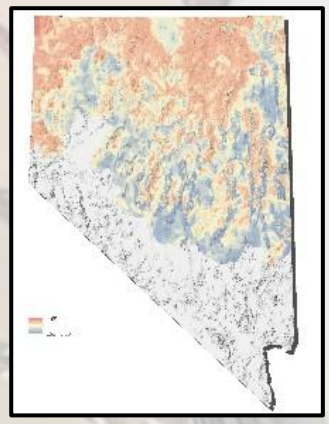

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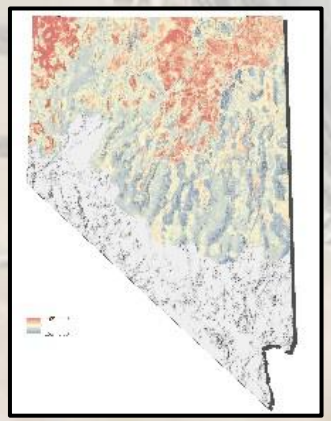

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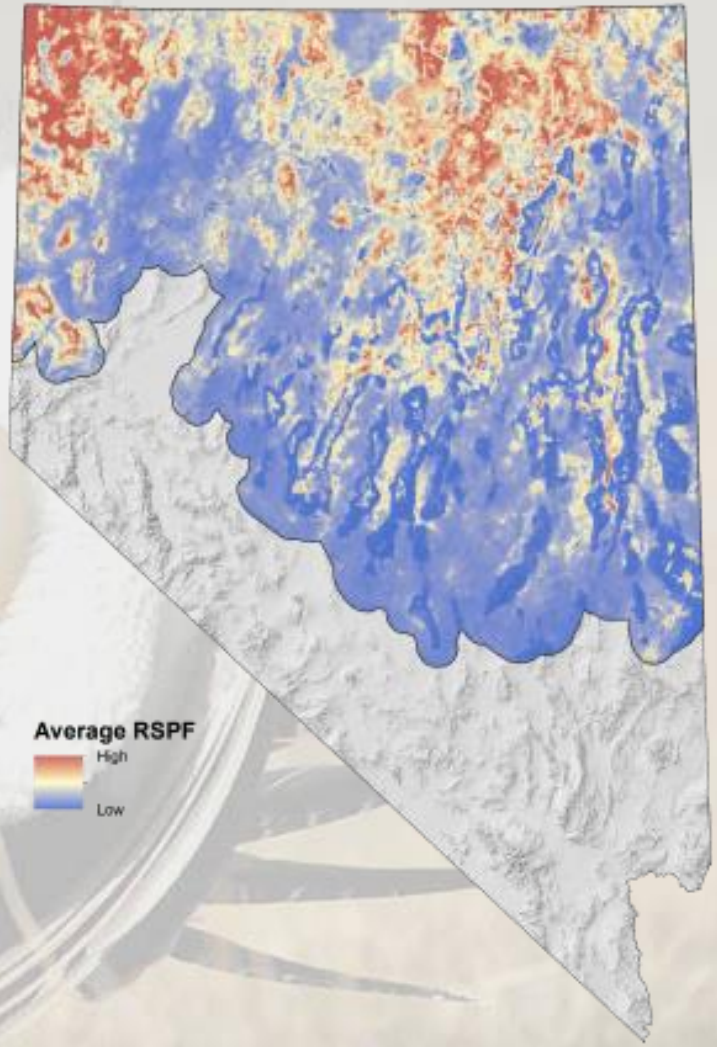

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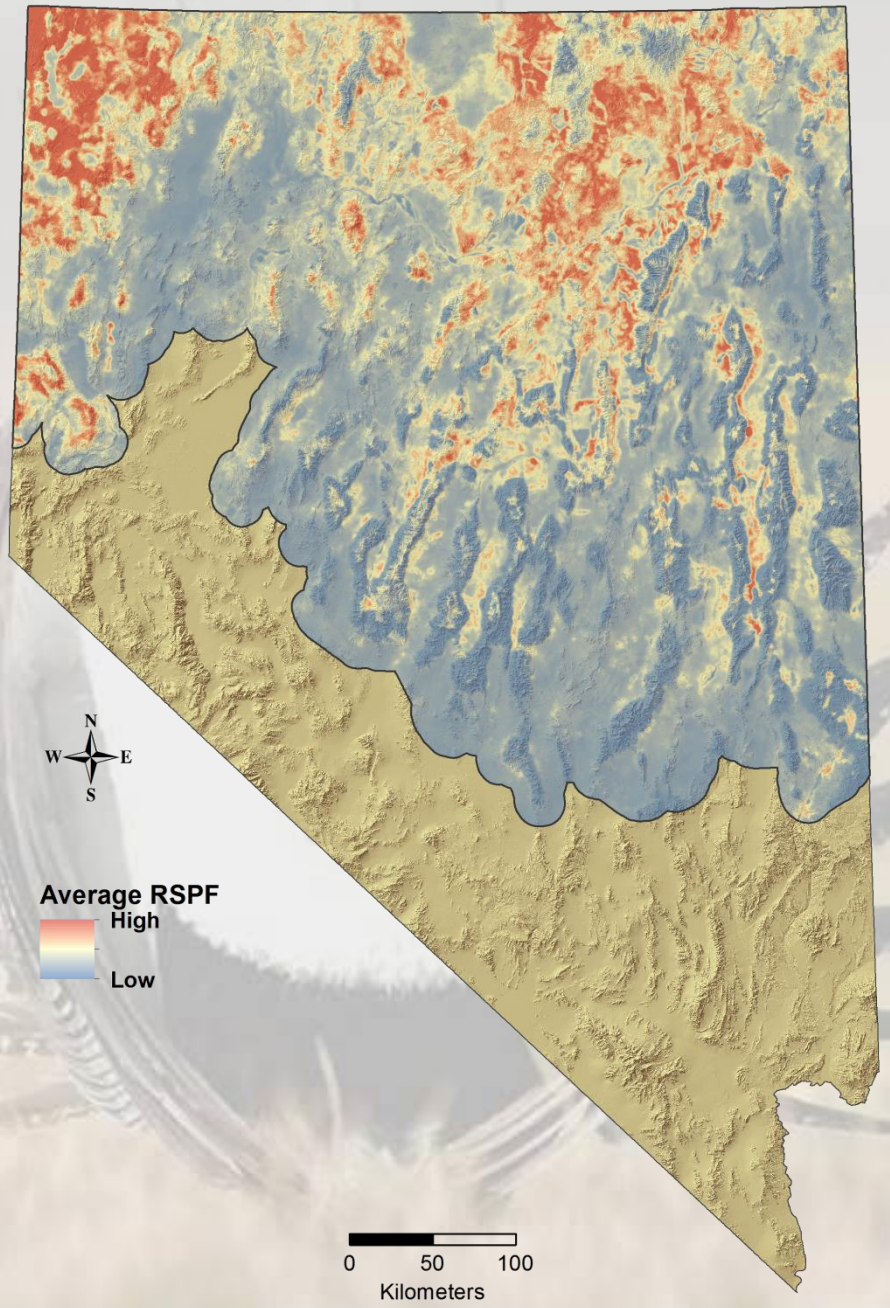
Habitat Suitability Index (HSI)



- **Measures a statewide relative probability of selection**
- **Continuous Index (0 to 1)**

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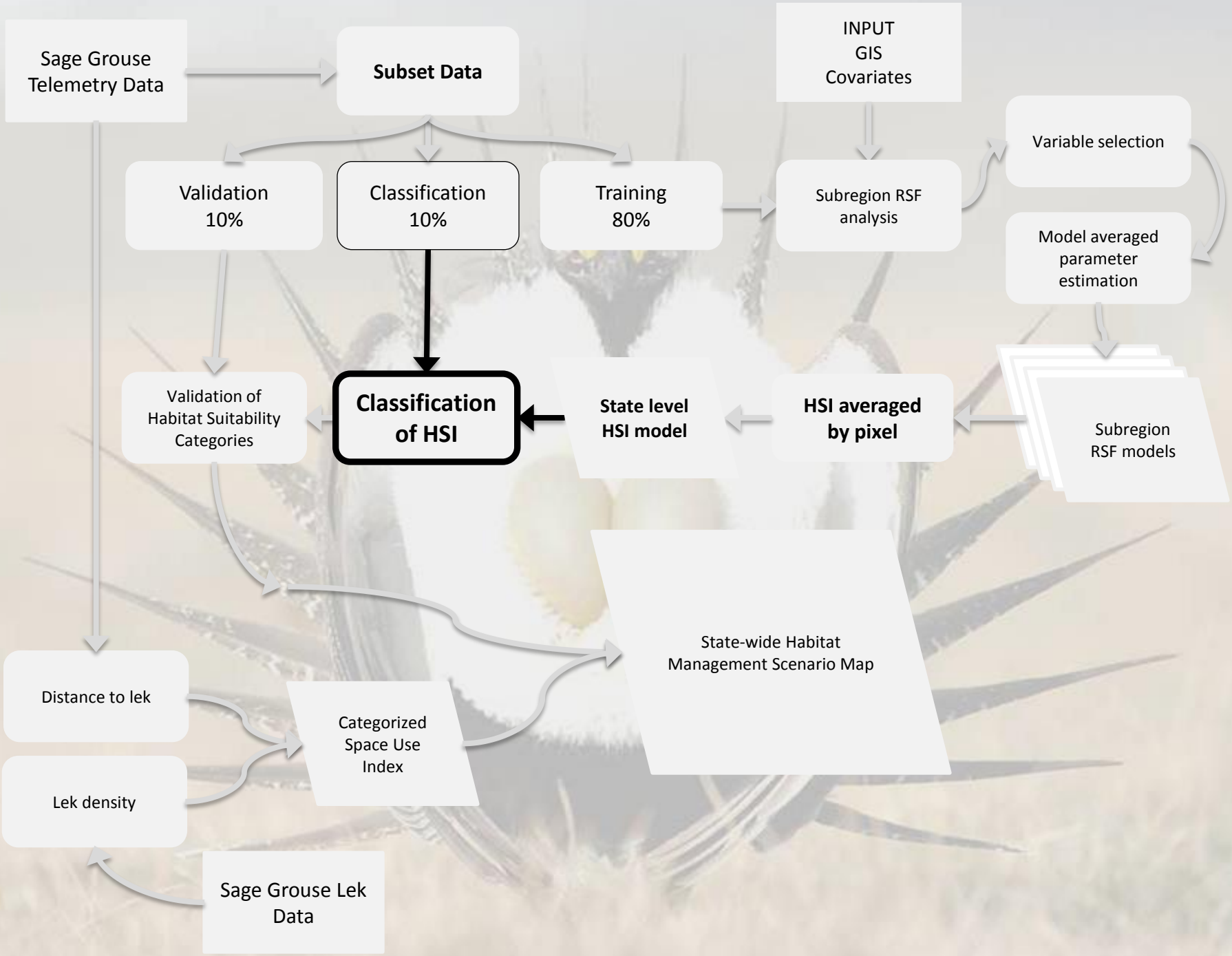
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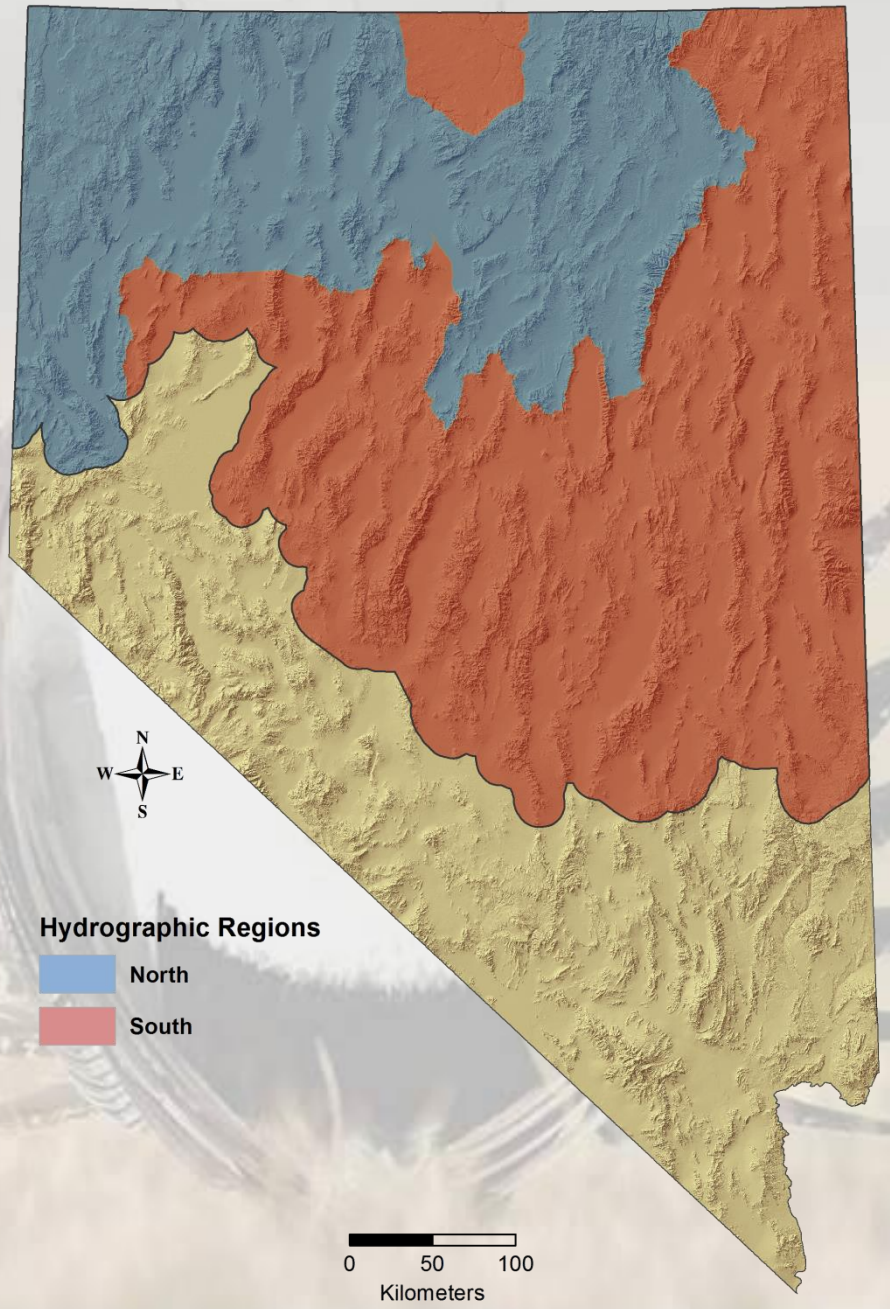
Subregion RSF models
State-wide Habitat Management Scenario Map
Distance to lek
Lek density
Categorized Space Use Index
Sage Grouse Lek Data

Hydrographic Regions

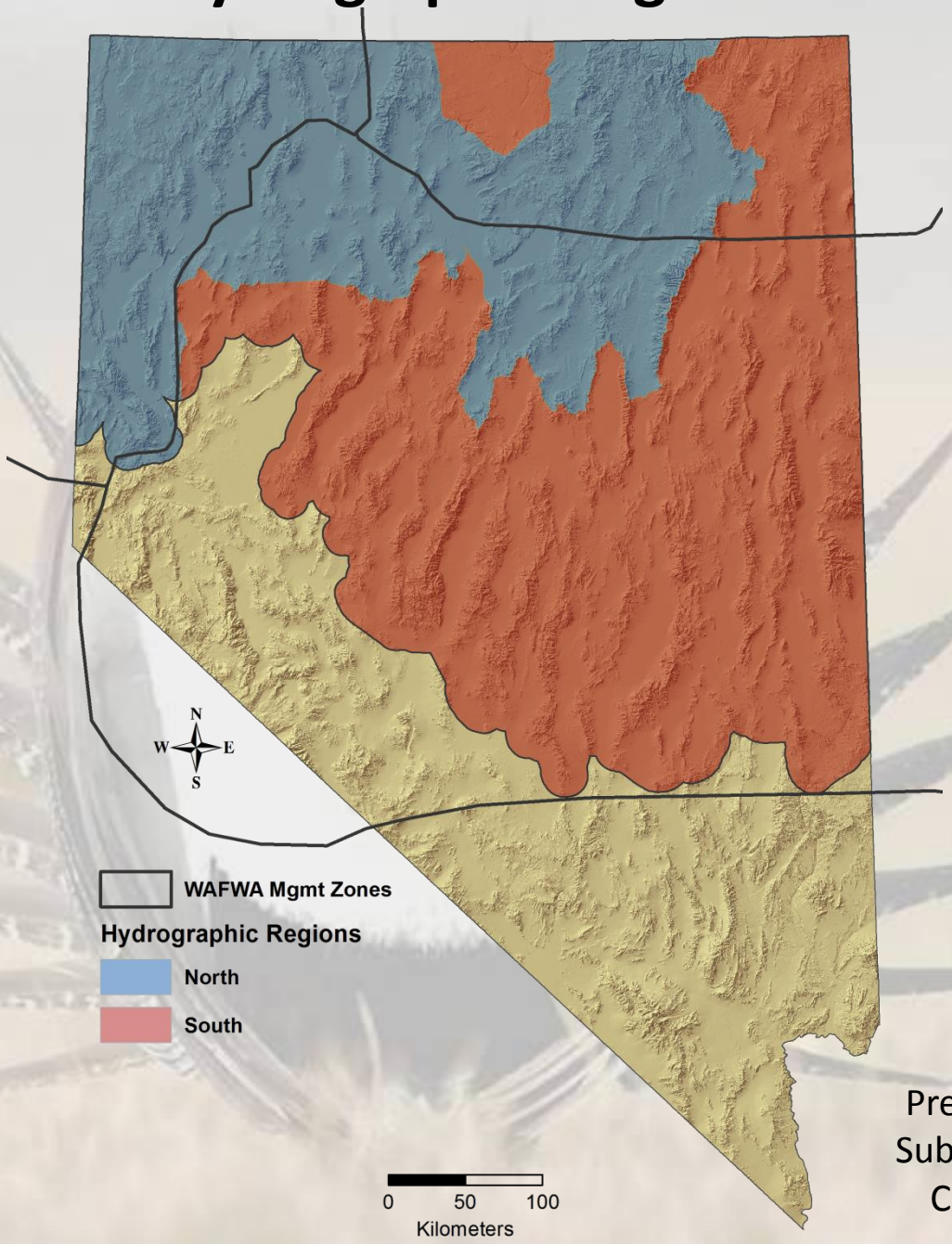


Create 'North' and 'South' regions based on USGS hydrographic regions

- **Surrogate for precipitation zones**
- **Accounts for differences in veg communities and regional habitat selection differences**
- **Exception was Owyhee Desert**

Preliminary Information—Subject to Revision. Not for Citation or Distribution

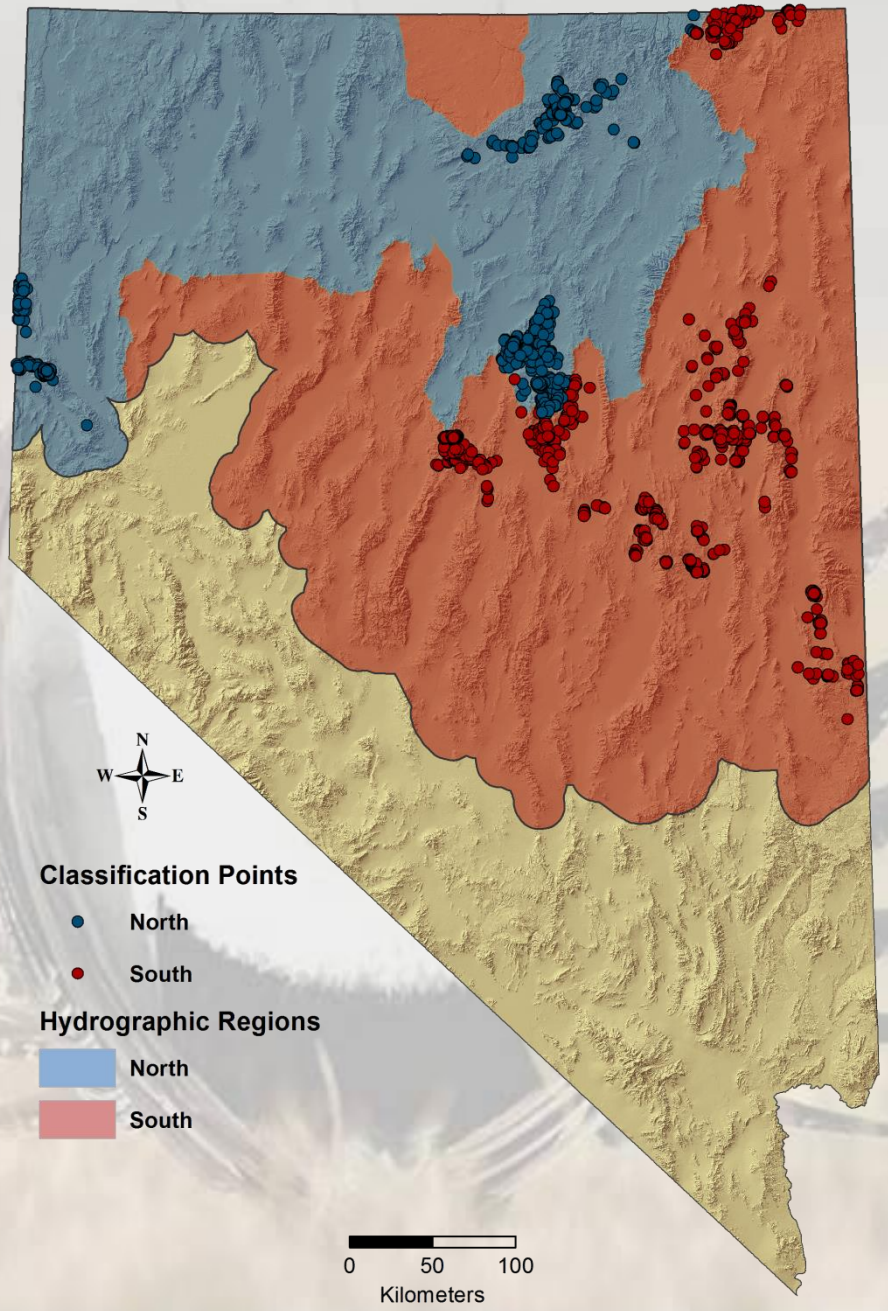
Hydrographic Regions



Roughly corresponds to sage-grouse management zones.

Preliminary Information—Subject to Revision. Not for Citation or Distribution

Hydrographic Regions



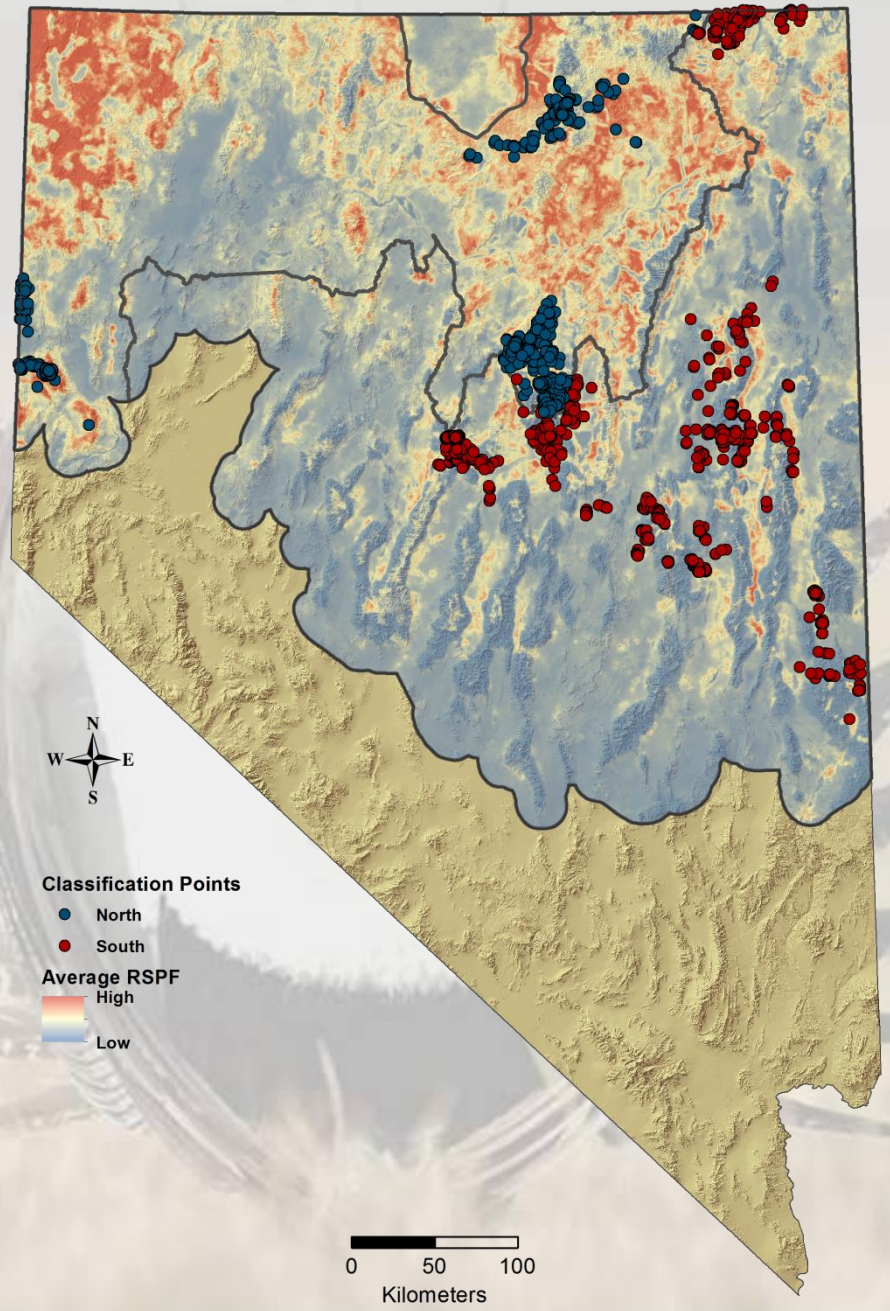
Classification points split according to hydrographic regions

3,766 points used for classification

Preliminary Information—Subject to Revision. Not for Citation or Distribution

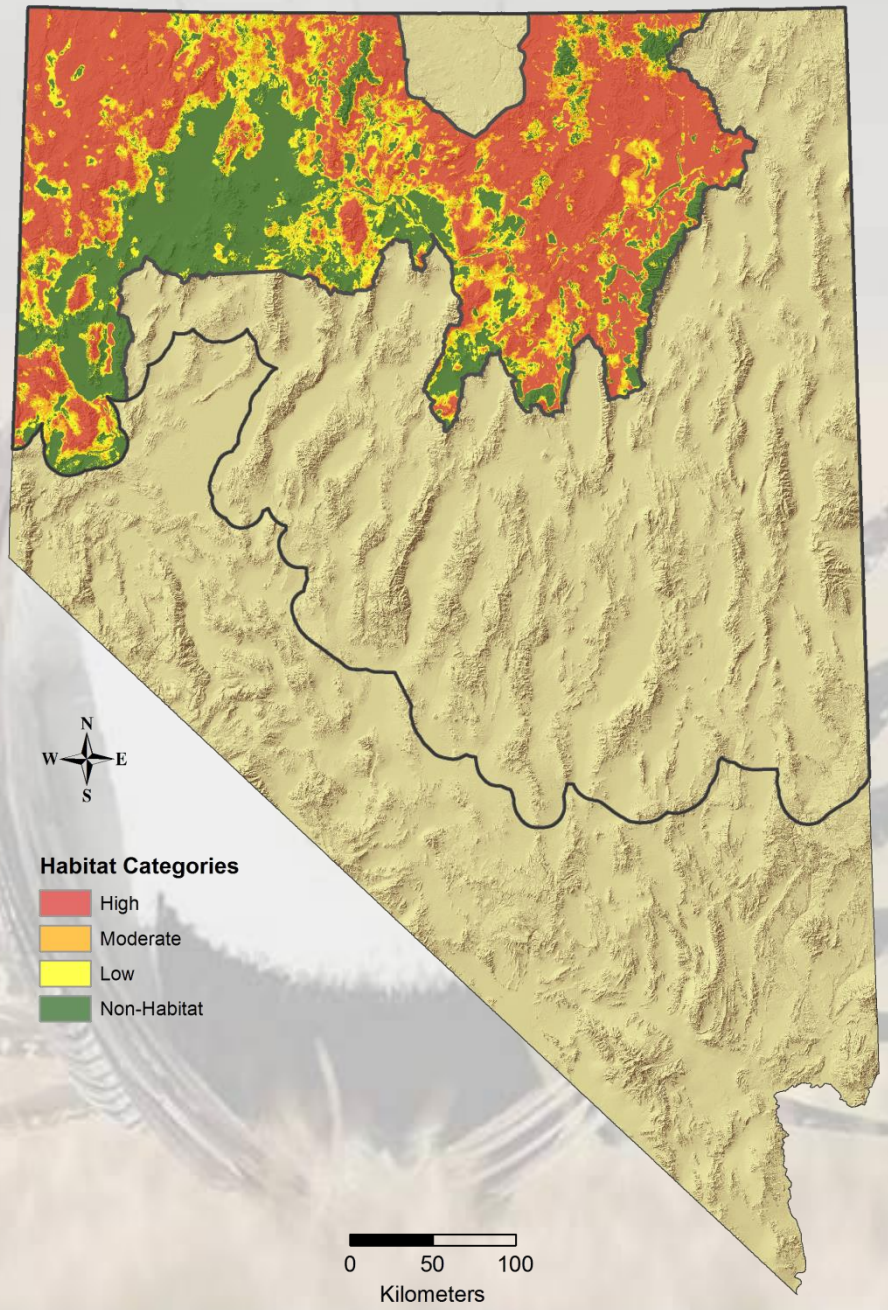
Hydrographic Regions

- Extract values to North and South classification points
- Calculate distribution of HSI values by North and South
- Use variance of the HSI distribution to determine classification cutpoints
- Biological and statistical basis for demarcation



Preliminary Information—Subject to Revision. Not for Citation or Distribution

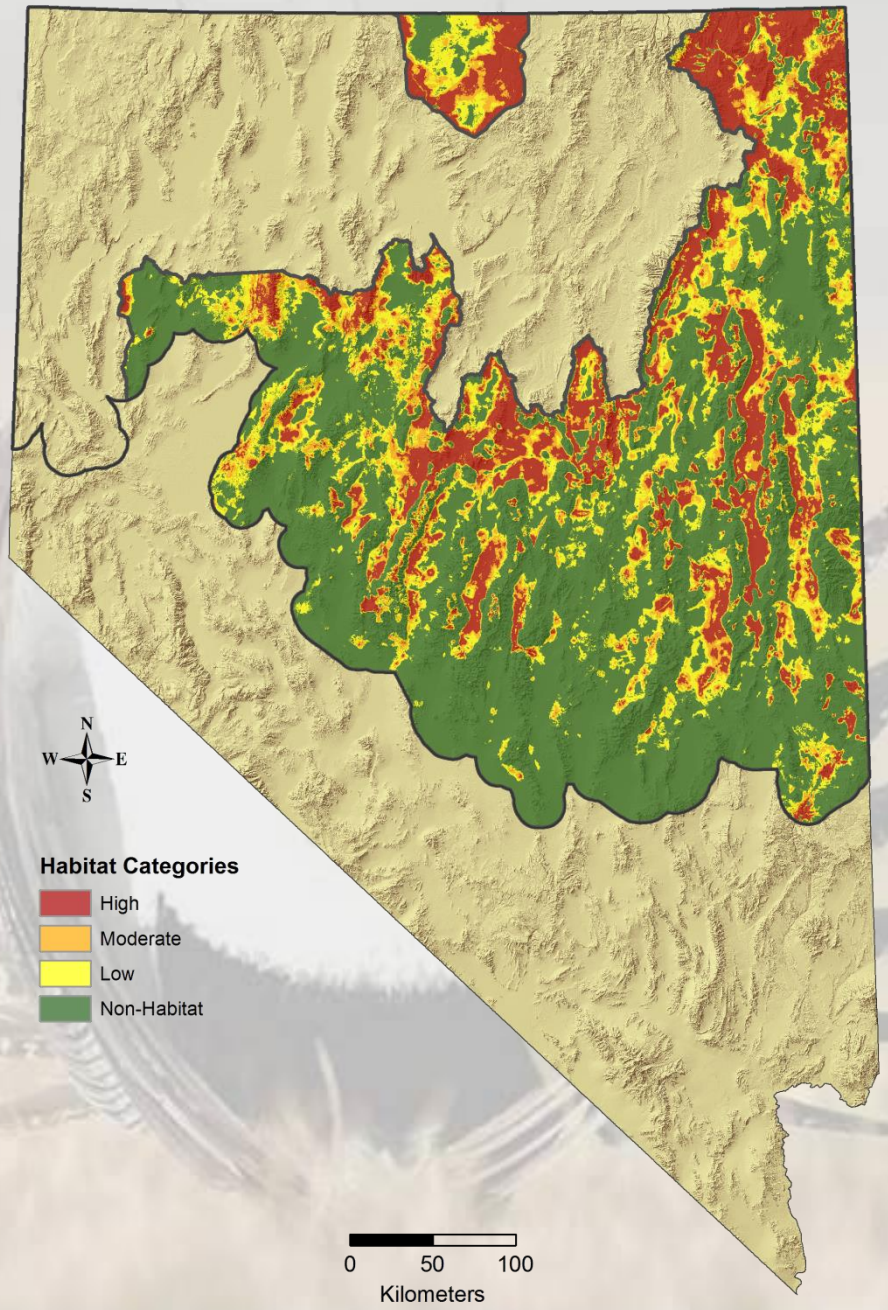
Hydrographic Regions



Classify habitat categories with North hydrographic classification point distribution

Preliminary Information—Subject to Revision. Not for Citation or Distribution

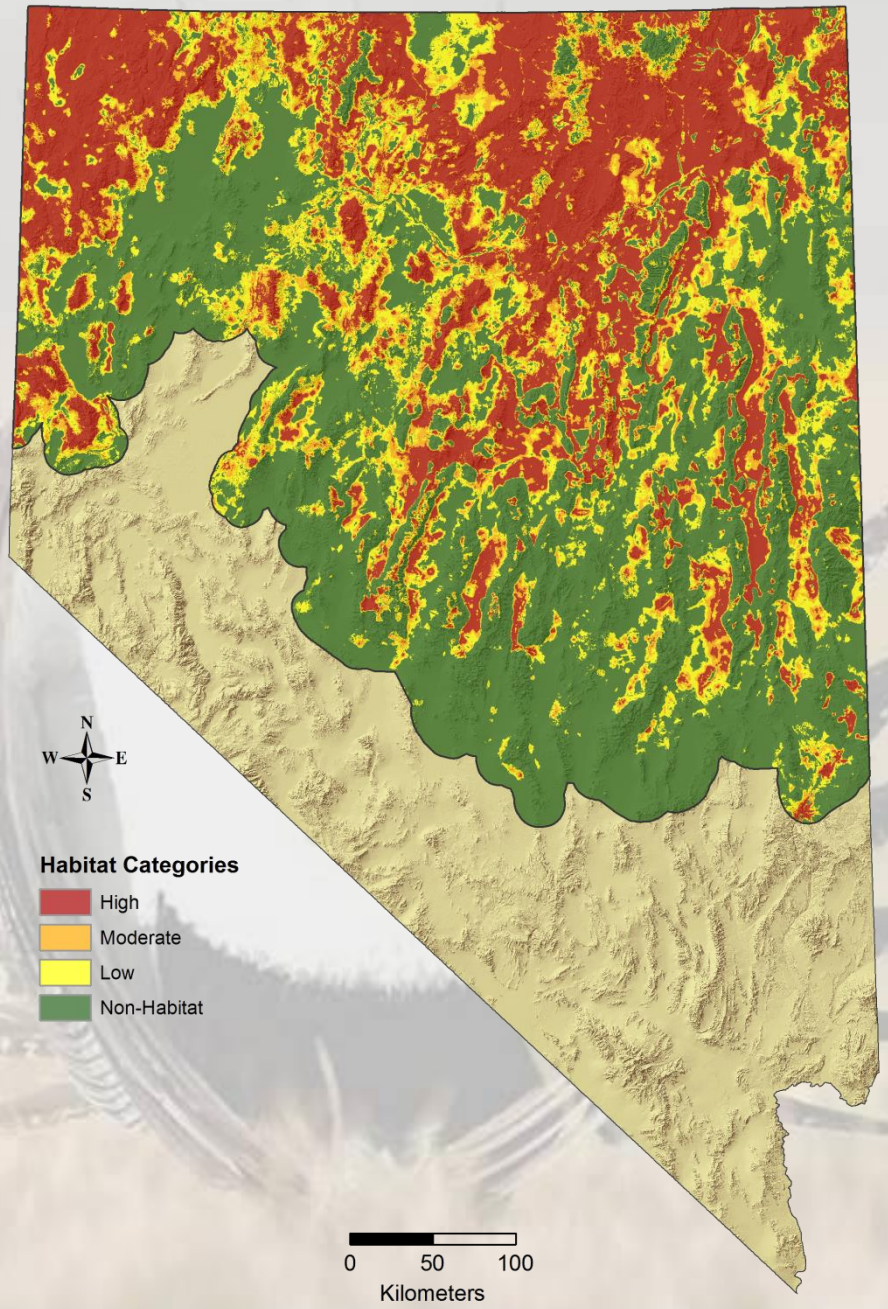
Hydrographic Regions



Classify habitat categories using South hydrographic classification point distribution

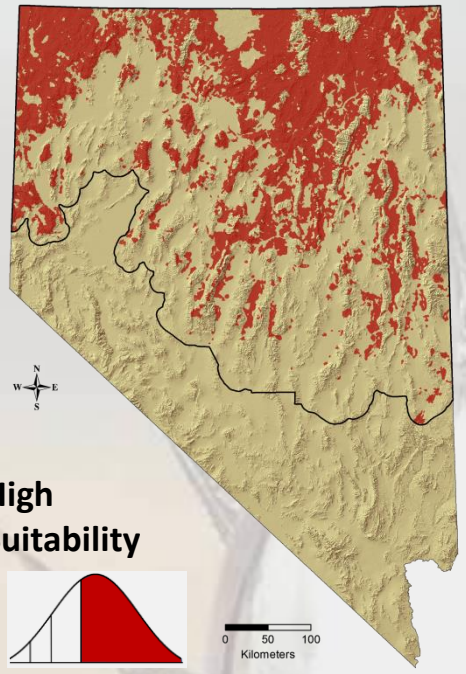
Preliminary Information—Subject to Revision. Not for Citation or Distribution

Hydrographic Regions

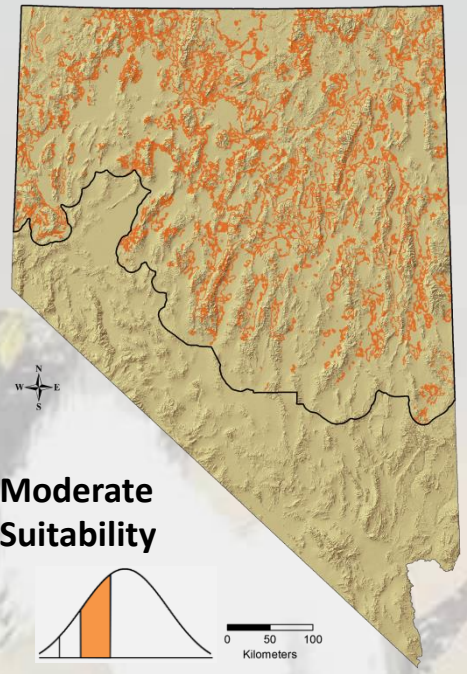


North and South Hydrographic Zone Mosaic

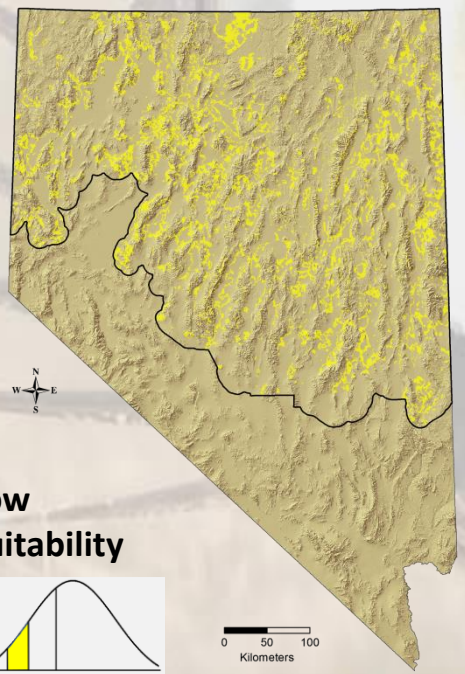
Preliminary Information—Subject to Revision. Not for Citation or Distribution



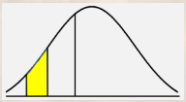
High Suitability



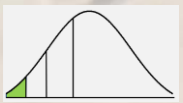
Moderate Suitability



Low Suitability



Non-habitat



Use variance of the HSI distribution to determine suitability cutpoints (e.g. standard deviations)

Criteria was set in terms of standard deviations below the mean HSI value:

- **High = 0.5**
- **Moderate = 1.0**
- **Low = 1.5**

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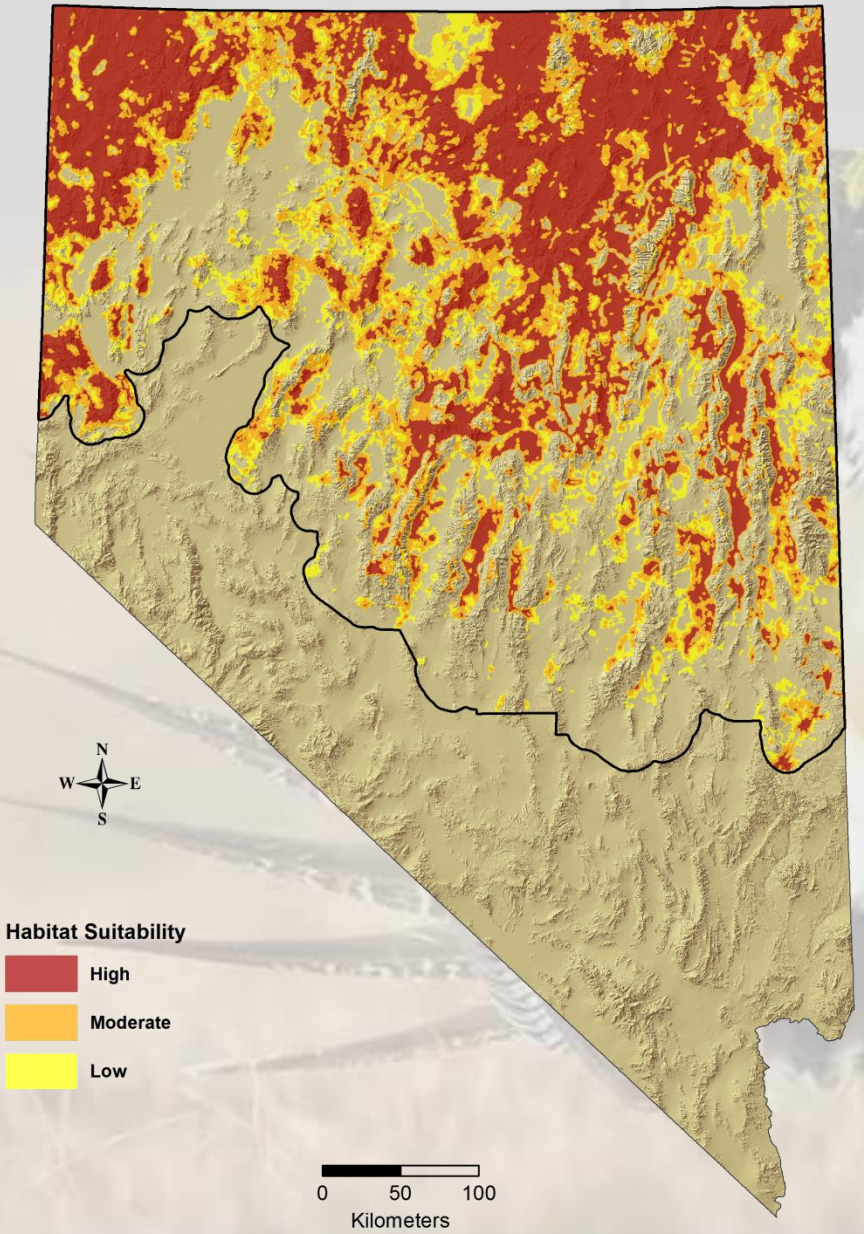
Habitat Suitability Areas



	Acres	Acre Change 2014 Map	% Change
All Habitat	27,046,301	1,623,267	6%

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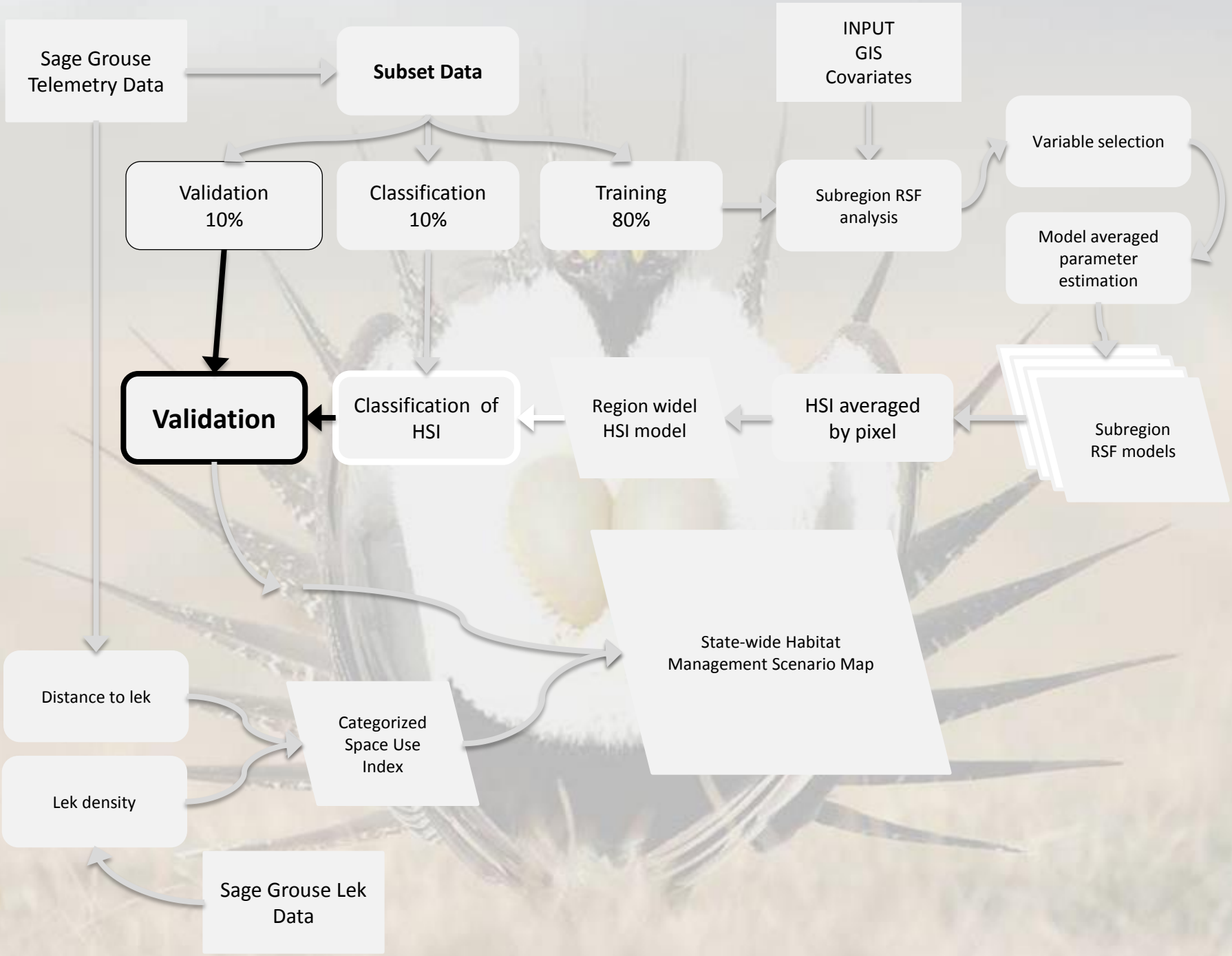
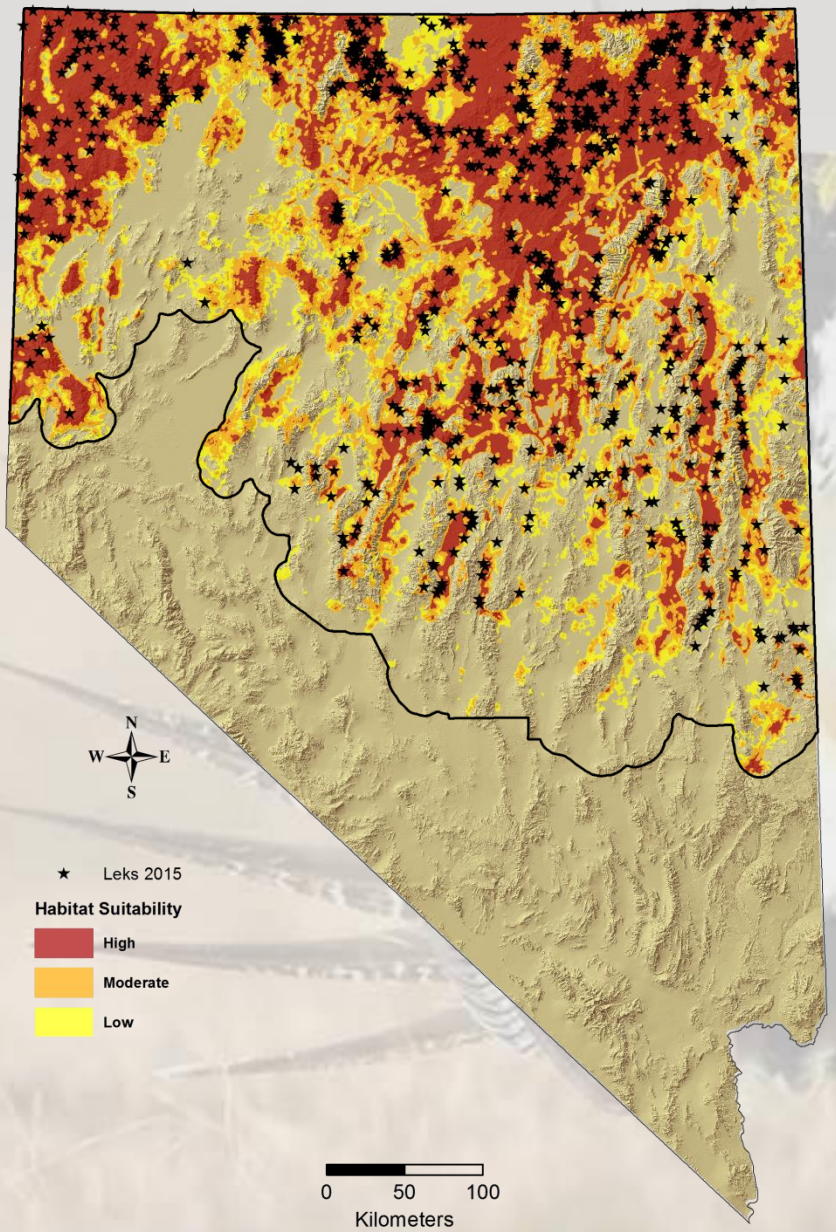

Sage Grouse Telemetry Data
Subset Data
INPUT GIS Covariates
Validation 10%
Classification 10%
Training 80%
Subregion RSF analysis
Variable selection
Model averaged parameter estimation
Validation
Classification of HSI
Region widel HSI model
HSI averaged by pixel
Subregion RSF models
State-wide Habitat Management Scenario Map
Distance to lek
Lek density
Categorized Space Use Index
Sage Grouse Lek Data

Lek Validation

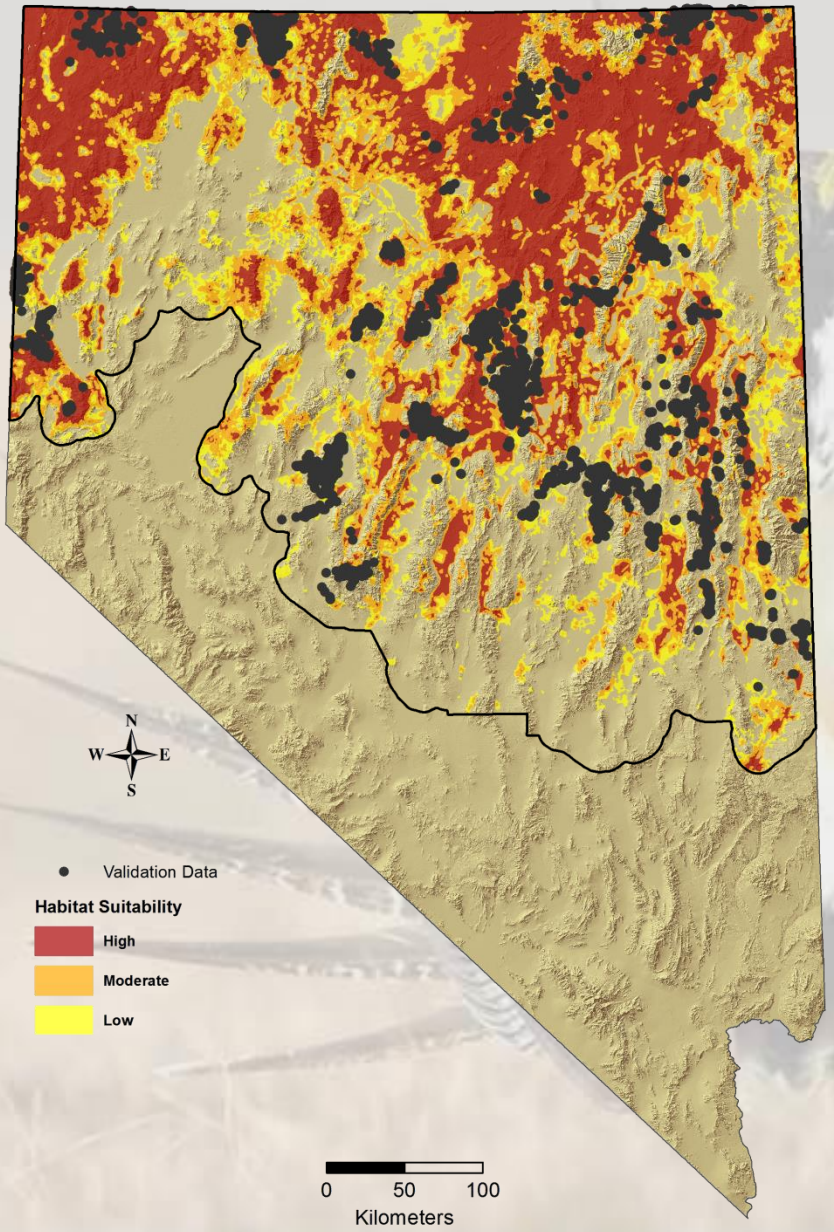


Category	Expected	Observed Overall	Ratio
High	69%	79%	1.14
Mod	84%	88%	1.04
Low	93%	96%	1.03

- 913 Leks used.

Preliminary Information—Subject to Revision. Not for Citation or Distribution

Bird Validation



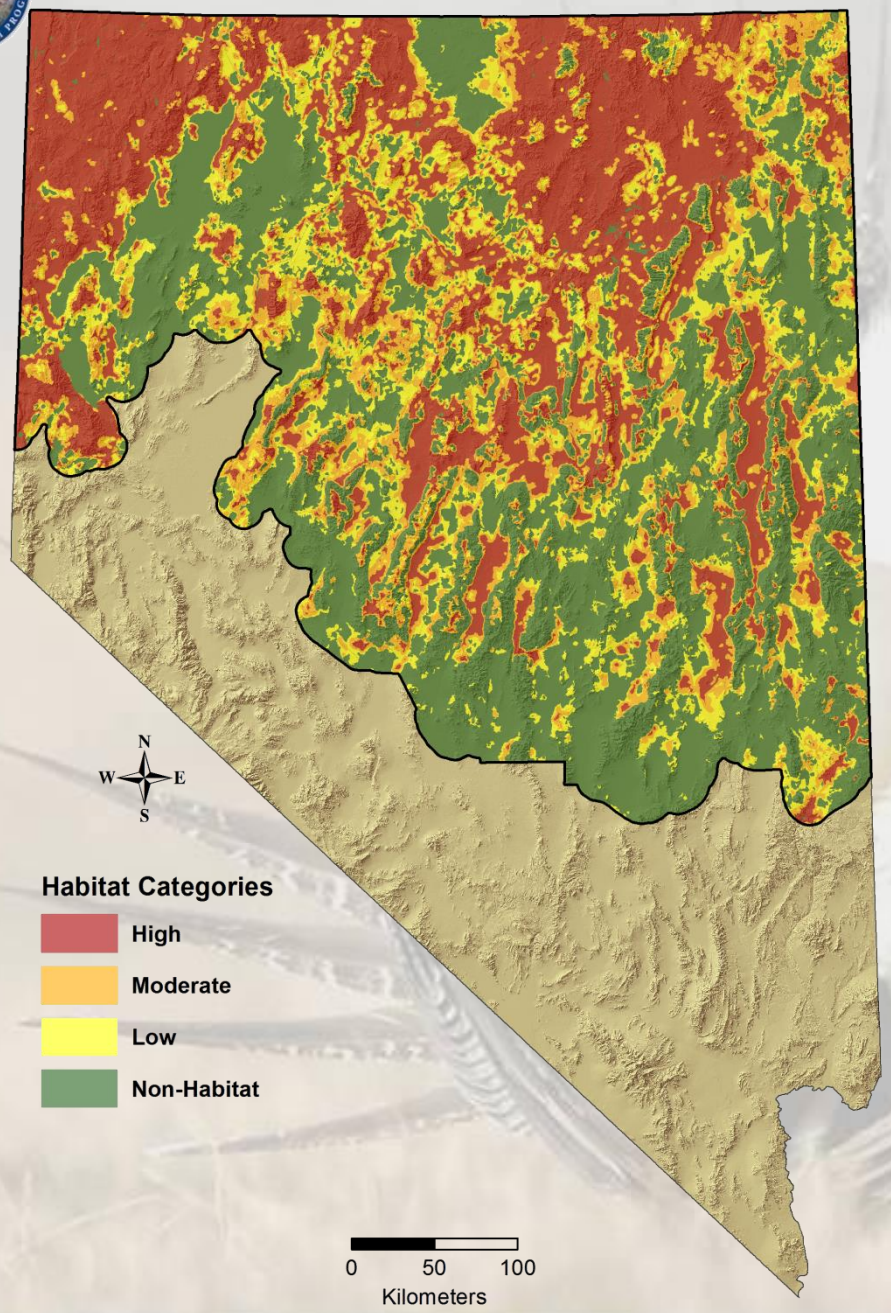
Seasonal Product

Cat.	Ratio	Cumul. Ratio	Cumul. Inside Ratio	Cumul. Outside Ratio
High	1.00	1.00	0.98	1.04
Mod	1.07	1.01	0.99	1.06
Low	0.87	1.00	0.99	1.02
Non	1.04			

10,402 points used for validation

Preliminary Information—Subject to Revision. Not for Citation or Distribution

Breeding Habitat



Cat.	Ratio	Cumul. Ratio	Cumul. Inside Ratio	Cumul. Outside Ratio
High	1.09	1.09	1.06	1.13
Mod	0.93	1.06	0.96	1.09
Low	0.65	1.02	1.02	1.03
Non	0.75			

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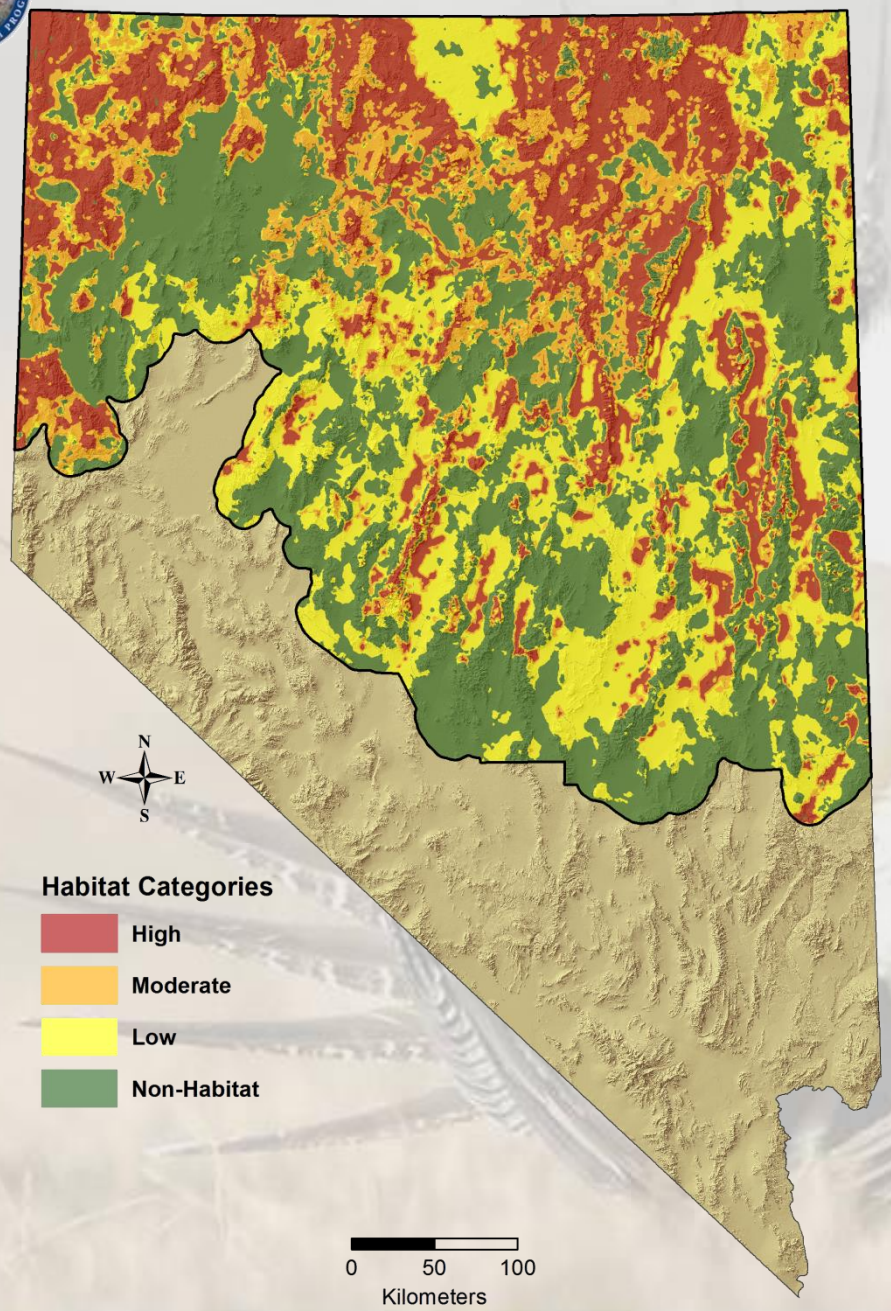
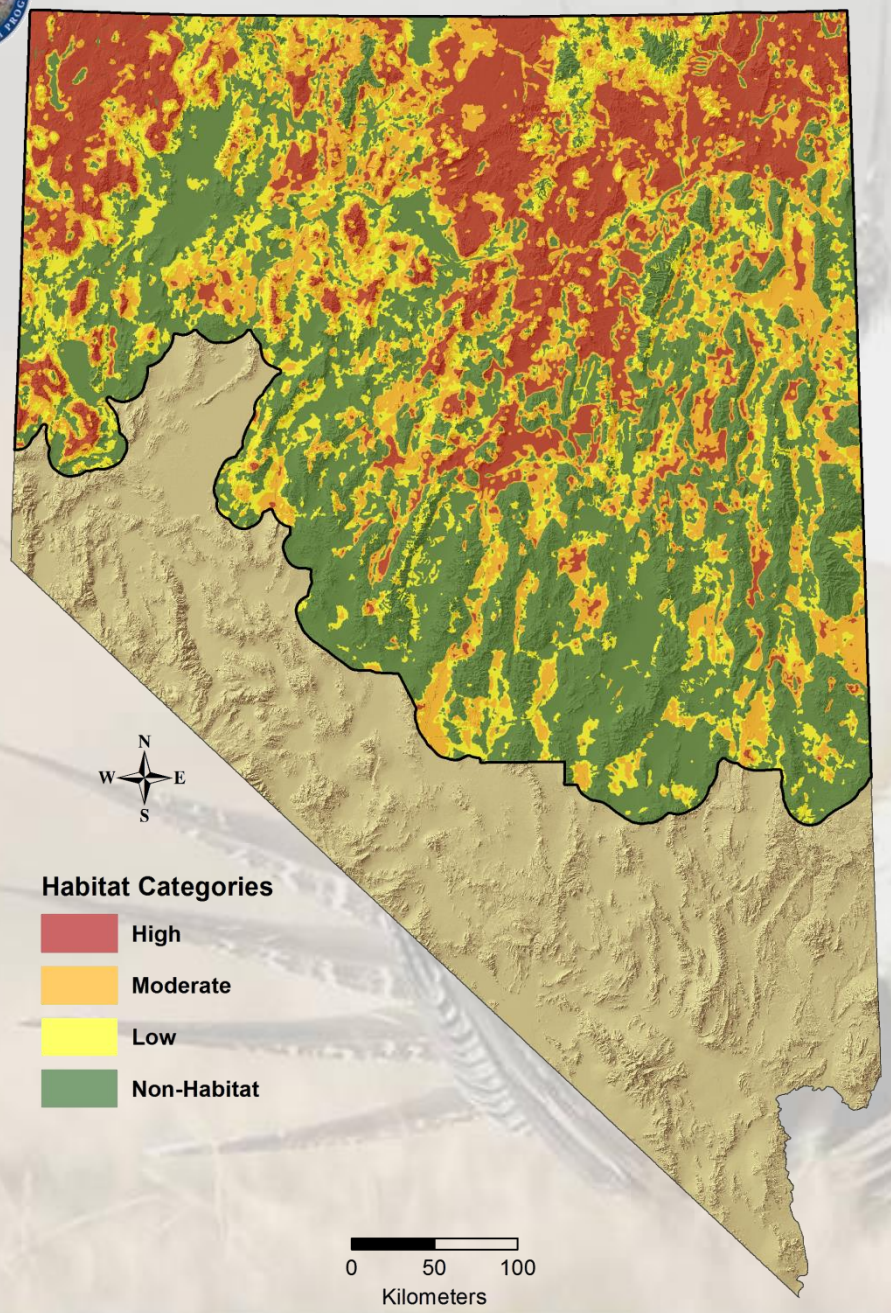
Brood Habitat



Cat.	Ratio	Cumul. Ratio	Cumul. Inside Ratio	Cumul. Outside Ratio
High	1.03	1.03	1.01	1.05
Mod	0.53	0.94	0.93	0.95
Low	1.85	1.03	1.02	1.04
Non	0.45			

Preliminary Information—Subject to Revision. Not for Citation or Distribution

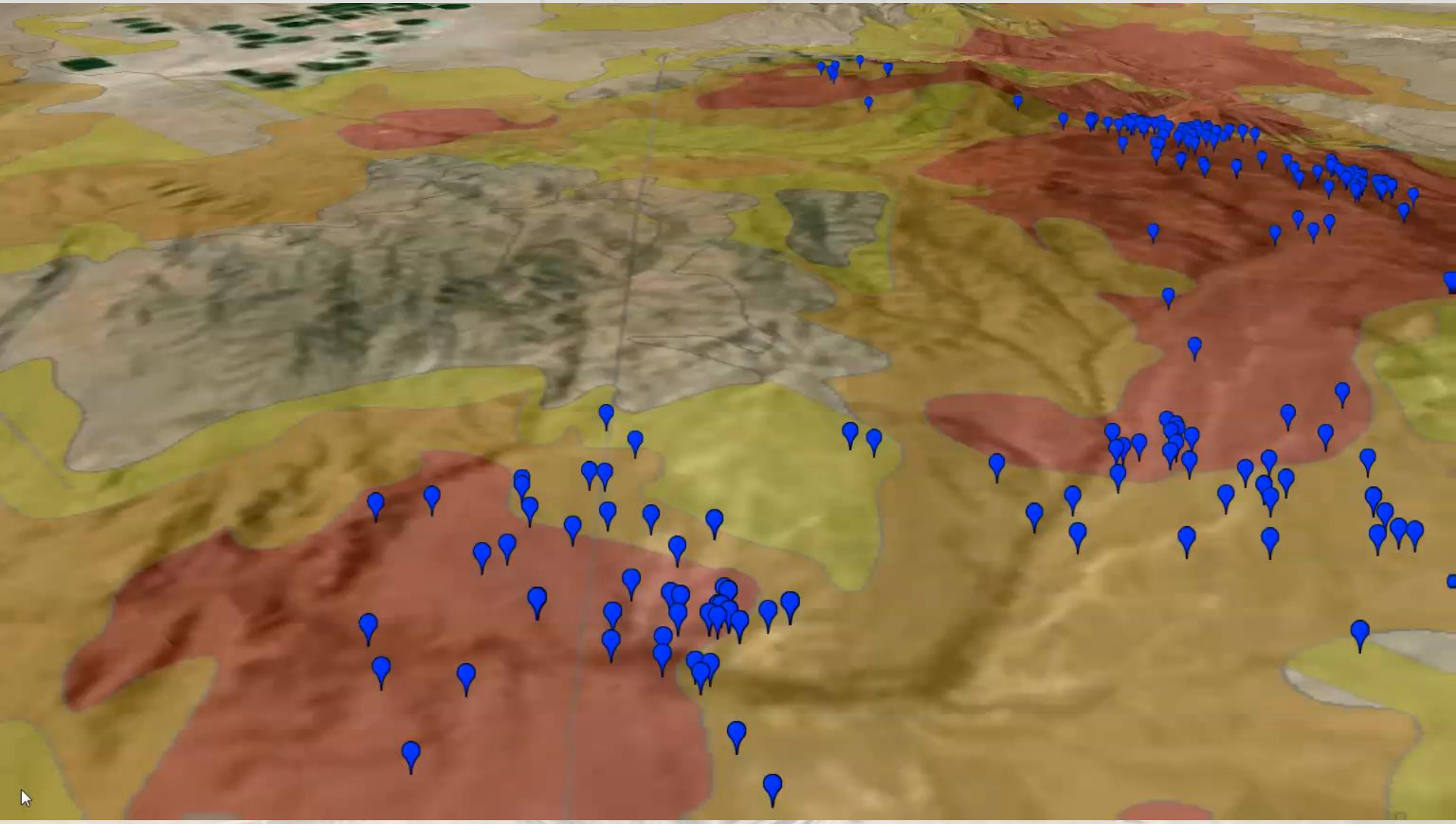
Winter Habitat



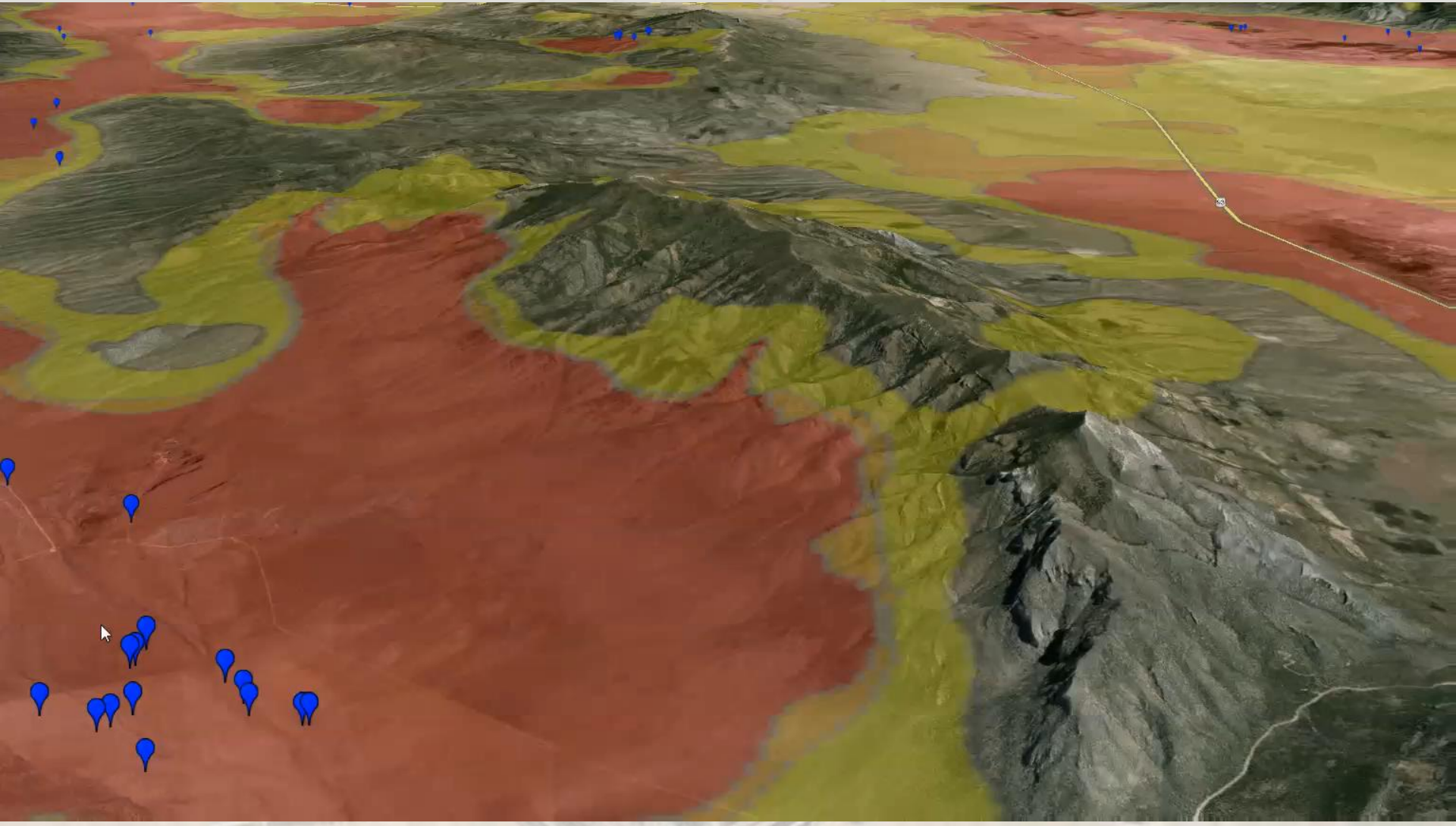
Cat.	Ratio	Cumul. Ratio	Cumul. Inside Ratio	Cumul. Outside Ratio
High	0.93	0.93	0.90	0.97
Mod	0.60	0.87	0.86	0.88
Low	1.85	0.96	0.93	1.01
Non	1.49			

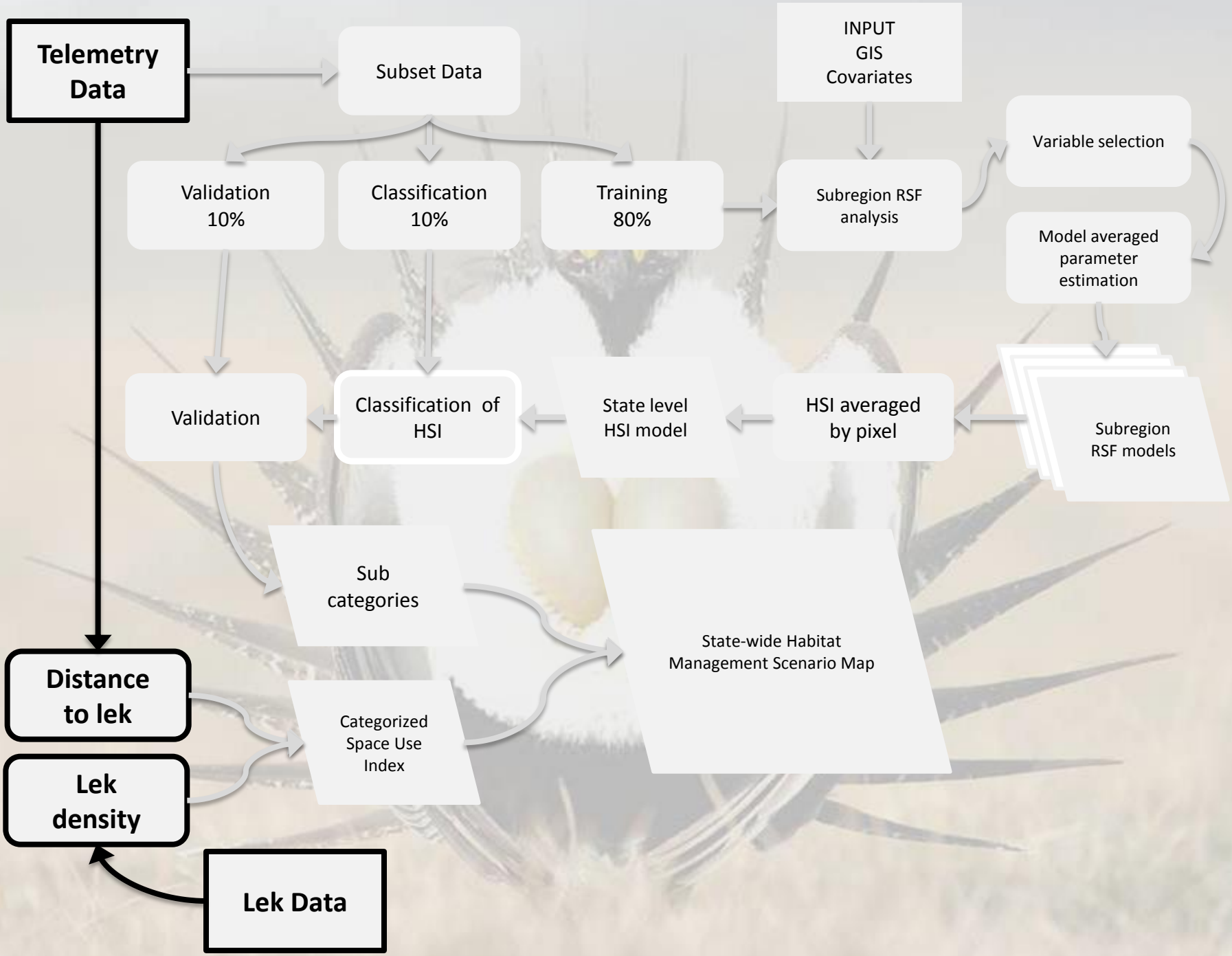
Preliminary Information—Subject to Revision. Not for Citation or Distribution

Video Graphic of Validation Points (Composite Habitat Map)



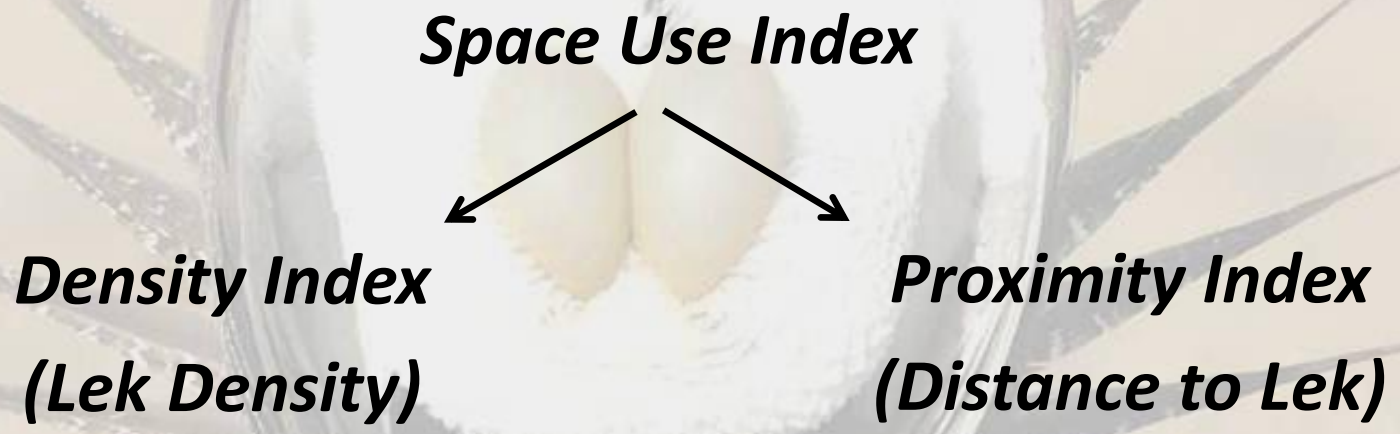
Video Graphic of Validation Points (Brood Period Habitat Map)




Telemetry Data
Subset Data
INPUT
GIS
Covariates
Validation
10%
Classification
10%
Training
80%
Subregion RSF
analysis
Variable selection
Model averaged
parameter
estimation
Validation
Classification of
HSI
State level
HSI model
HSI averaged
by pixel
Subregion
RSF models
Sub
categories
State-wide Habitat
Management Scenario Map
Distance
to lek
Categorized
Space Use
Index
Lek
density
Lek Data

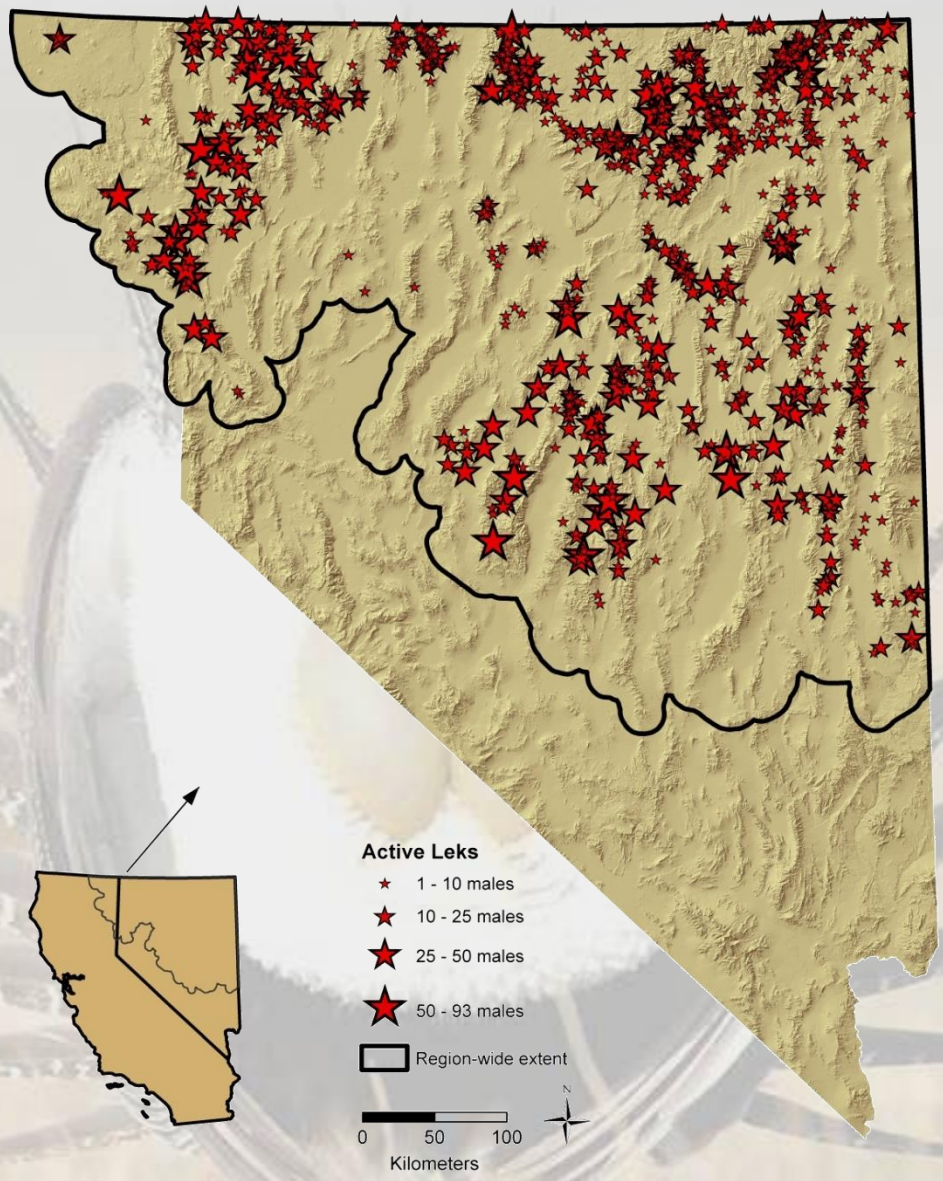
USGS
science for a changing world

Accounting for Known Occupancy of Lek Sites Sage-Grouse

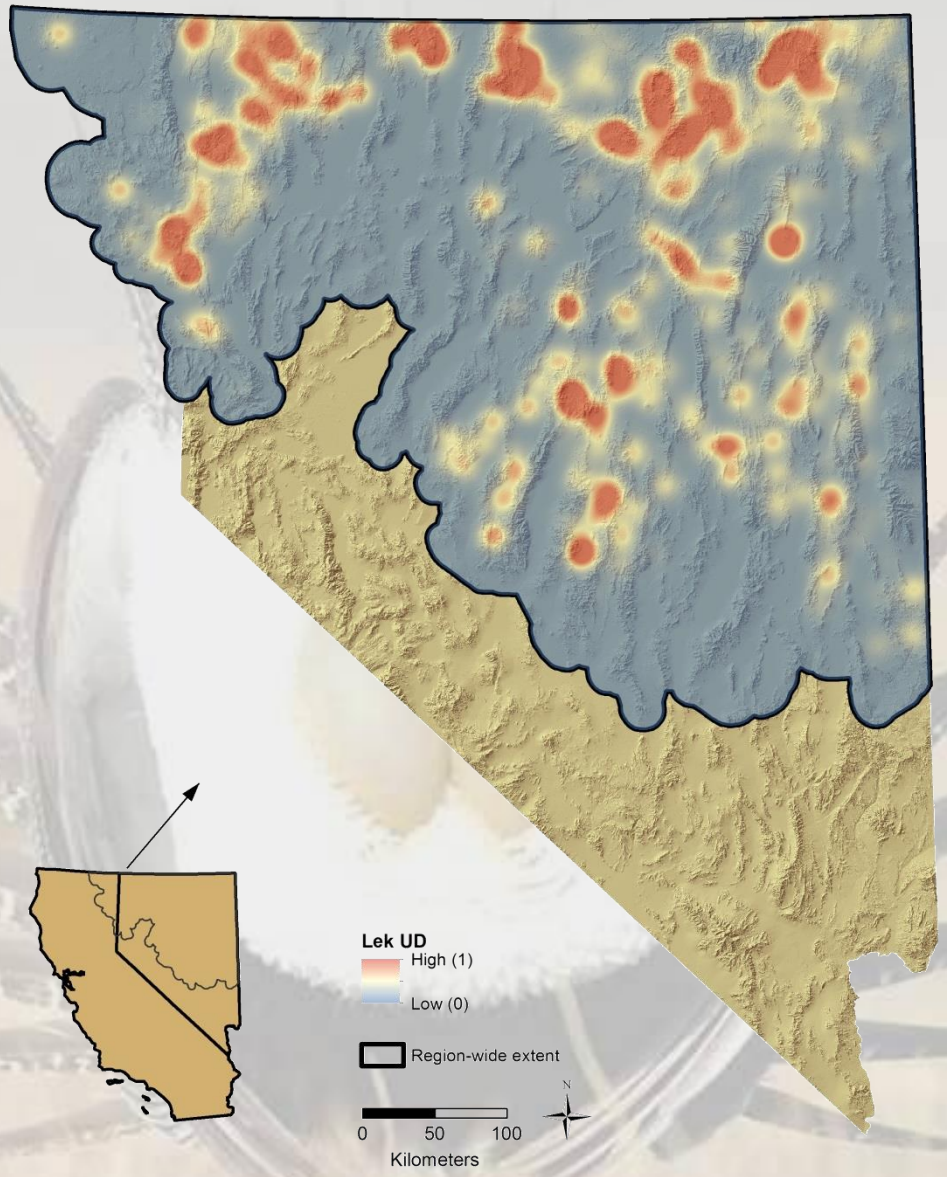


USGS
science for a changing world

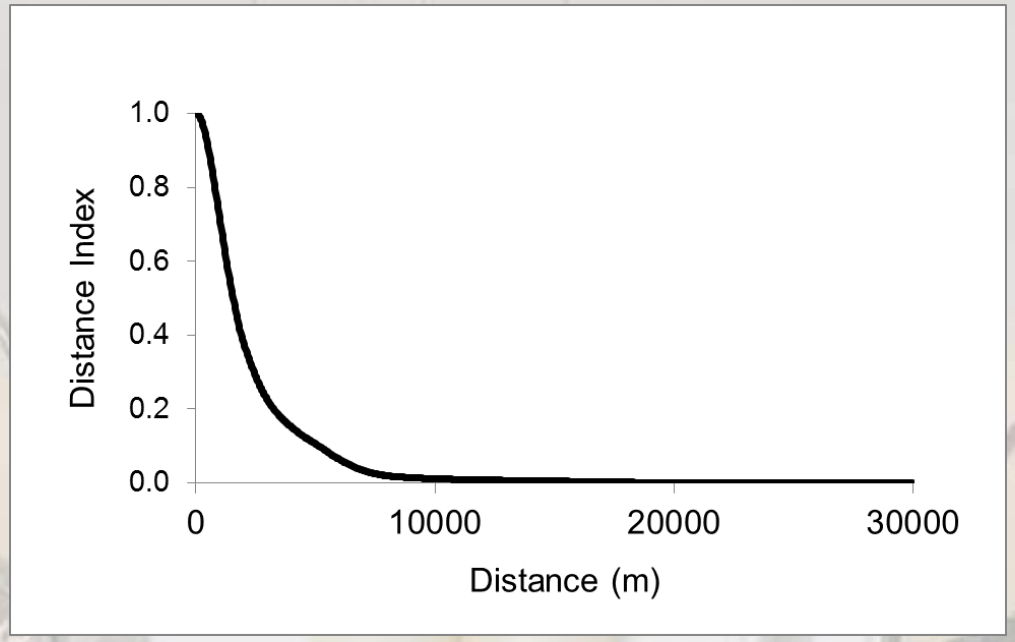
Average 5-year lek counts



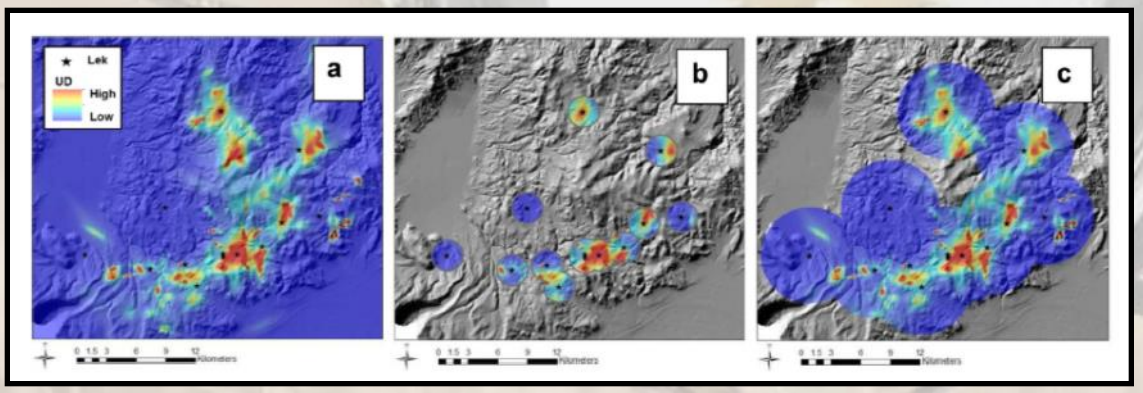
Example Lek Density Index Estimator

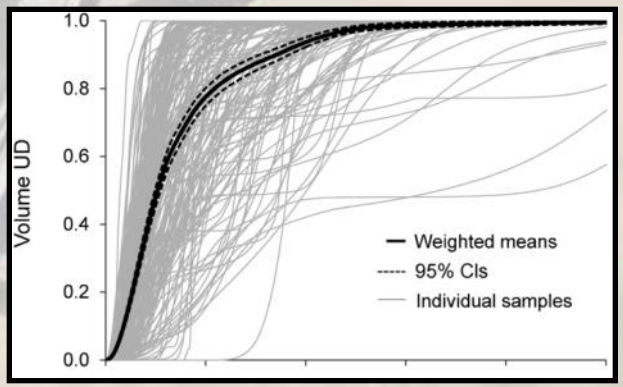


- *Kernel Estimator*
- *Weighted by 5 year count*
- *CVh smoothing*

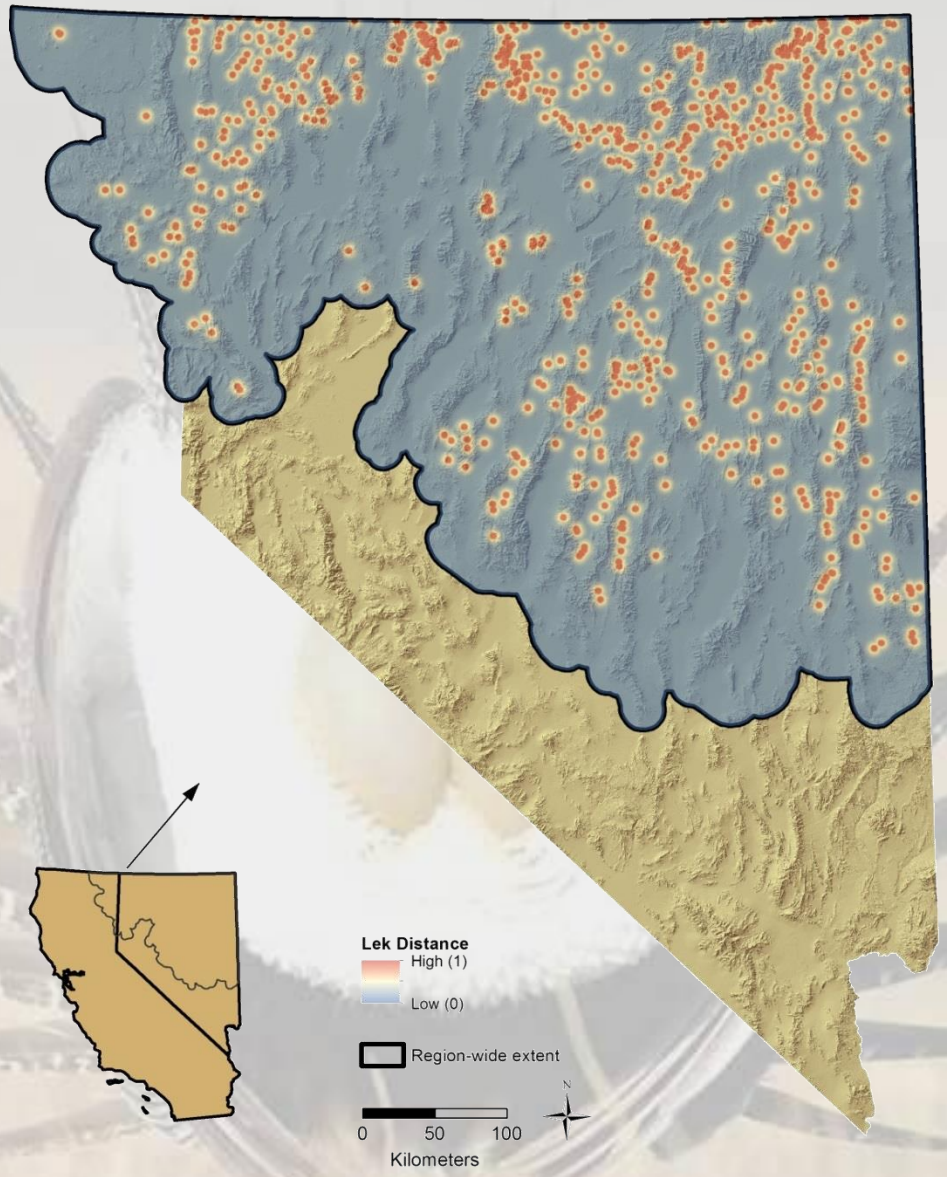


Coates et al. 2013. JWM 77:1598–1609.



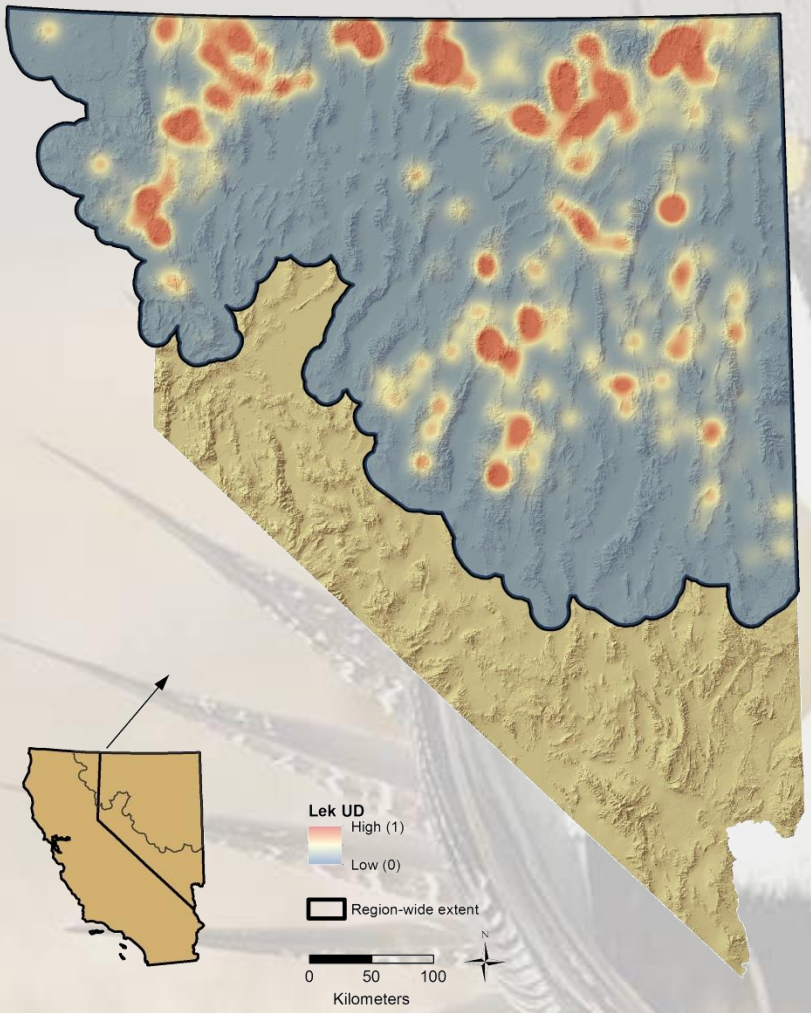


Example Distance to Lek

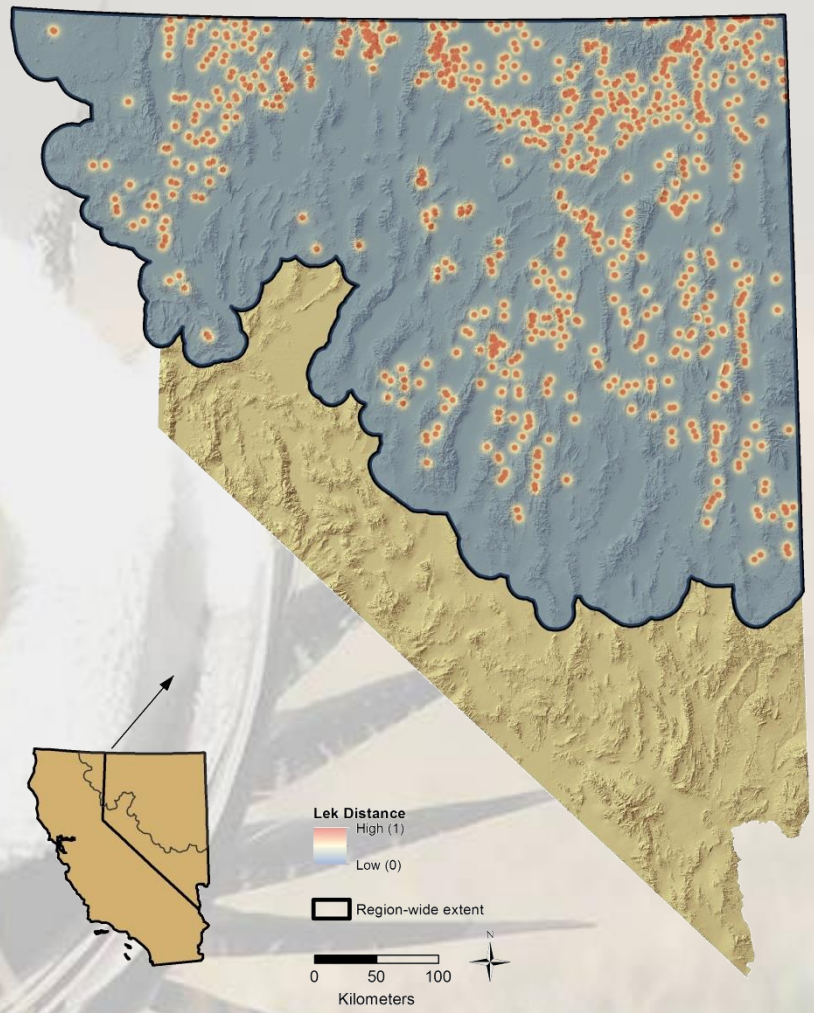


USGS
science for a changing world

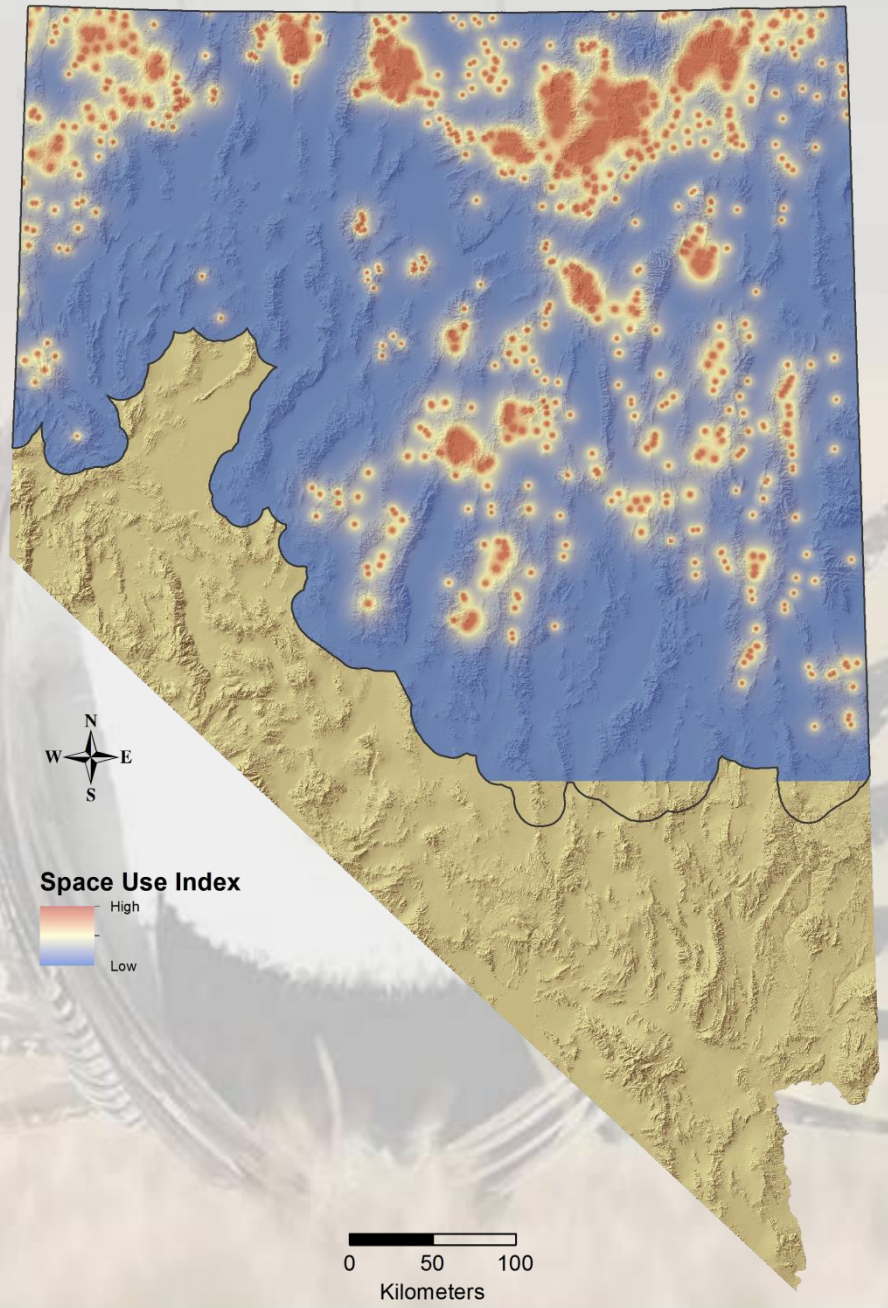
Density Index



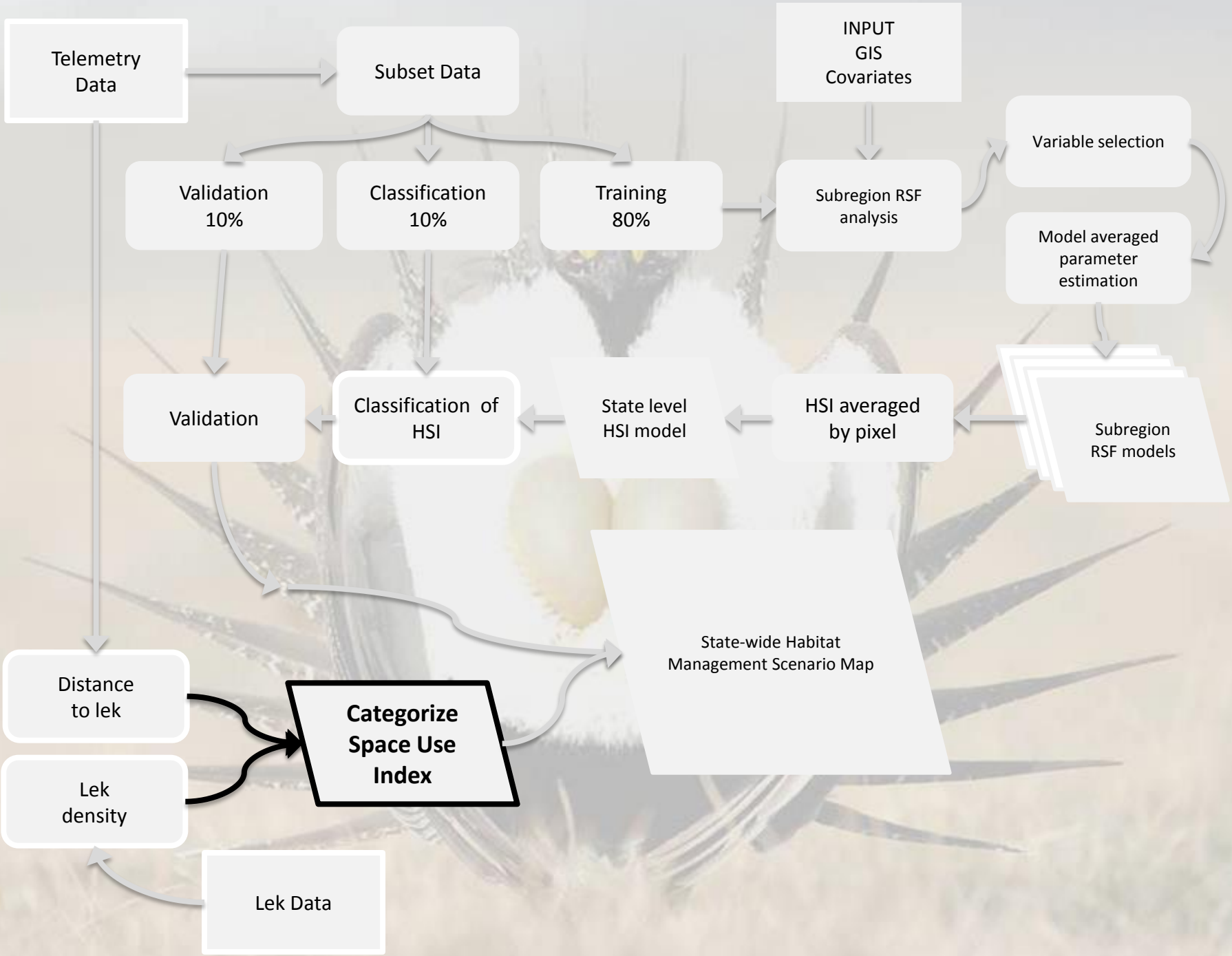
Distance Index



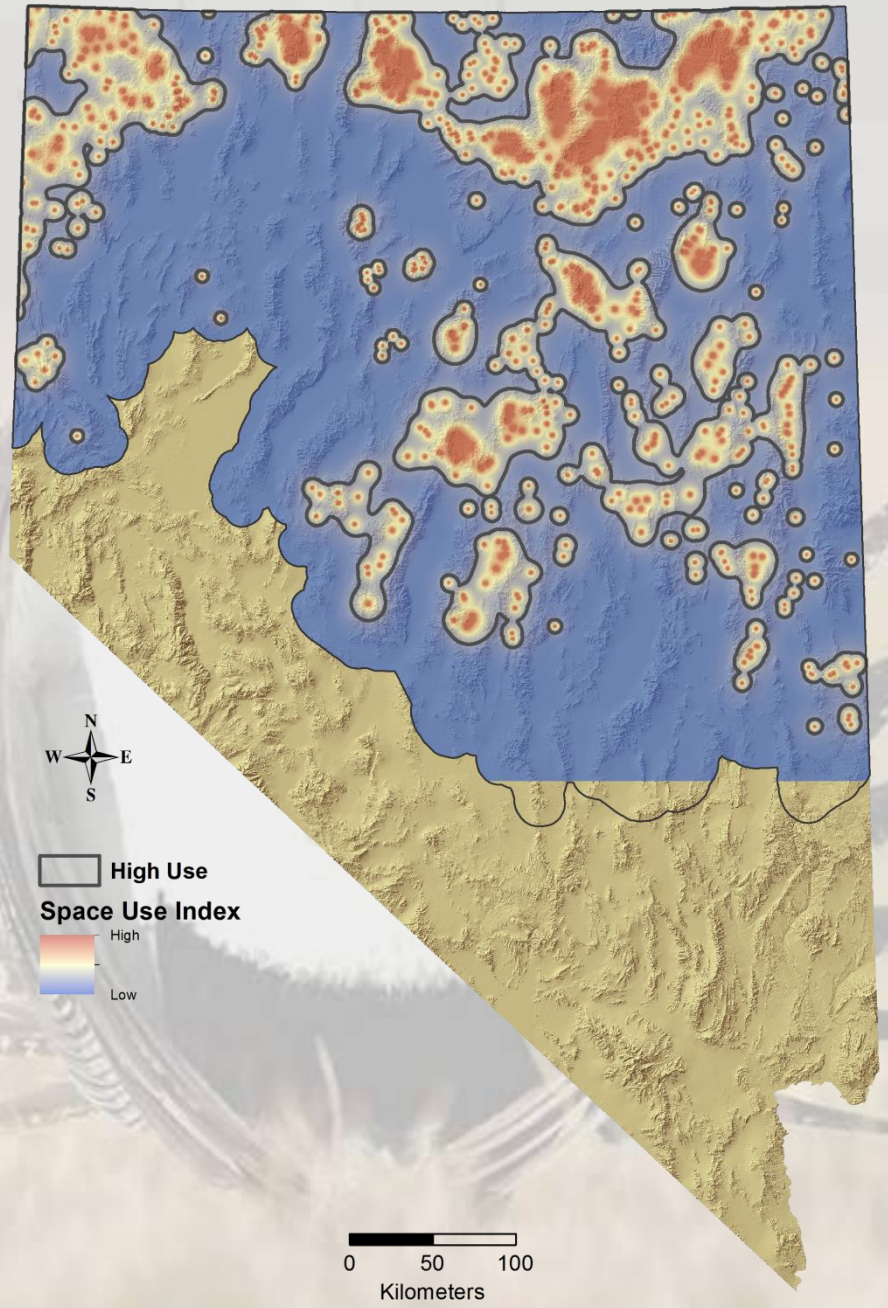
Space Use Index (SUI)



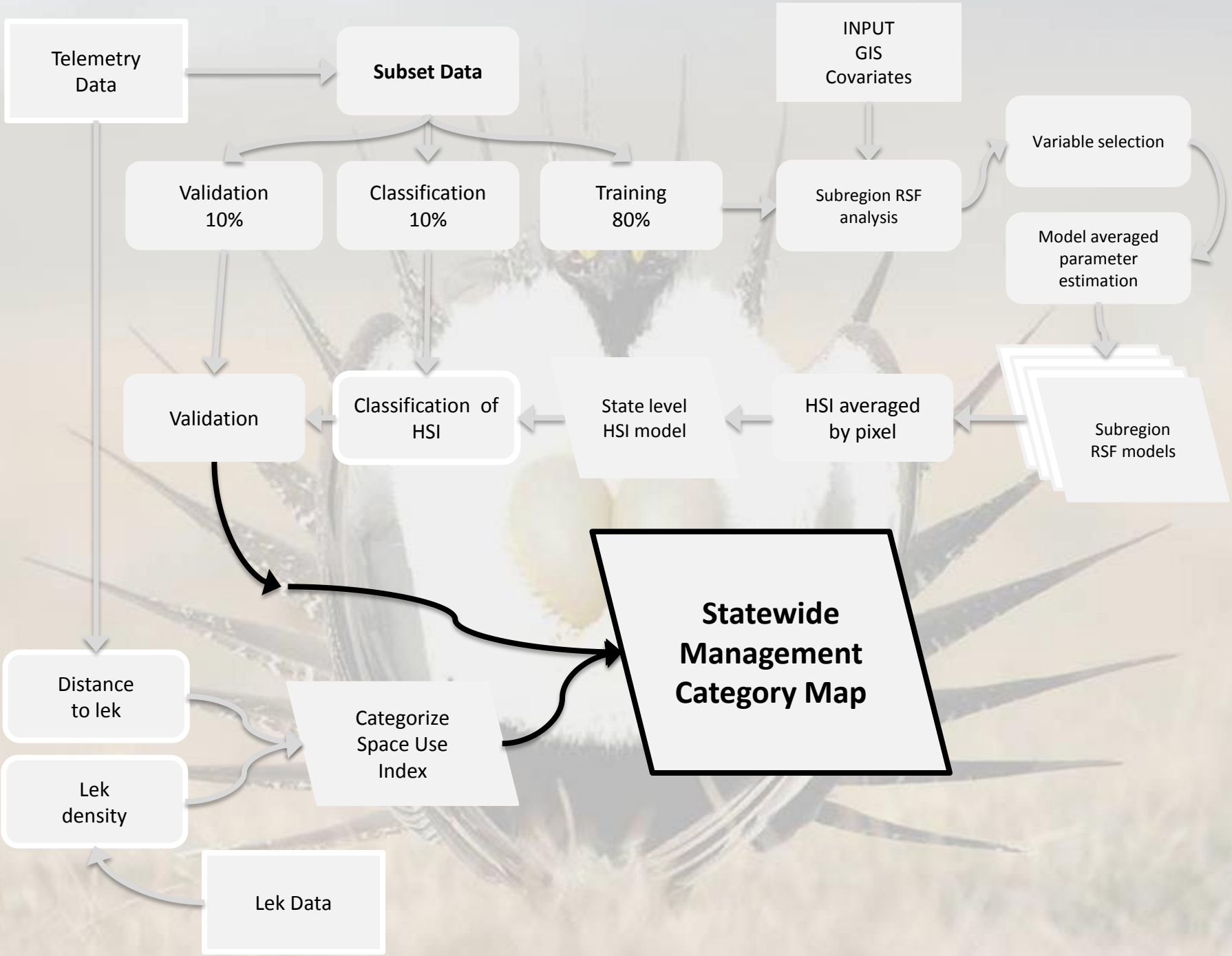
- Product of lek density, sage-grouse abundance, and distance to lek
- Use the 85% percentile to delineate ‘high use’


Telemetry Data
Subset Data
INPUT GIS Covariates
Validation 10%
Classification 10%
Training 80%
Subregion RSF analysis
Variable selection
Model averaged parameter estimation
Validation
Classification of HSI
State level HSI model
HSI averaged by pixel
Subregion RSF models
State-wide Habitat Management Scenario Map
Distance to lek
Lek density
Categorize Space Use Index
Lek Data

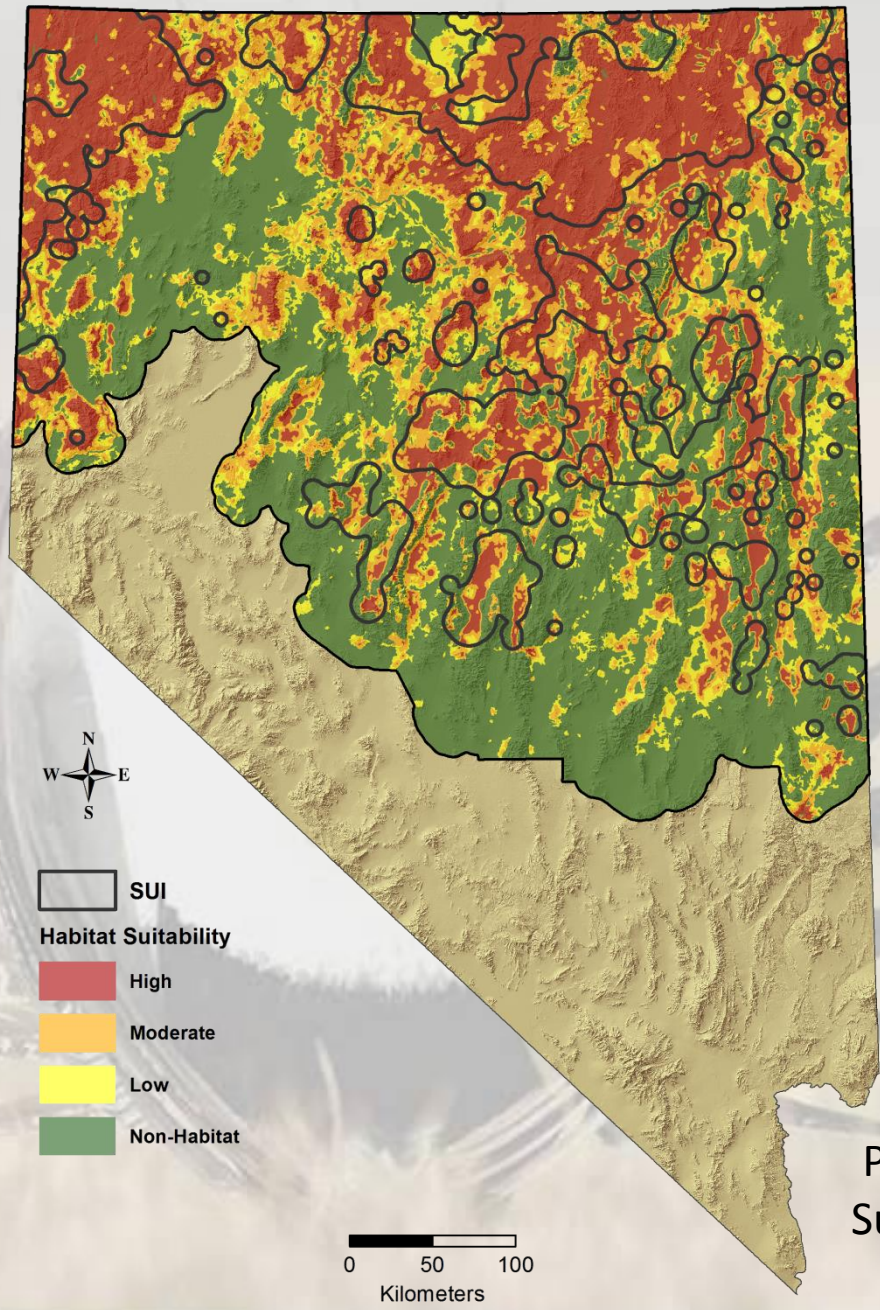
Space Use Index (SUI)



- Product of lek density, sage-grouse abundance, and distance to lek
- Use the 85% percentile to delineate ‘high use’


Telemetry Data
Subset Data
INPUT GIS Covariates
Validation 10%
Classification 10%
Training 80%
Subregion RSF analysis
Variable selection
Model averaged parameter estimation
Validation
Classification of HSI
State level HSI model
HSI averaged by pixel
Subregion RSF models
Statewide Management Category Map
Distance to lek
Lek density
Categorize Space Use Index
Lek Data

SUI (use and abundance) intersected with HSI (habitat)



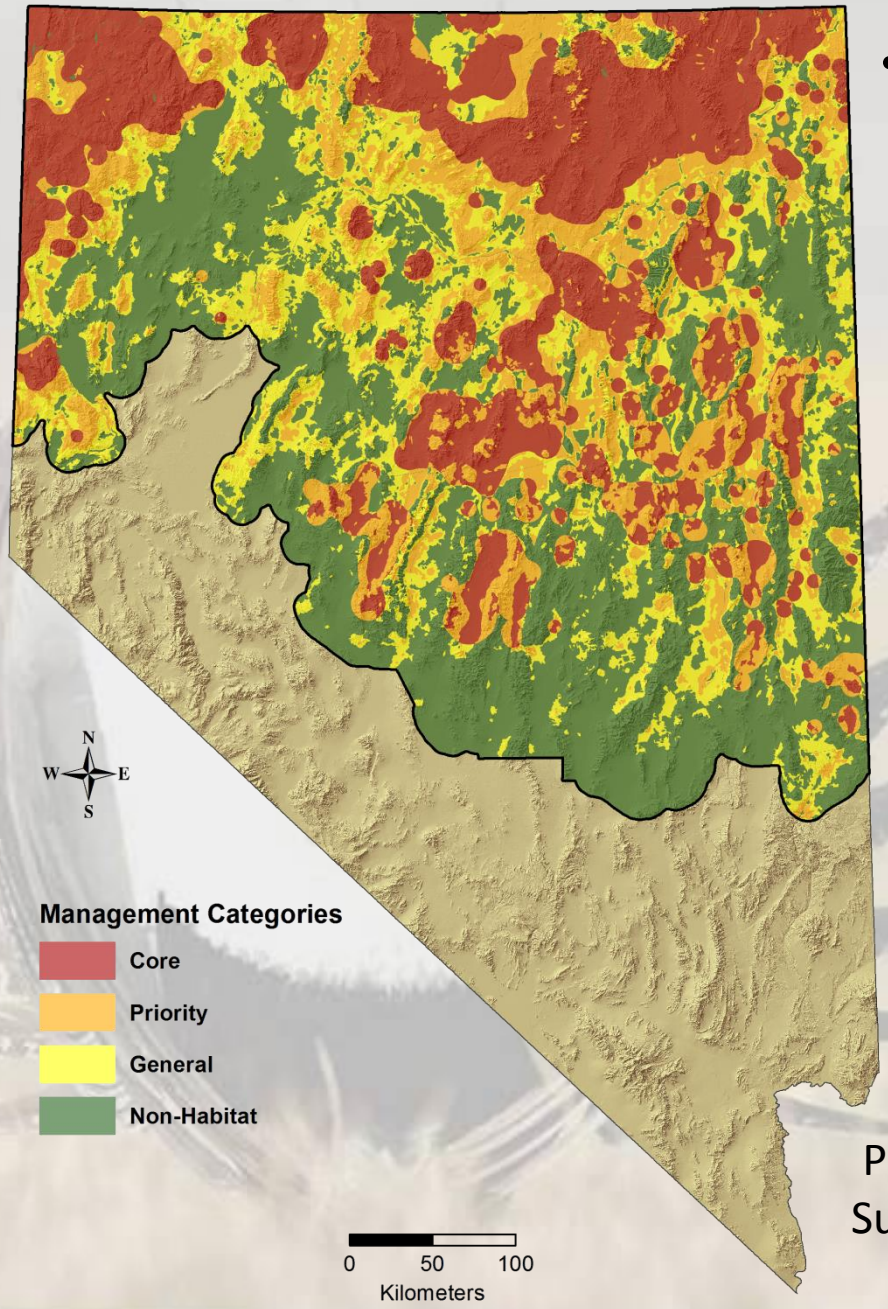
Preliminary Information—Subject to Revision. Not for Citation or Distribution

Management Categories

Core

All habitats intersect the space use and abundance

Represents conducive conditions with sage-grouse use



- **Management categories based on intersection of habitat suitability and space use**

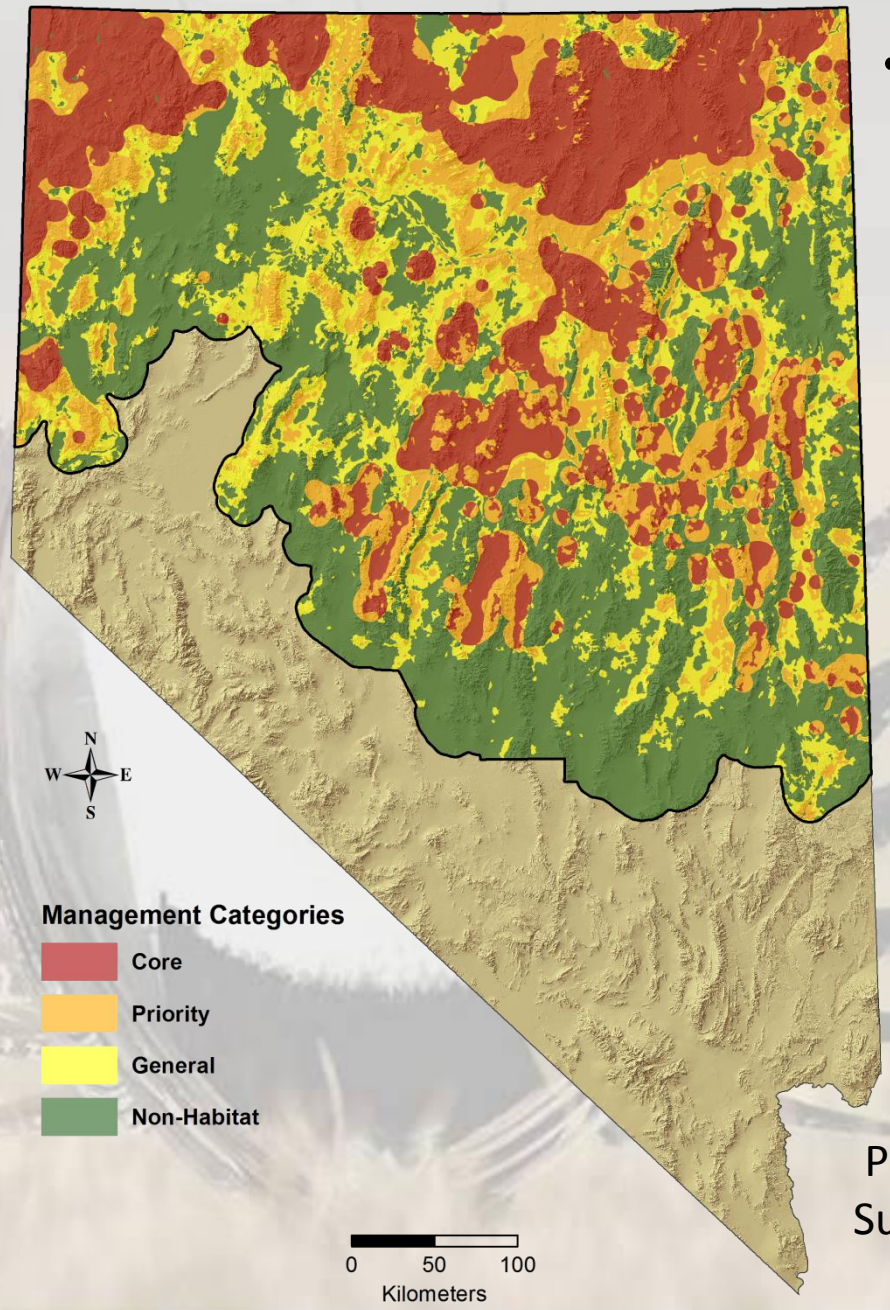
Preliminary Information—Subject to Revision. Not for Citation or Distribution

Management Categories

Priority

High quality habitat and outside of core areas

Represents conducive conditions but low sage-grouse use



- **Management categories based on intersection of habitat suitability and space use**

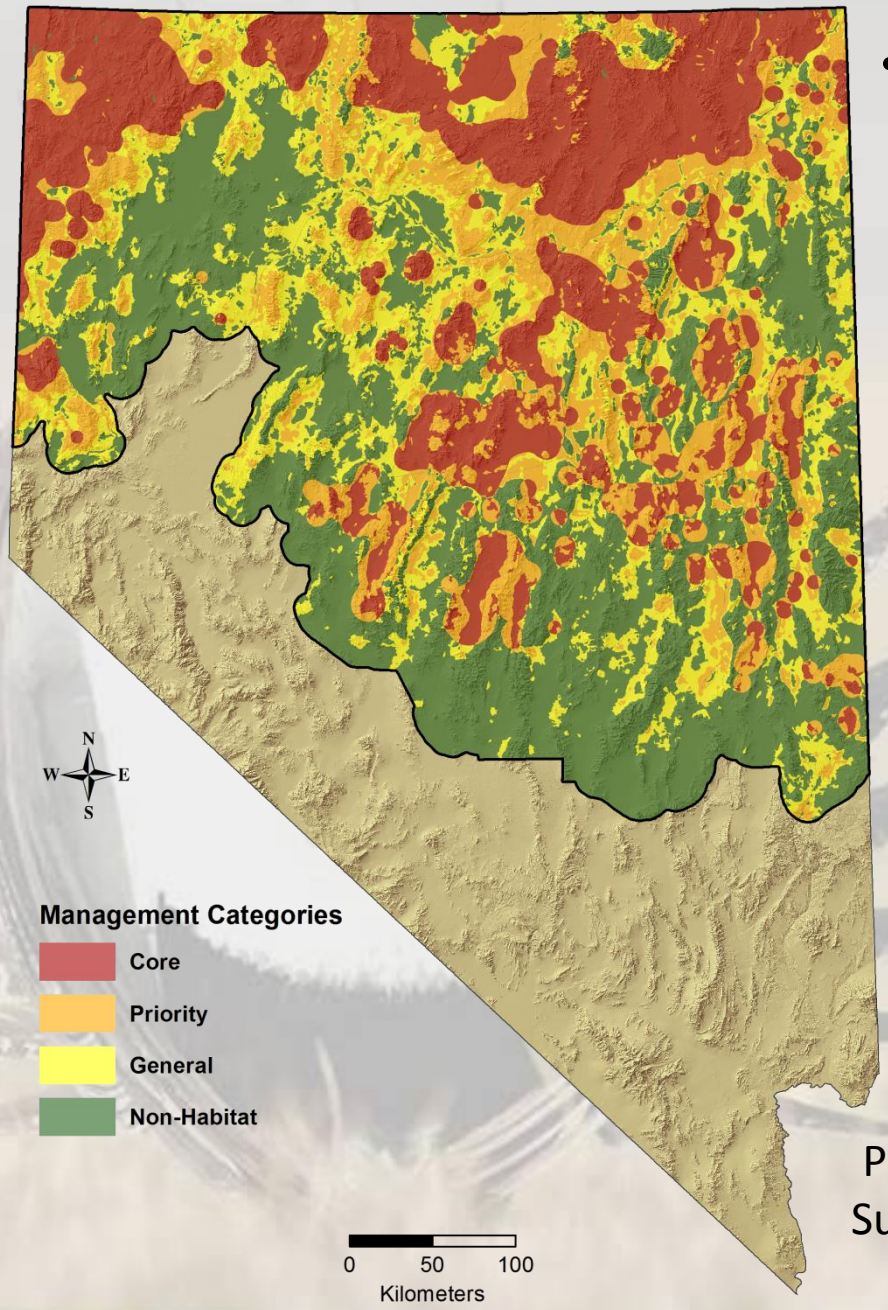
Preliminary Information—Subject to Revision. Not for Citation or Distribution

Management Categories

General

Low and Moderate habitat and outside of core areas

Represents lower quality conditions and low sage-grouse use



- **Management categories based on intersection of habitat suitability and space use**

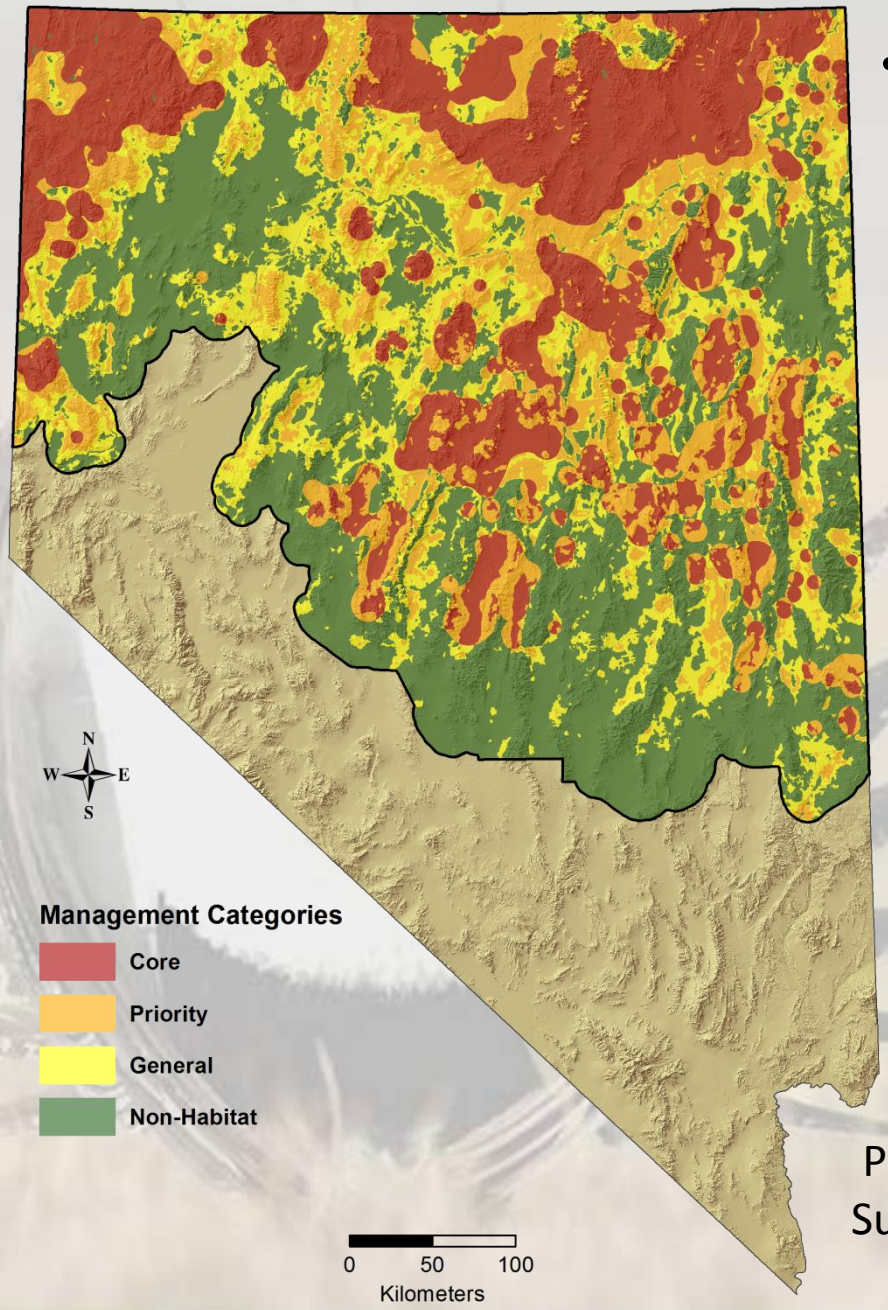
Preliminary Information—Subject to Revision. Not for Citation or Distribution

Management Categories

Non-habitat

Non-habitat and outside of core areas

Represents poor conditions and low sage-grouse use

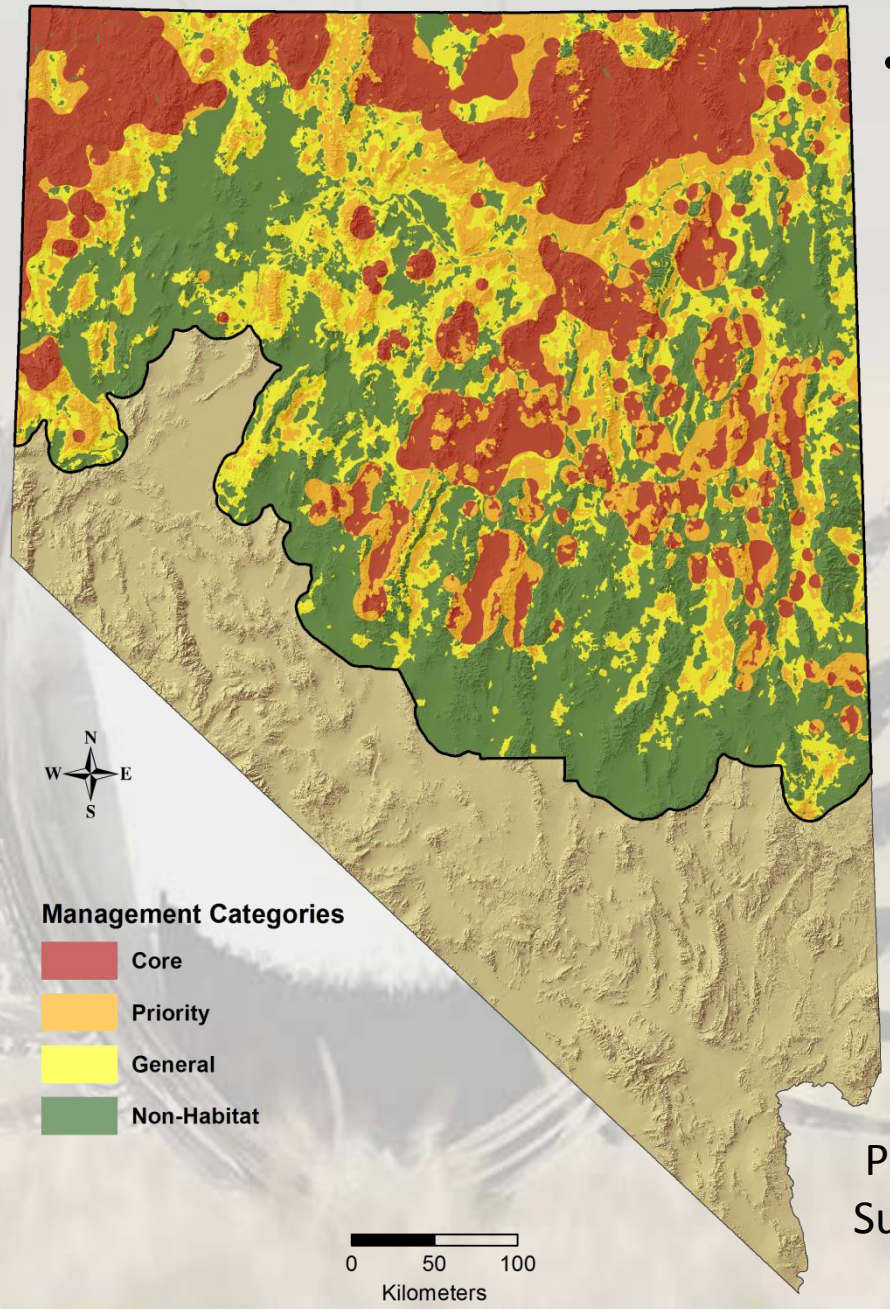


- **Management categories based on intersection of habitat suitability and space use**

Preliminary Information—Subject to Revision. Not for Citation or Distribution

Management Categories

Category	% Change from Coates et al. 2014
Core and Priority	~6.5%
All Mang.	8%



- **Management categories based on intersection of habitat suitability and space use**

Preliminary Information—Subject to Revision. Not for Citation or Distribution

Example Improvement (Conifer Areas)

Example Improvement (Conifer Areas)

Example Improvement (Conifer Areas)

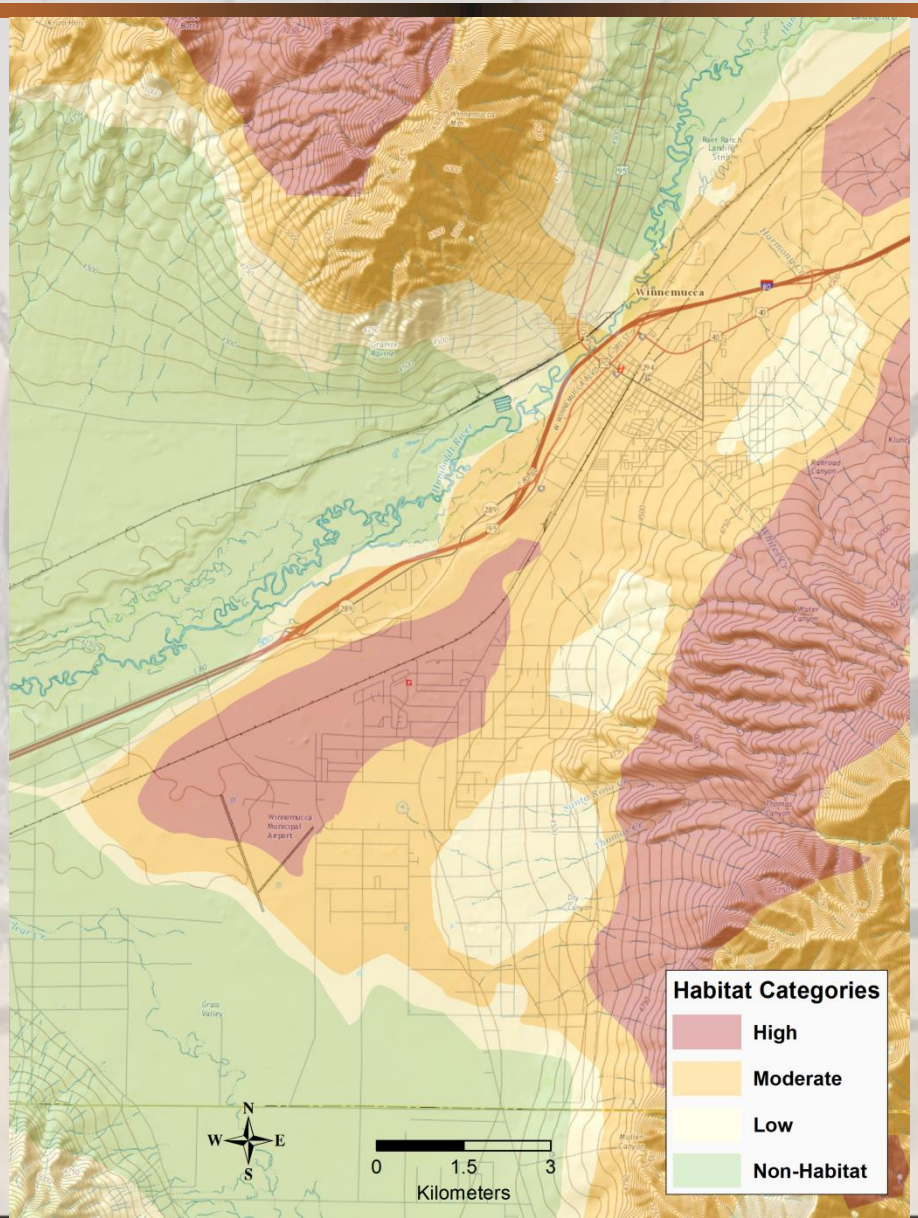
Previous version released in 2014

Example Improvement (Conifer Areas)

Updated version

Example Improvement (Urban Areas)

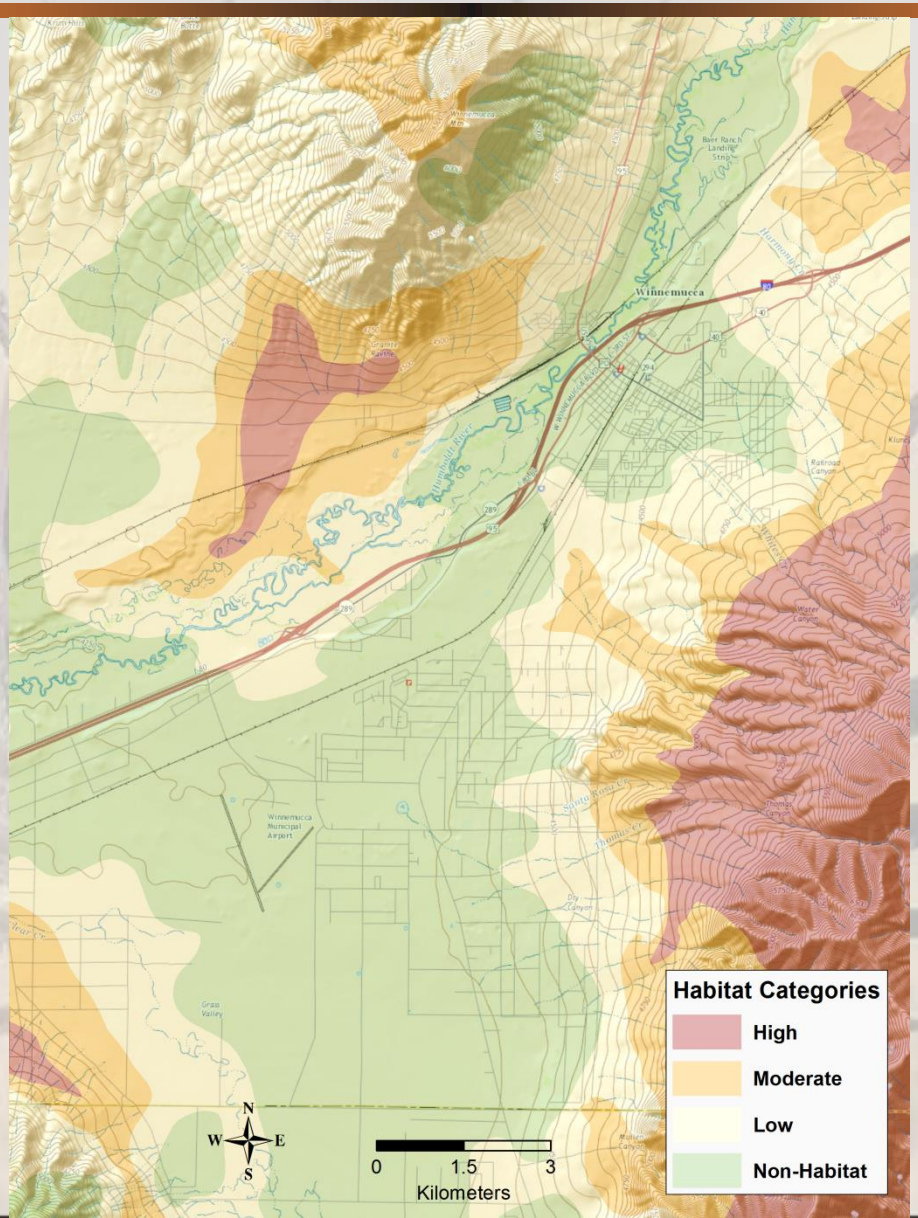
Previous version released in 2014



Annual Map from 2014 showing habitat categorized within Winnemucca.

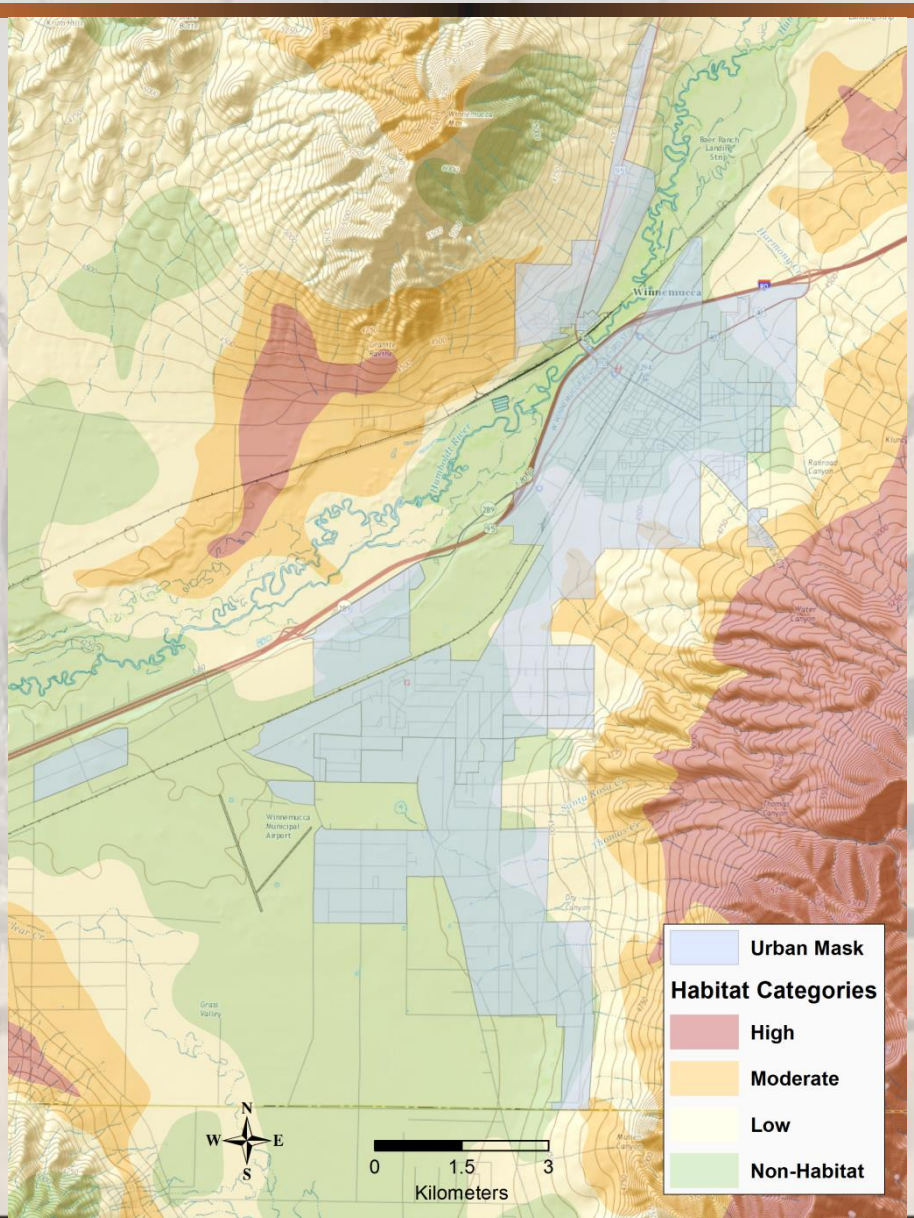
Example Improvement (Urban Areas)

Updated version



With improvements to model urban areas are non-habitat

Example Improvement (Urban Areas)



- **Urban areas were further masked with best available GIS census data**
- **Some surface disturbances may not be masked – limitation of available data**

Summary Points for Updated Map

- High resolution (< 2 m) inputs for land cover types most relevant to sage-grouse (2014 map based on 30-m resolution)

  Big-sagebrush, low-sagebrush, non-sage shrub, bare ground, herbaceous interspace, pinyon-juniper, and pinyon-juniper understory

- Seasonal maps: 24 season by sub-regional RSF combinations (2014 map had 12 sub-regional RSFs)

- Updated with 2014 telemetry and lek count data

- Urban areas 'masked out'

- Improvement in accuracy assessment using validation process (~2%)

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Acknowledgments

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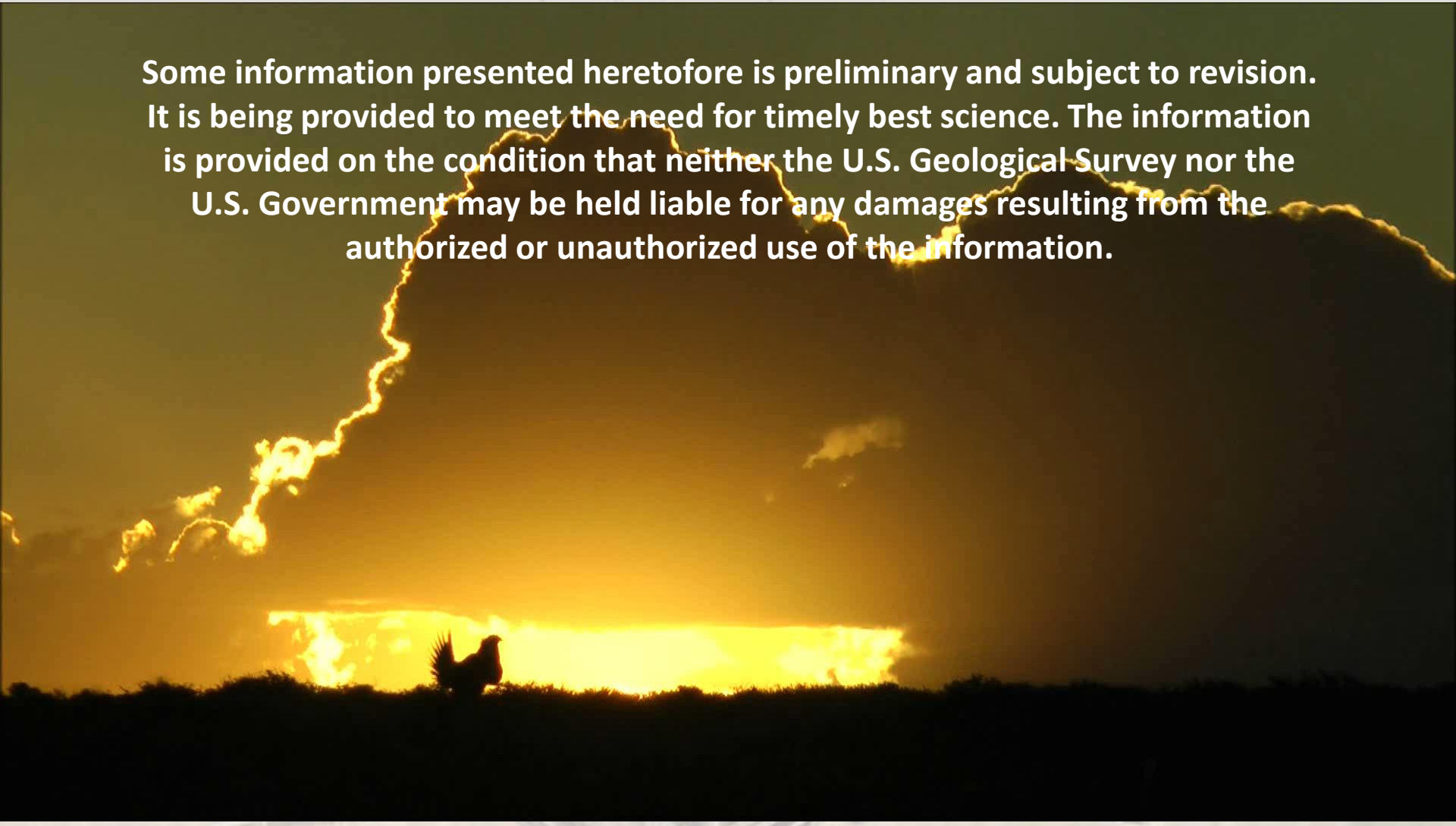
Bureau of Land Management (CA)
Bureau of Land Management (NV)
US Fish and Wildlife Service



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