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Modeling Greater Sage-grouse Habitat Suitability, Habitat Potential, and Risks in Wyoming Through an Interactive Web-based Map

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Background and Purpose

- The greater sage-grouse (*Centrocercus urophasianus*, herein “sage-grouse”) has experienced declines in distribution and abundance across its range due to various factors
- Sage-grouse are often viewed as an umbrella species – activities which preserve sage-grouse habitat will also benefit other sagebrush-obligate species
- Collaboration between Wyoming Department of Environmental Quality (WDEQ) Abandoned Mine Land Division (AML) and multiple partners through the Native Plants Project (NP2) to identify and prioritize areas for reclamation and sage-grouse habitat restoration
- AML’s goal is to transfer this technology to Wyoming stakeholders through a publicly accessible map so that a single practitioner can easily assess and incorporate sage-grouse habitat data into decision-making
- Website displaying a Habitat Suitability Index (HSI) model for sage-grouse habitat quality

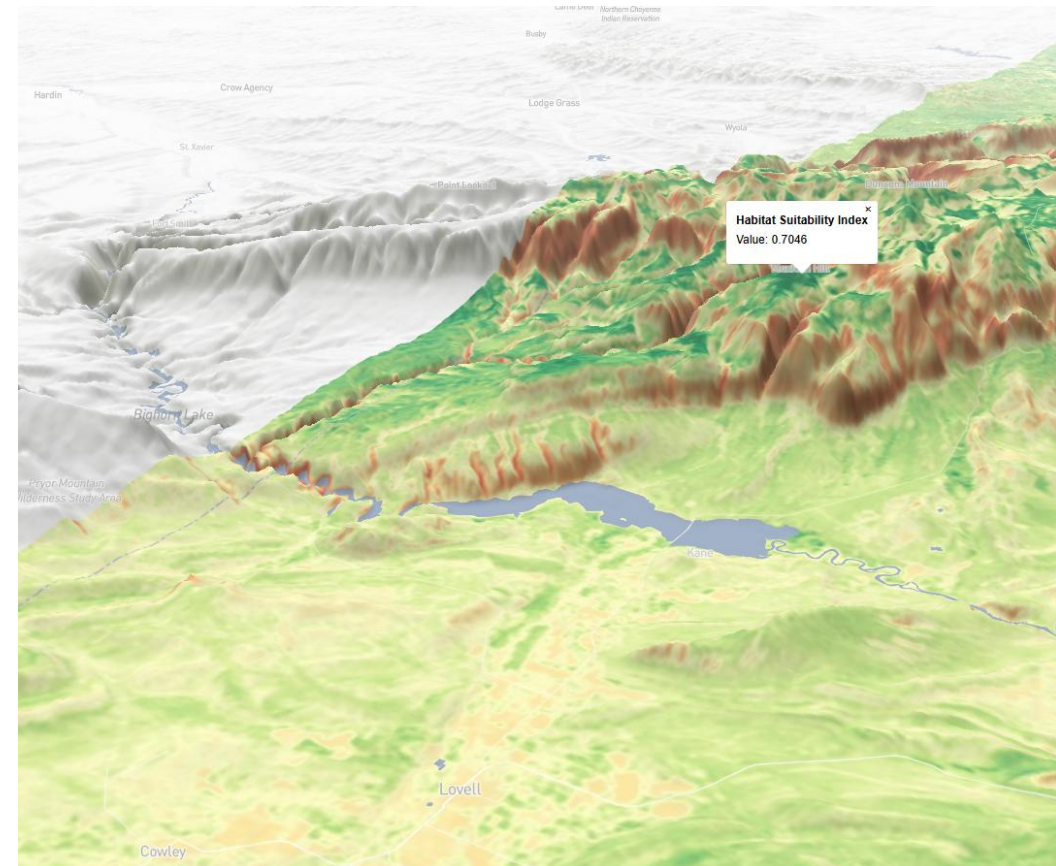
Sage-grouse Mapper – Habitat Suitability Index

- HSI models allow for the creation of a map showing suitability within a landscape of interest based on inputs which are directly linked to habitat selection/suitability
- Model built in GIS Suitability Modeler
- Inputs and model creation process intentionally kept simplistic:
 - Terrain Ruggedness Index
 - Sagebrush
 - Perennial Herbaceous Cover
 - Litter Cover
- RAP vegetation products used in most of the state, RCMAP used in the northeast
 - Testing showed that RCMAP was more accurate in the northeast, most likely due to differences in modeling of sagebrush cover



Habitat Suitability Index – Web Application

- Screenshot on right is from a still Work-In-Progress version of the map
- Shows high elevation “benches” of high-quality habitat which may be attractive to sage-grouse in the summer
- Clicking on map shows user the HSI value at that location, function which allows a user to draw a polygon and receive a value in currently being produced (as of mid-May)
- User able to select additional context layers to inform decision-making
 - General sage-grouse range map
 - Core Habitat areas
 - US Ecoregions



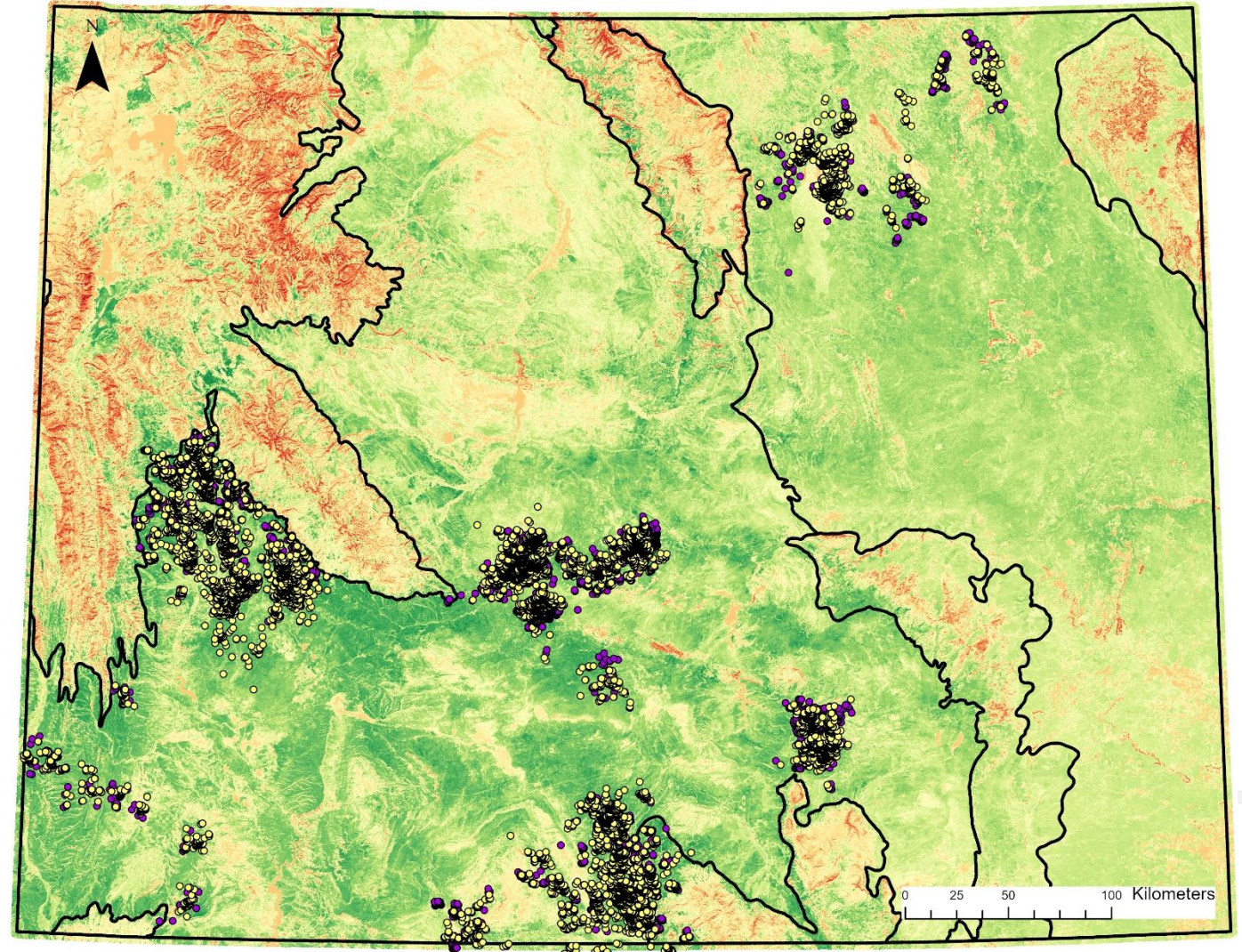
- Maximum HSI
 - Uses RCMAP Ecological Potential layers to determine the historically “best” conditions for each input over the past ~40 years
 - Output HSI shows area of interest under “best possible” conditions
 - Potentially a way to identify areas which could be improved
- Delta HSI
 - Subtracts Maximum HSI from the current HSI to highlight areas which have decreased in sage-grouse habitat suitability
 - Specific inputs can be pulled out as the cause of decrease in habitat quality, for example if a fire occurs -> decrease in cover
- Season-specific Models?
 - Current model was built to be year-round but performs the best in the spring and the summer (nesting and late-brood rearing)
 - We have discussed putting together a winter-specific model
 - We have also discussed assembling a model which specifically targets mesic-area habitats which are desirable to sage-grouse in the summer so degraded areas can be targeted for improvement
- Multi-year Models
 - The Sage-grouse Mapper will be updated annually, and a feature will be added to allow a user to switch between model years and track habitat suitability change over time

HSI Model Validation – Sage-Grouse Location Data



HSI Model Validation – Sage-Grouse Location Data

- Sage-grouse location data from 7 distinct study areas
- Location data grouped into spring (14 March to 22 June) and summer-fall (26 June to 12 October) life stages
- In total validation included 25,989 use locations from transmitted sage-grouse
- HSI Model validated for all of WY and for the two primary ecoregions inhabited by the sage-grouse in WY
 - North American Desert
 - Great Plains



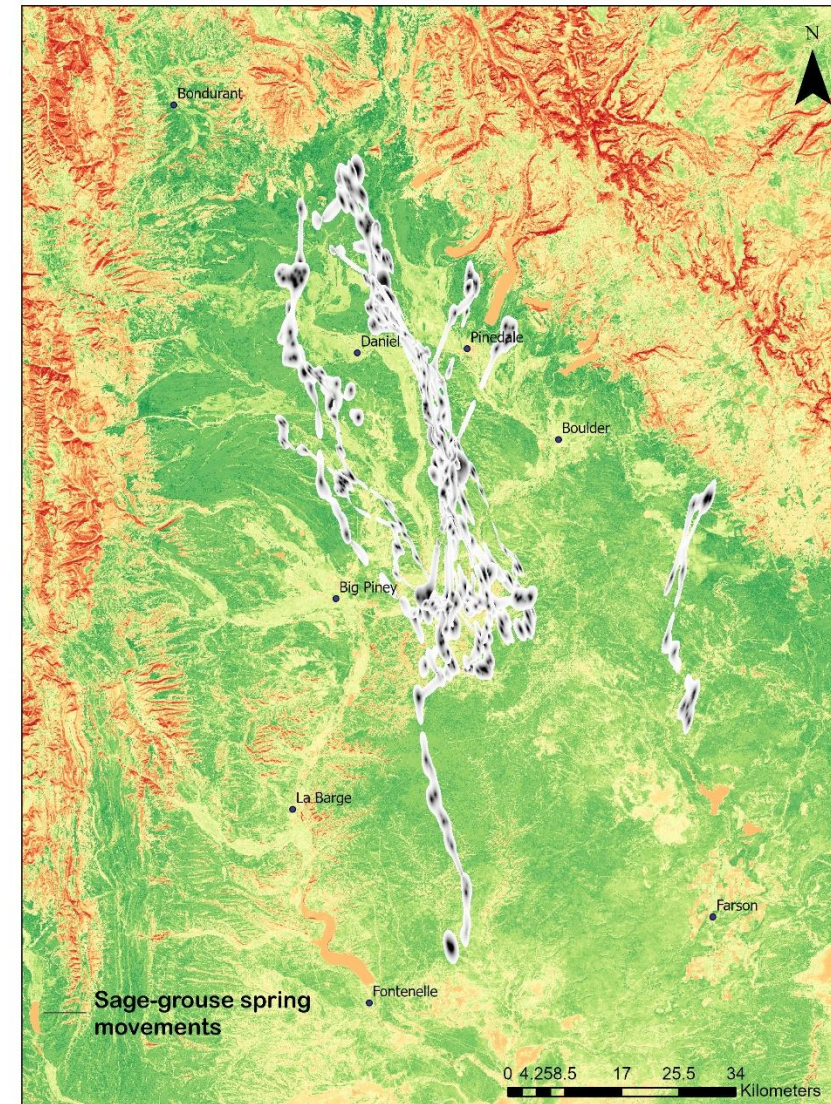
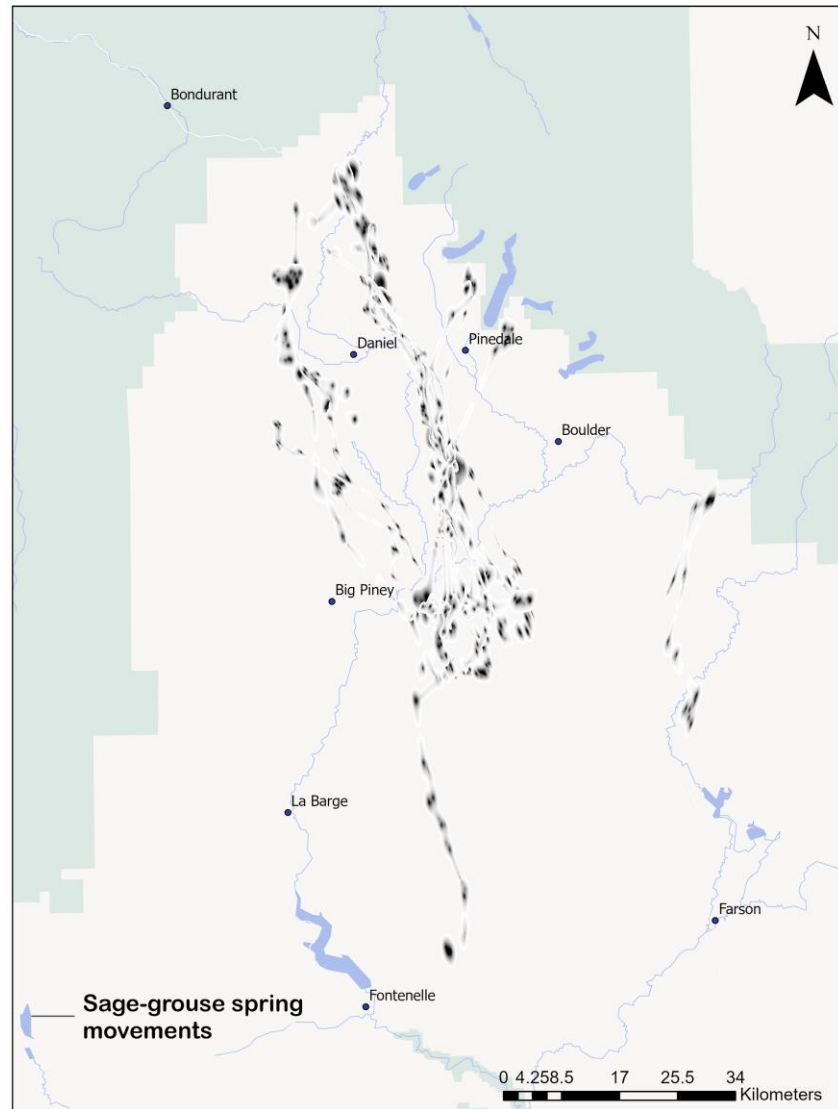
HSI Model Validation – Sage-Grouse Location Data

- Boyce 5-fold Metric (Boyce Index; Boyce et al. 2002 & Hirzel et al. 2006) used to test versions of our HSI against sage-grouse use locations
- The Boyce Index tests the power of the model to predict the presence of the sage-grouse
 - 1 = 100% accuracy at predicting the presence
 - > 0 indicate predictions consistent with the distribution of presences (better model)
 - ≈ 0 indicate no relationship (the model is not predicting presence)
- Results found that the models performed very well in the Spring and Summer-Fall at prediction the presence of sage-grouse
 - 0.9879 – Spring, RAP model, entire state
 - 0.9612 – Summer, RAP model, entire state
 - 0.9540 – Spring, RCMAP model, Great Plains Ecoregion
 - 0.9431 – Summer, RCMAP model, Great Plains Ecoregion

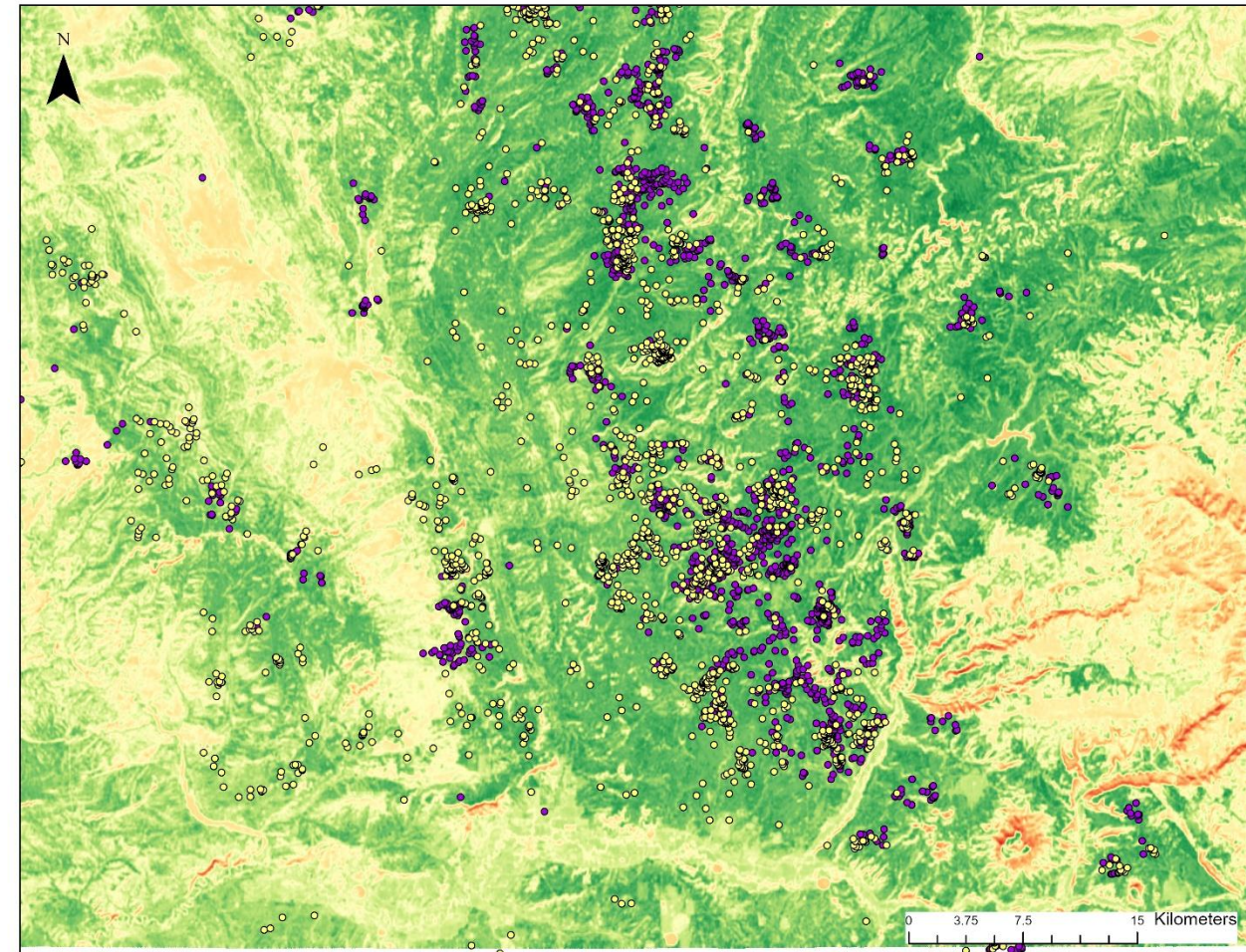
Boyce, M. S., P. R. Vernier, S. E. Nielsen, and F. K. A. Schmiegelow. 2002. Evaluating resource selection functions. *Ecological Modelling* 157:281–300.

Hirzel, A. H., J. Hausser, D. Chessel, and N. Perrin. 2006. Evaluating the ability of habitat suitability models to predict species presences. *Ecological Modelling* 199:142–152.

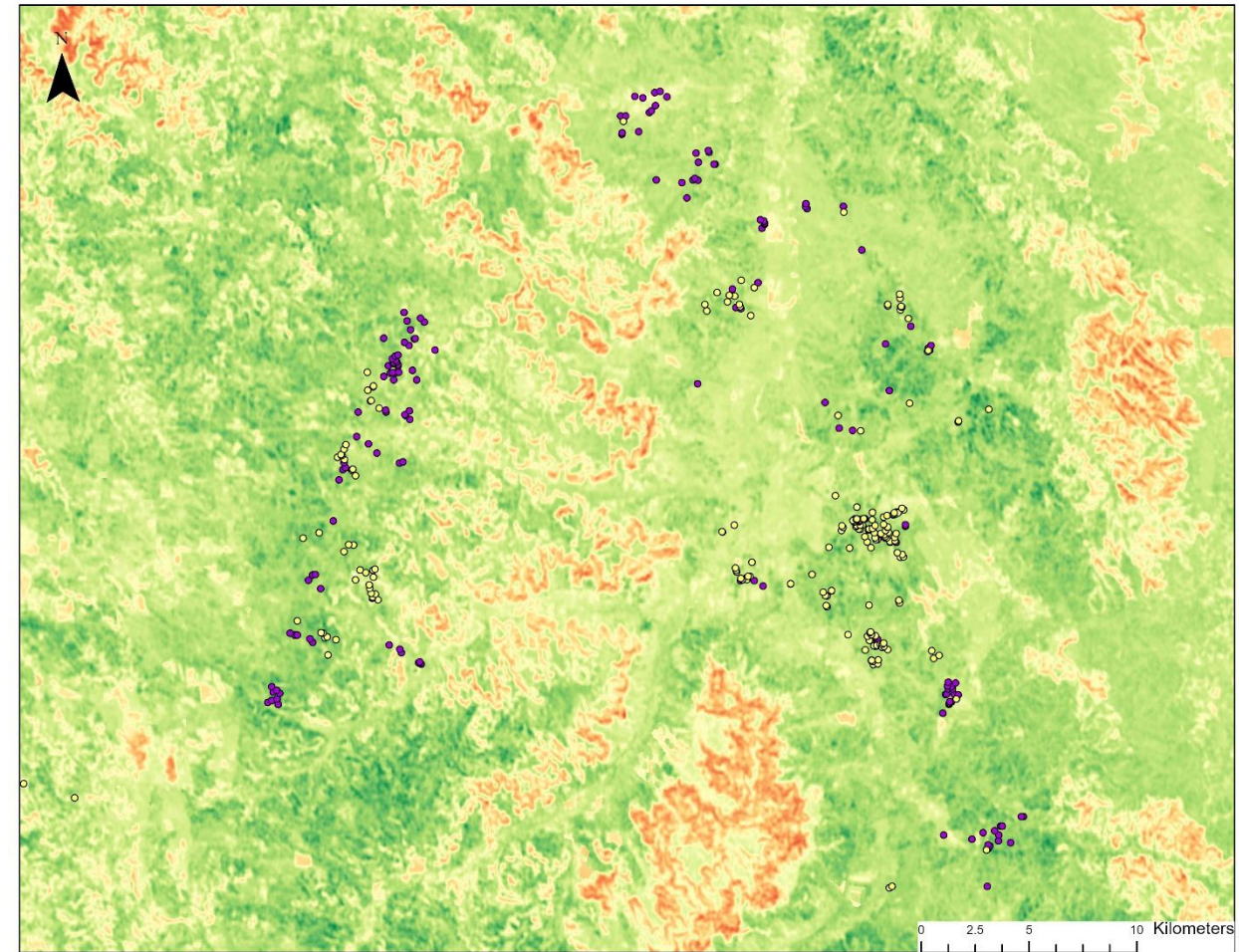
Sage-Grouse HSI – Upper Green River Basin



Sage-Grouse HSI – Other Examples of Predictability



Atlantic Rim north of Rawlins, WY



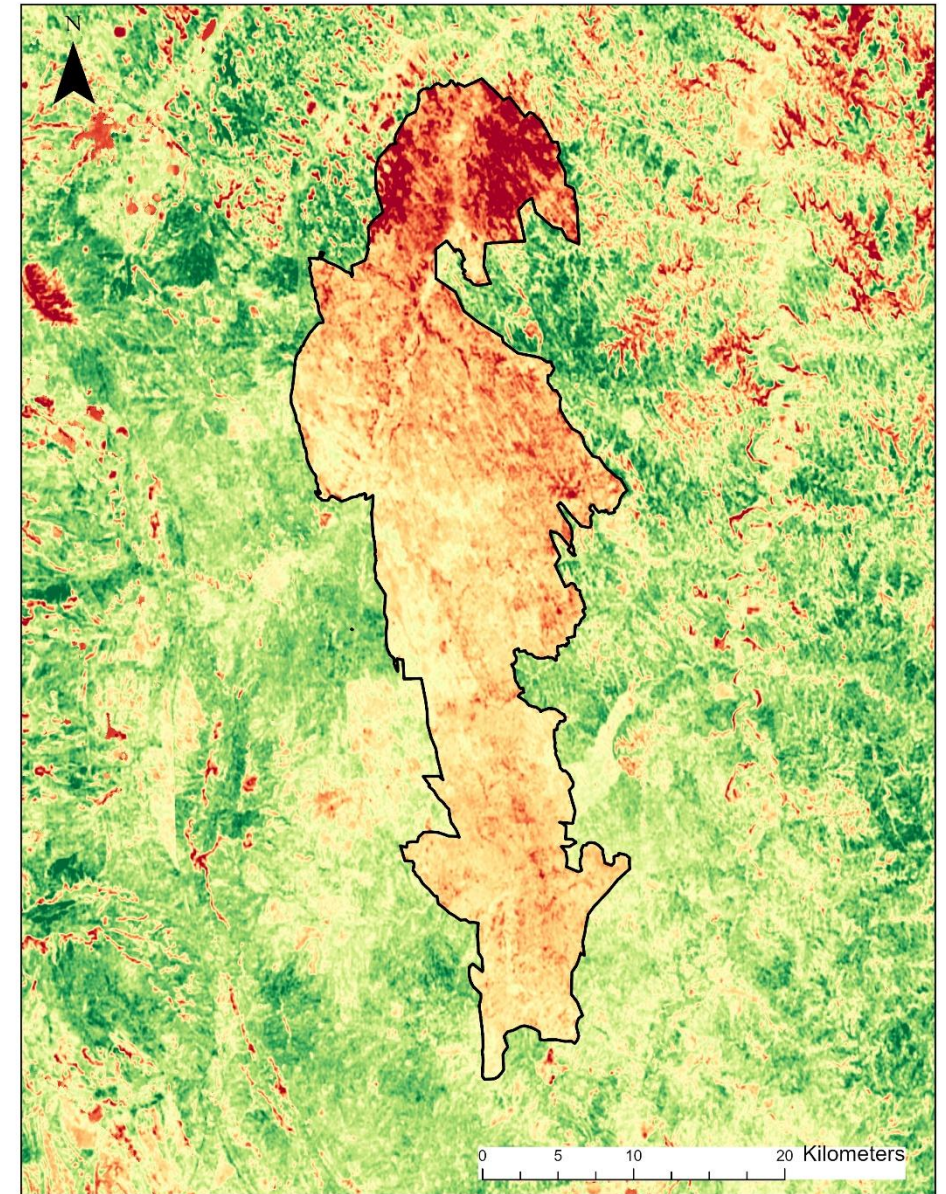
Powder River Basin northwest of Gillette, WY

Potential Uses for Sage-grouse Mapper

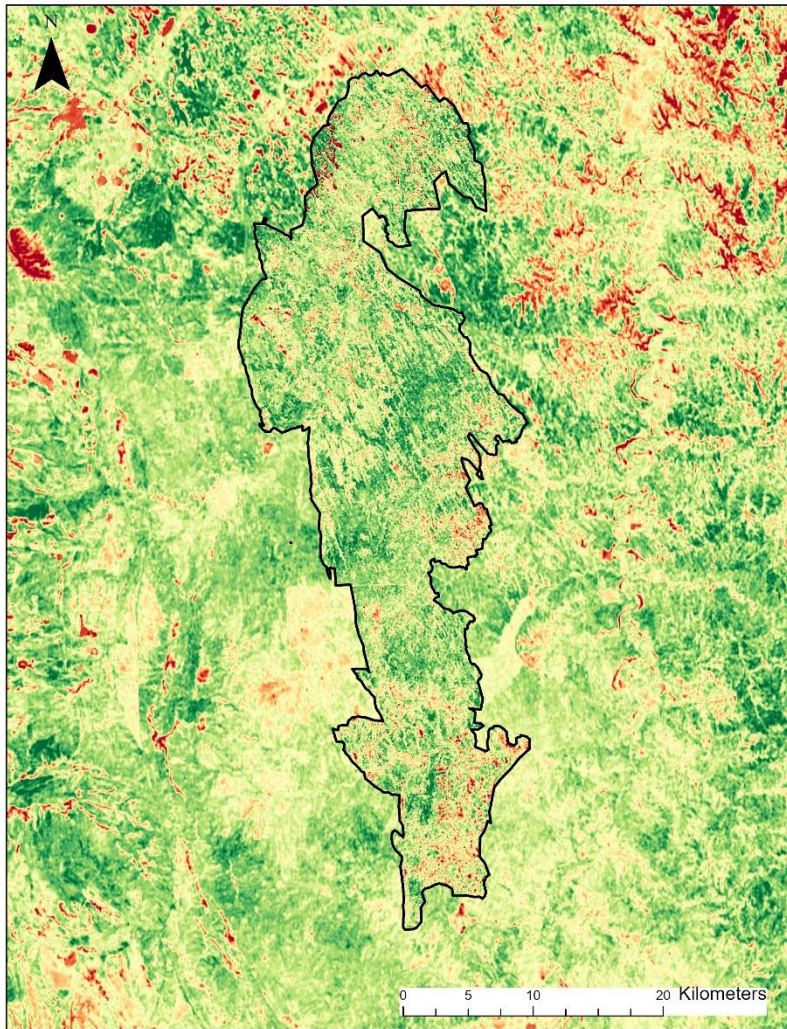
- Targeted habitat restoration
 - Limited funding can be applied to habitat areas that are most important to sage-grouse
- Industrial siting and planning
 - Allows industries to use the tool and HSI model to place infrastructure in areas with lower value habitat to reduce impacts on sage-grouse
- Gauge the effectiveness of restoration efforts over time
 - For example, did sagebrush reseeding or planting efforts increase sage-grouse habitat value over time?
 - For example, did invasive grass treatments increase sage-grouse habitat value over time?
- Public accessibility of tool allows for private landowner usage in support of sage-grouse conservation on private lands

Real World Example – House Draw Fire

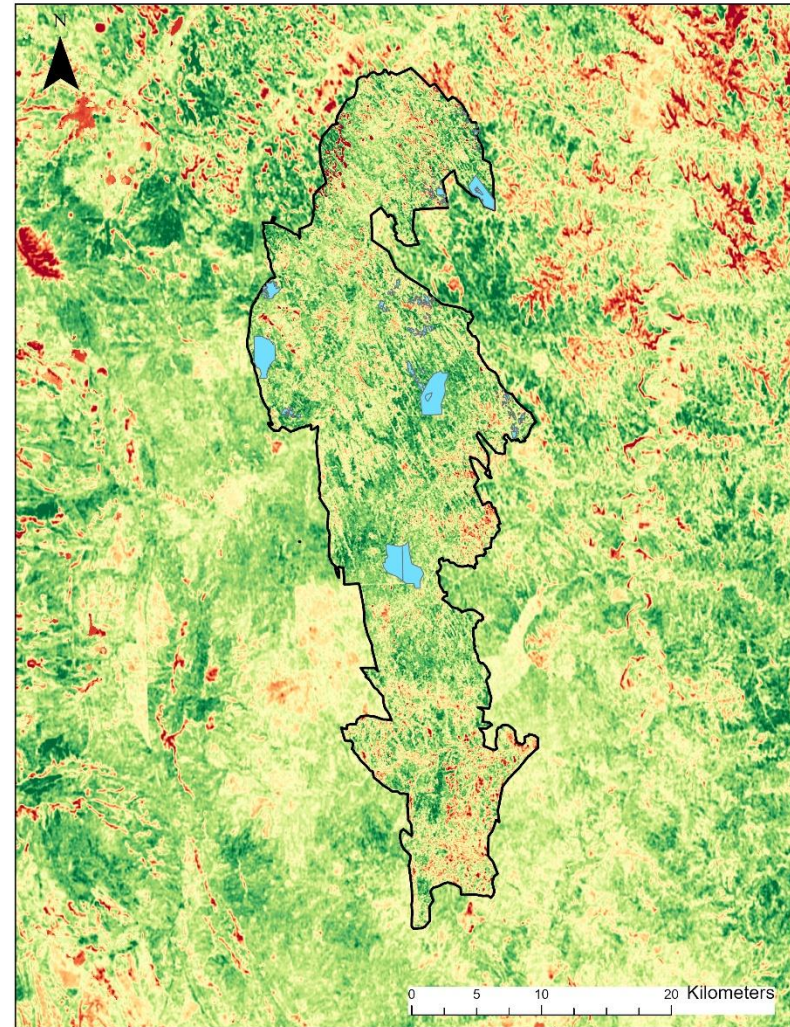
- In 2024, the House Draw Fire burned 175,000 acres of high-quality sagebrush habitat
- There are large investments in money and personnel time that are focused on restoring important sage-grouse habitats lost due to this fire
 - Broad scale treatments of invasive grasses to prevent their establishment
 - Aerial and ground based-based seeding of Wyoming big sagebrush and native forbs and grasses
 - Mesic draw restoration



Real World Example – House Draw Fire



Pre-fire sage-grouse HSI



Sagebrush and native forb and grasses seeding units

Conclusion

- Habitat Suitability Index models provide a useful tool for representing real world conditions
- Our model performed well after testing and can provide a useful tool for assisting management decisions
- Prioritizing areas for seeding/additional actions after a disturbance – House Draw Fire

Thank you!

