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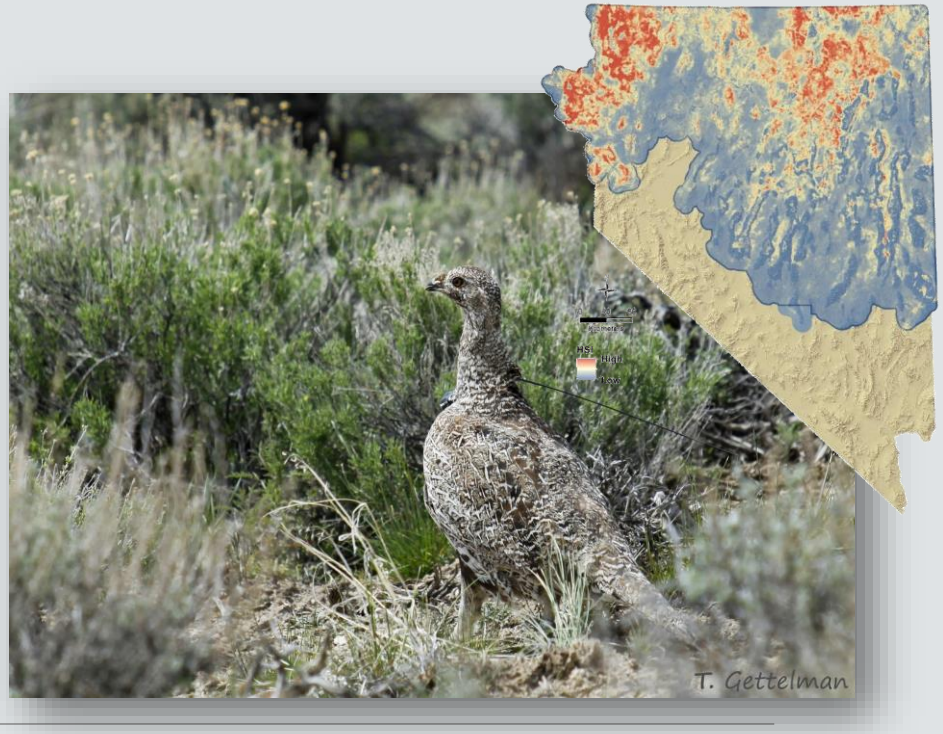
Updates in Modeling Habitat Suitability and Space Use for Greater Sage-Grouse in Nevada and Northeastern California

Presented to Sagebrush Ecosystem Council
May 12, 2023
Reno, NV



PETER S. COATES, PH.D.

PRODUCT CO-AUTHORS: MEGAN C. MILLIGAN, PH.D., SHAWN T. O'NEIL, PH.D., BRIANNE E. BRUSSEE, MICHAEL P. CHENAILLE, MARK A. RICCA, PH.D., MICHAEL L. CASAZZA, K. BENJAMIN GUSTAFSON, SHAWN ESPINOSA, SCOTT GARDNER, AND DAVID J. DELEHANTY, PH.D.

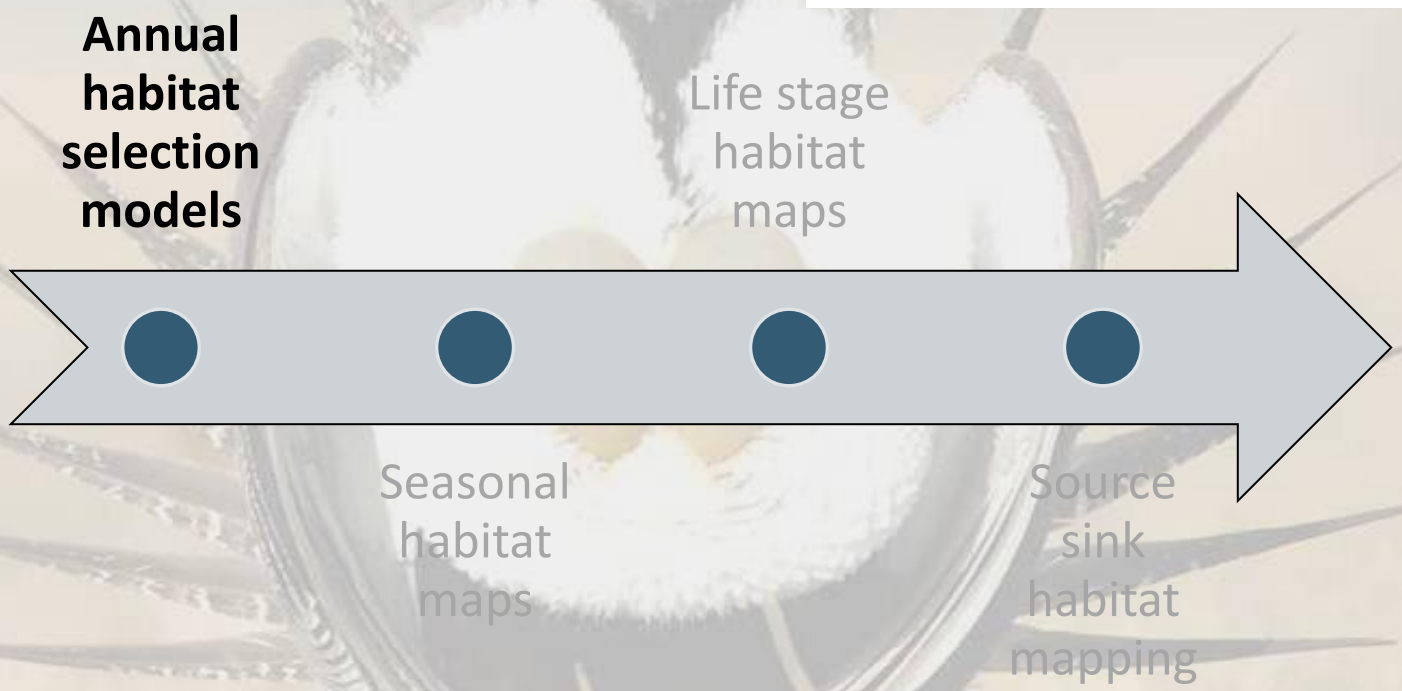
Journal of Applied Ecology
BRITISH ECOLOGICAL SOCIETY

Standard Paper | Open Access

Integrating spatially explicit indices of abundance and habitat quality: an applied example for greater sage-grouse management

Peter S. Coates, Michael L. Casazza, Mark A. Ricca, Brianne E. Brussee, Erik J. Blomberg, K. Benjamin Gustafson, Cory T. Overton, Dawn M. Davis, Lara E. Niell, Shawn P. Espinosa, Scott C. Gardner, David J. Delehanty, ... See fewer authors

First published: 20 October 2015 | https://doi.org/10.1111/1365-2664.12558 | Citations: 32



2015 Annual Habitat Selection Maps

Definitions for Mapping Sage-Grouse Habitat

- **Index -** Number assignment between 0 and 1 used as a relative indicator (1 represents highest value)

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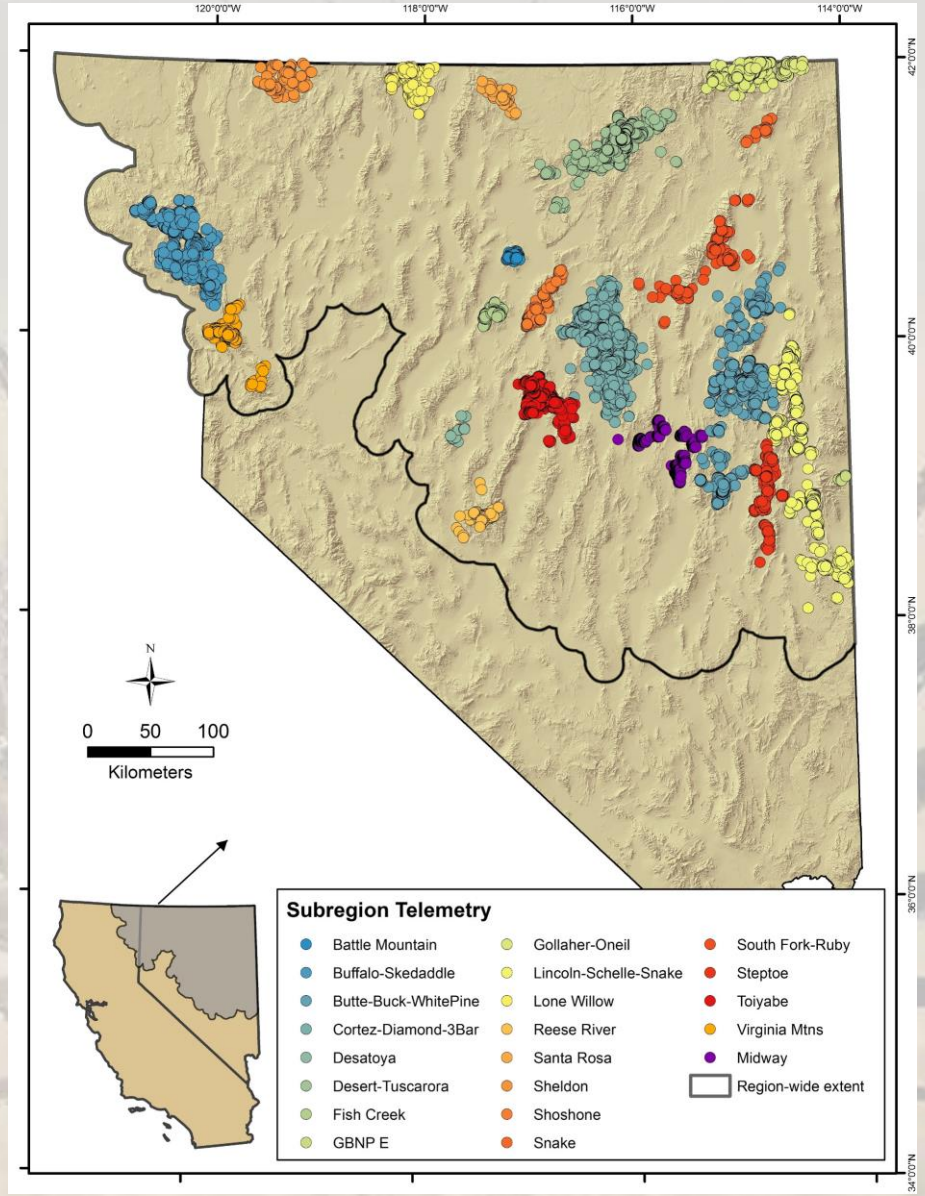
- **Index -** Number assignment between 0 and 1 used as a relative indicator (1 represents highest value)

- **Habitat Selection Index –** Numerical index that represents the highest probability that individual sage-grouse select an area (e.g., typically based on use vs. availability analyses)

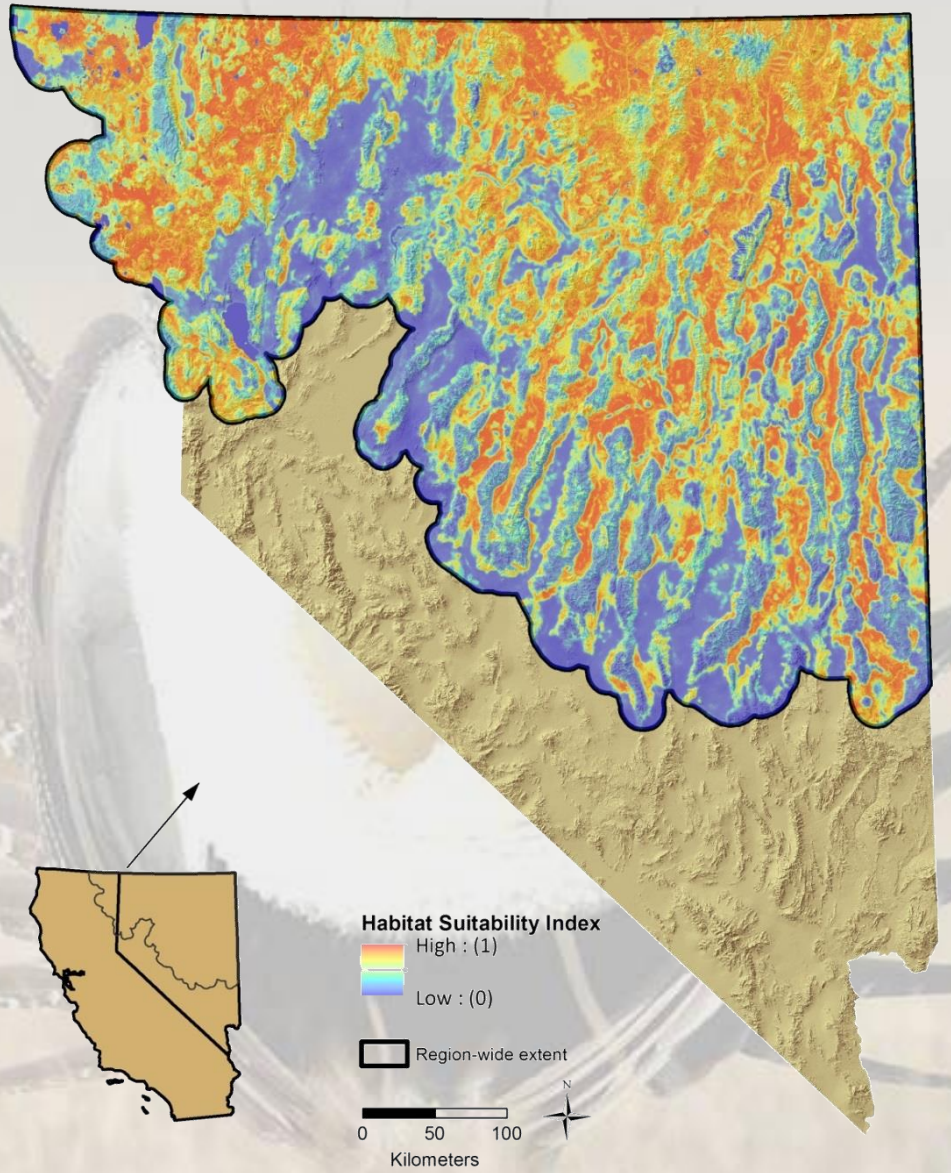
Annual Habitat Selection Model



- **>35,000 telemetry locations from VHF and GPS**
- **>1,500 sage-grouse**
- **12 study regions**

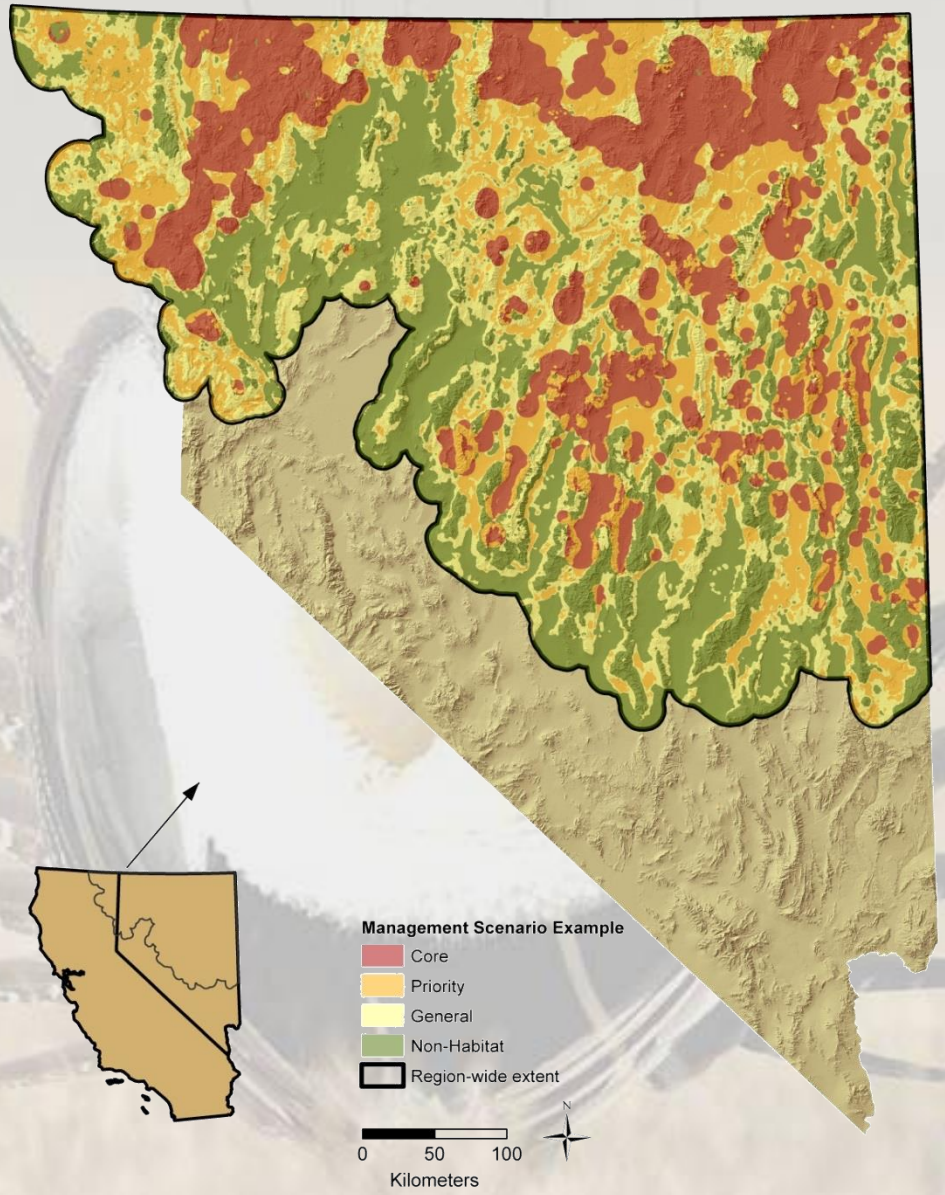
Coates et al. 2016. Journal of Applied Ecology, 53(1), 83-95.

Annual Habitat Selection Model



Coates et al. 2016. Journal of Applied Ecology, 53(1), 83-95.

Management Area Map



- Highest 'value' for areas of greatest selected habitat and high probability of abundant sage-grouse
- 2nd Order Habitat Selection Example

Coates et al. 2016. Journal of Applied Ecology, 53(1), 83-95.

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2019 Seasonal Habitat Selection Models

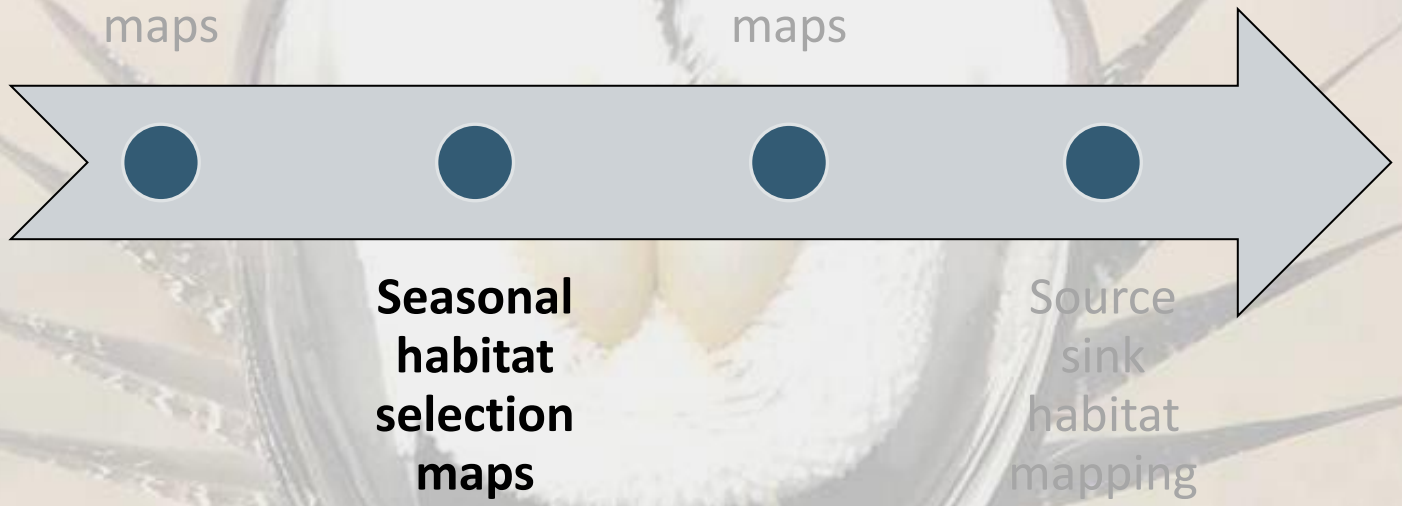
Ecology and Evolution
Open Access

ORIGINAL RESEARCH | Open Access

Spatially explicit models of seasonal habitat for greater sage-grouse at broad spatial scales: Informing areas for management in Nevada and northeastern California

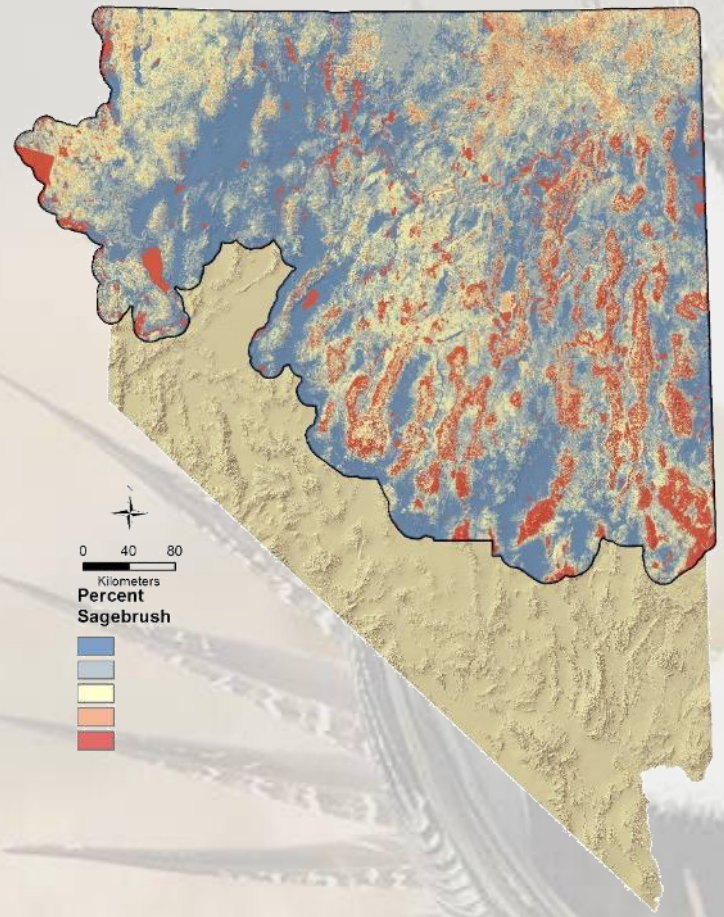
Peter S. Coates, Brianne E. Brussee, Mark A. Ricca, John P. Severson, Michael L. Casazza, Kit Benjamin Gustafson, Shawn P. Espinosa, Scott C. Gardner, David J. Delehanty,

First published: 25 November 2019 | https://doi.org/10.1002/ece3.5842 | Citations: 4

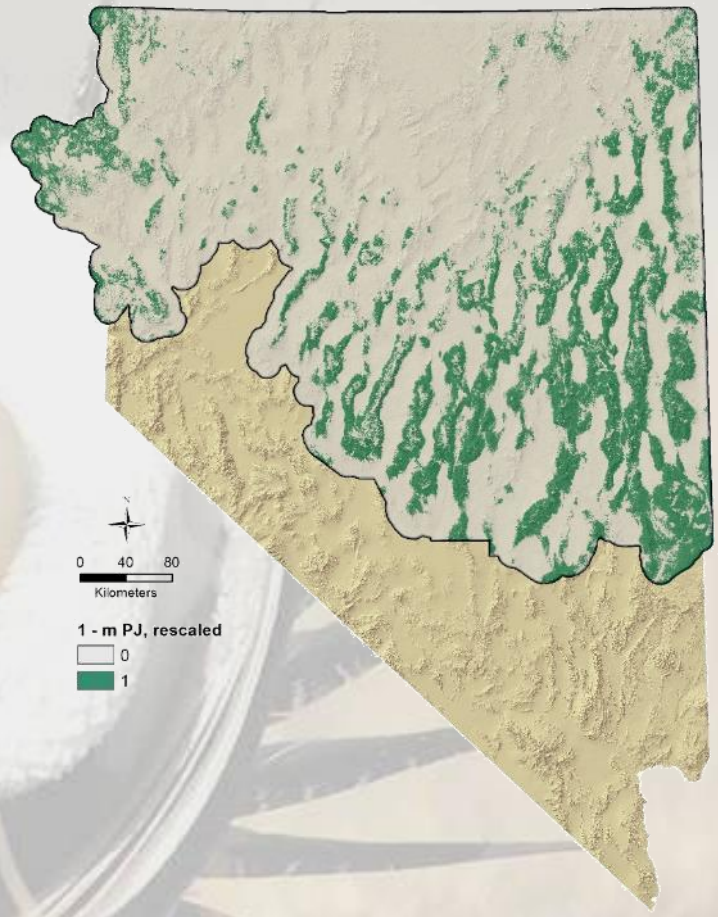


Higher Spatial Resolution Land Cover Data

RCMAP (e.g., sagebrush)



Conifers



Same shrubland spatial layers as previous versions. Updated conifer map to USGS 1-m product.

Coates et al. 2020. Ecology and Evolution, 10(1), 104-118.

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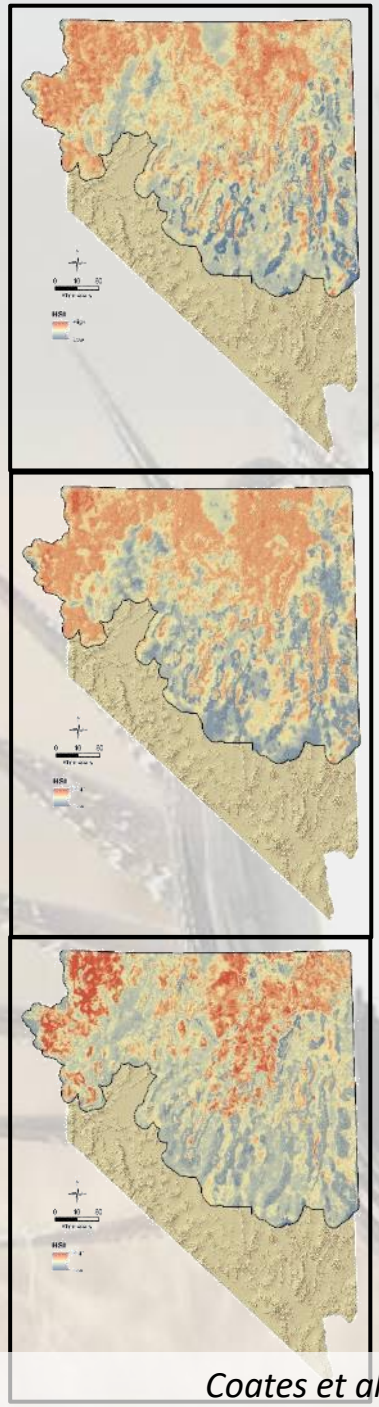
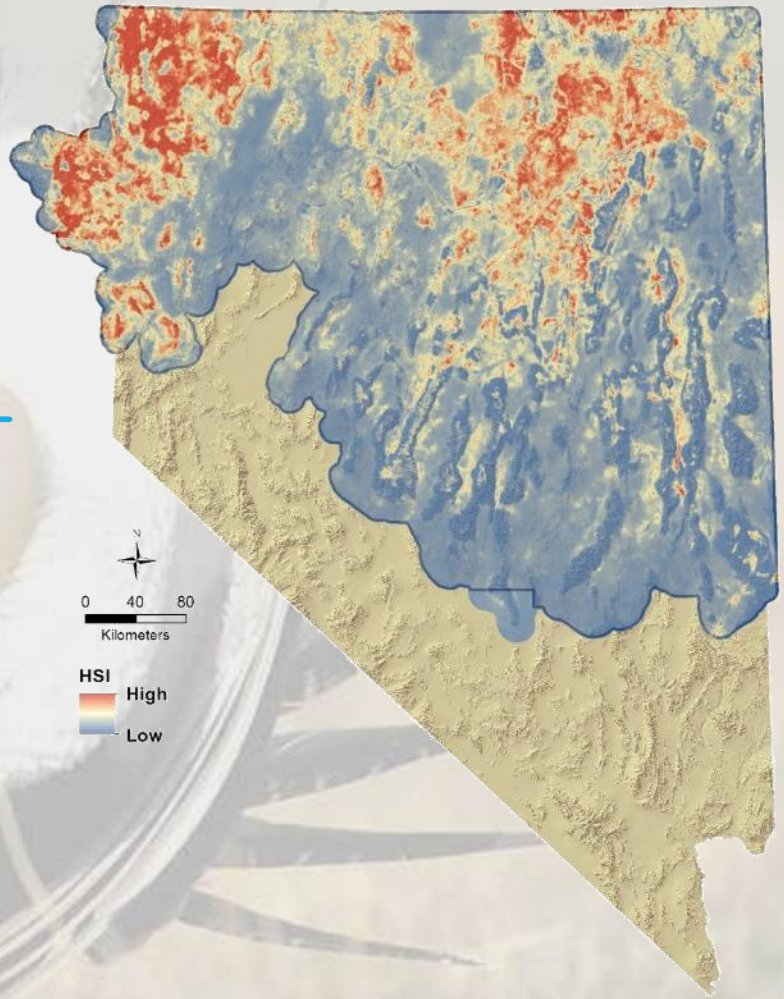
Annual Habitat Selection Index (Product of seasonal probabilities)

Spring

Summer

Winter





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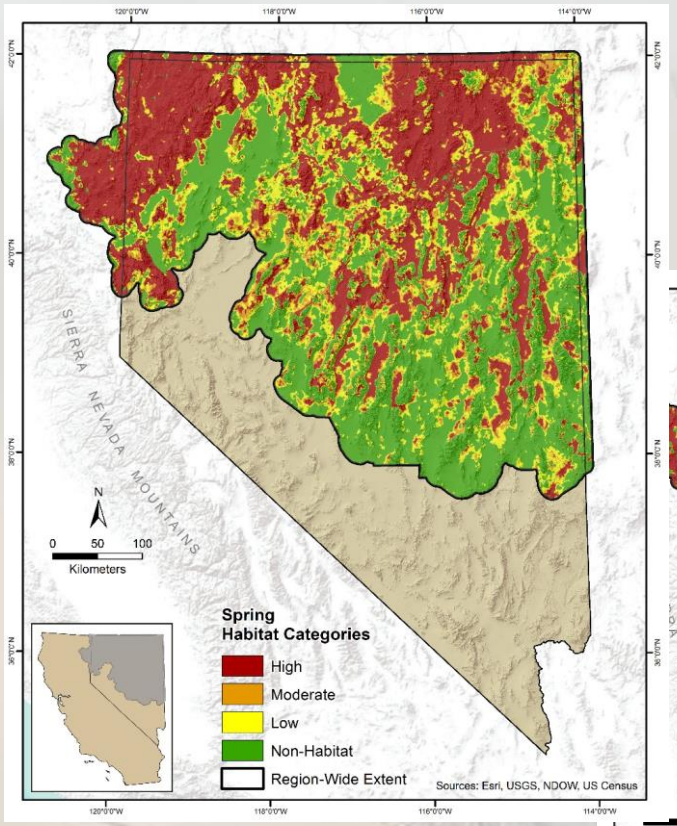

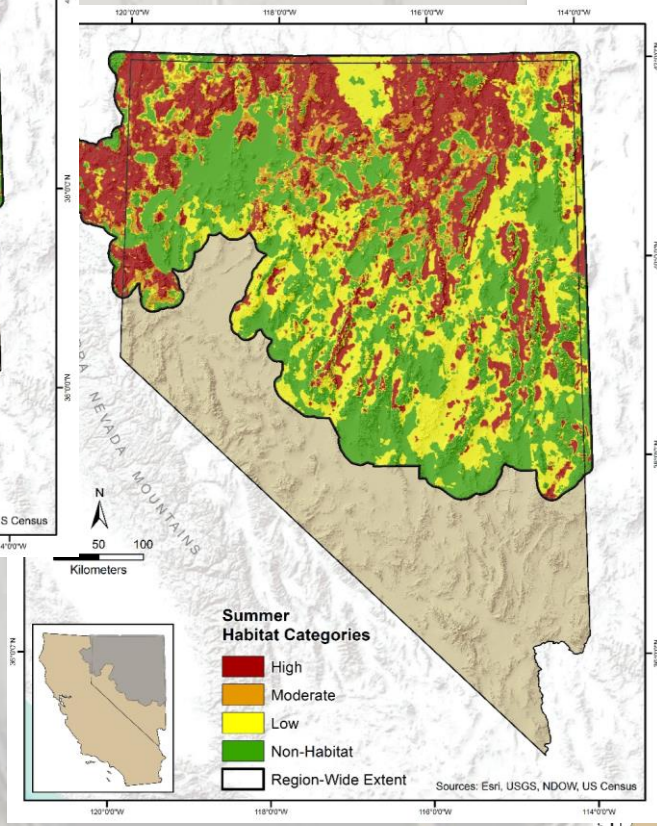

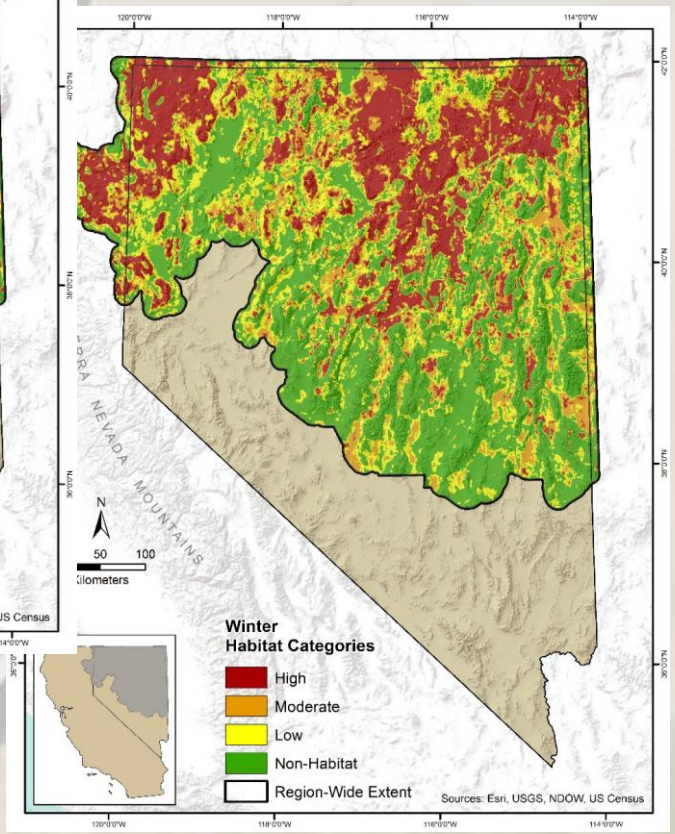

Ecology and Evolution
Open Access
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25 November 2019 | https://doi.org/10.1002/ece3.5842 | Citations: 4

Seasonal mapping efforts

- Phenological-based not life-stage
- No incorporation of success

Coates et al. 2020. Ecology and Evolution, 10(1), 104-118.

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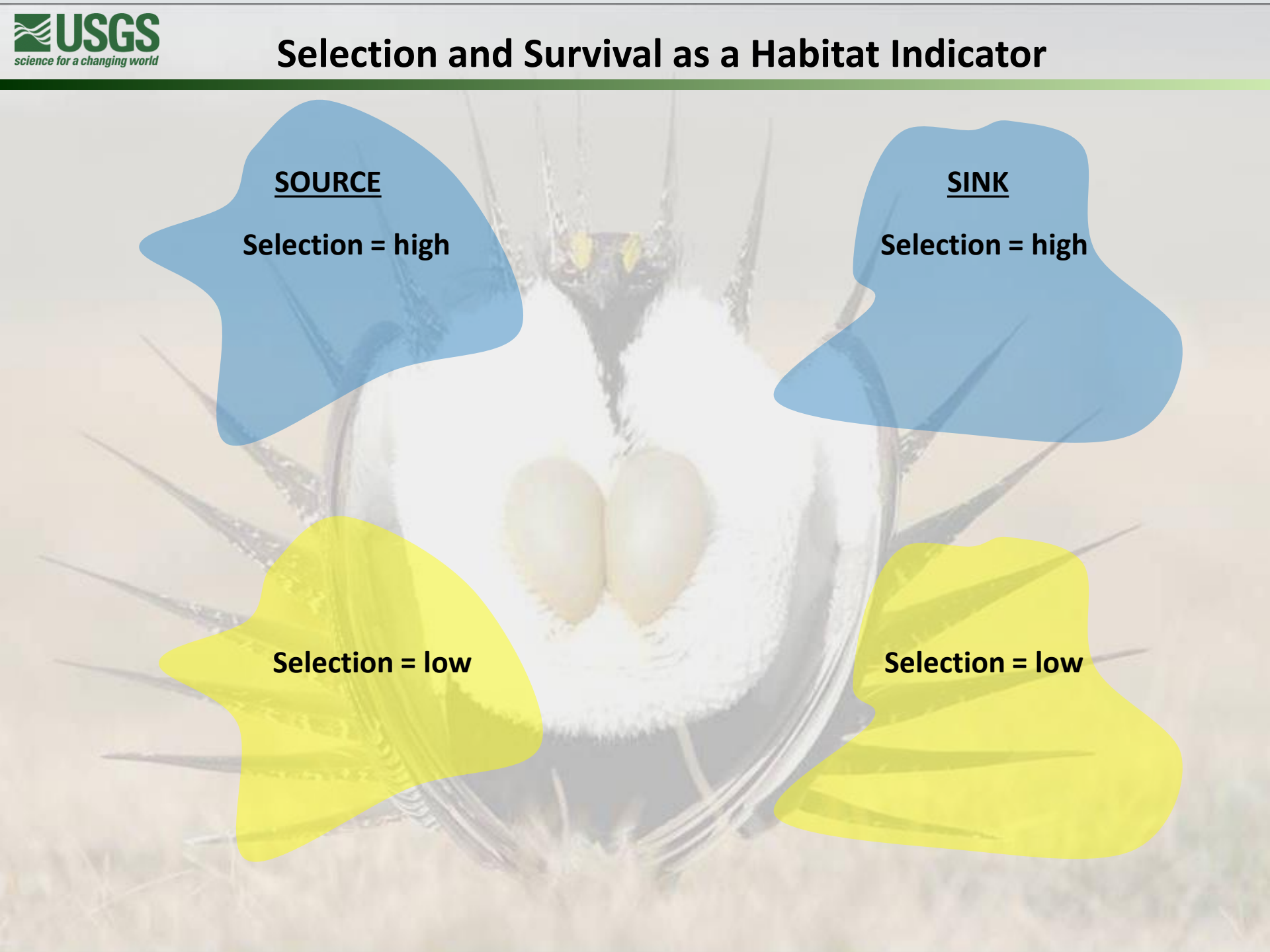
- **Habitat Suitability Index –** Numerical index that represents the capacity of a given habitat to support a species of interest (e.g., survival)

Selection and Survival as a Habitat Indicator



Selection and Survival as a Habitat Indicator

SOURCE

Selection = high
Survival = high

SINK

Selection = high
Survival = low

Selection = low
Survival = low

Selection = low
Survival = high

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Contents lists available at ScienceDirect

Global Ecology and Conservation

journal homepage: www.elsevier.com/locate/gecco

Invasion of annual grasses following wildfire corresponds to maladaptive habitat selection by a sagebrush ecosystem indicator species

Brianne E. Brussee[a], Peter S. Coates[a,*], Shawn T. O'Neil[a], Michael L. Casazza[a], Shawn P. Espinosa[b], John D. Boone[c], Elisabeth M. Ammon[c], Scott C. Gardner[d], David J. Delehanty[e]

Annual habitat maps

Life stage habitat maps

Seasonal habitat maps

Source sink habitat mapping

Global Change Biology

PRIMARY RESEARCH ARTICLE | Open Access

Wildfire and the ecological niche: Diminishing habitat suitability for an indicator species within semi-arid ecosystems

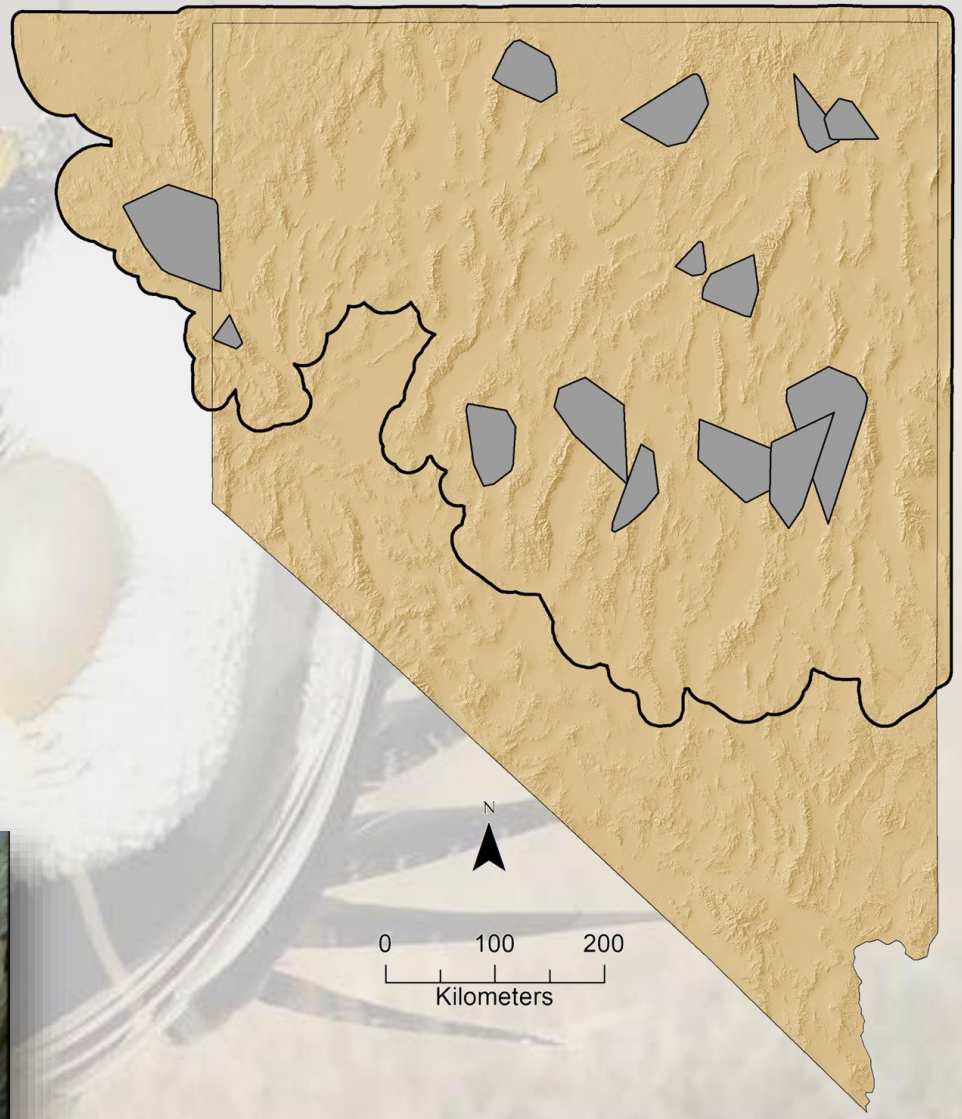
Shawn T. O'Neil, Peter S. Coates, Brianne E. Brussee, Mark A. Ricca, Shawn P. Espinosa, Scott C. Gardner, David J. Delehanty,

First published: 02 August 2020 | https://doi.org/10.1111/gcb.15300 | Citations: 6

Field Methods and Study Sites

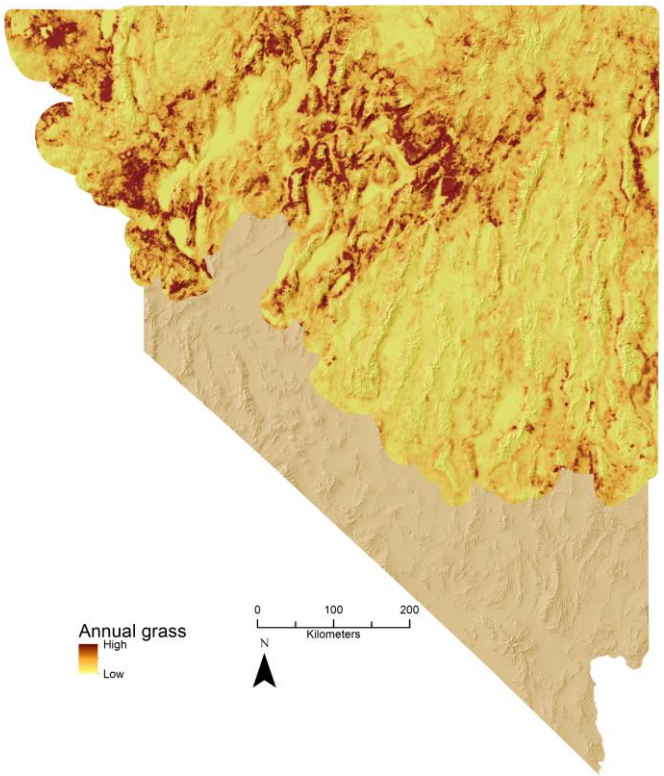
Captured and monitored female sage-grouse across different life stages

- 14 study areas
- Fitted sage-grouse with VHF & GPS transmitters
- Monitored fate of nests and broods
  - *N* = 1,220 nests
  - *N* = 480 broods



Land Cover Variables Used in HSI Models

Annual Grass



O'Neil et al. 2020, Journal of Applied Ecology; Brussee et al. 2022, Global Ecology and Conservation

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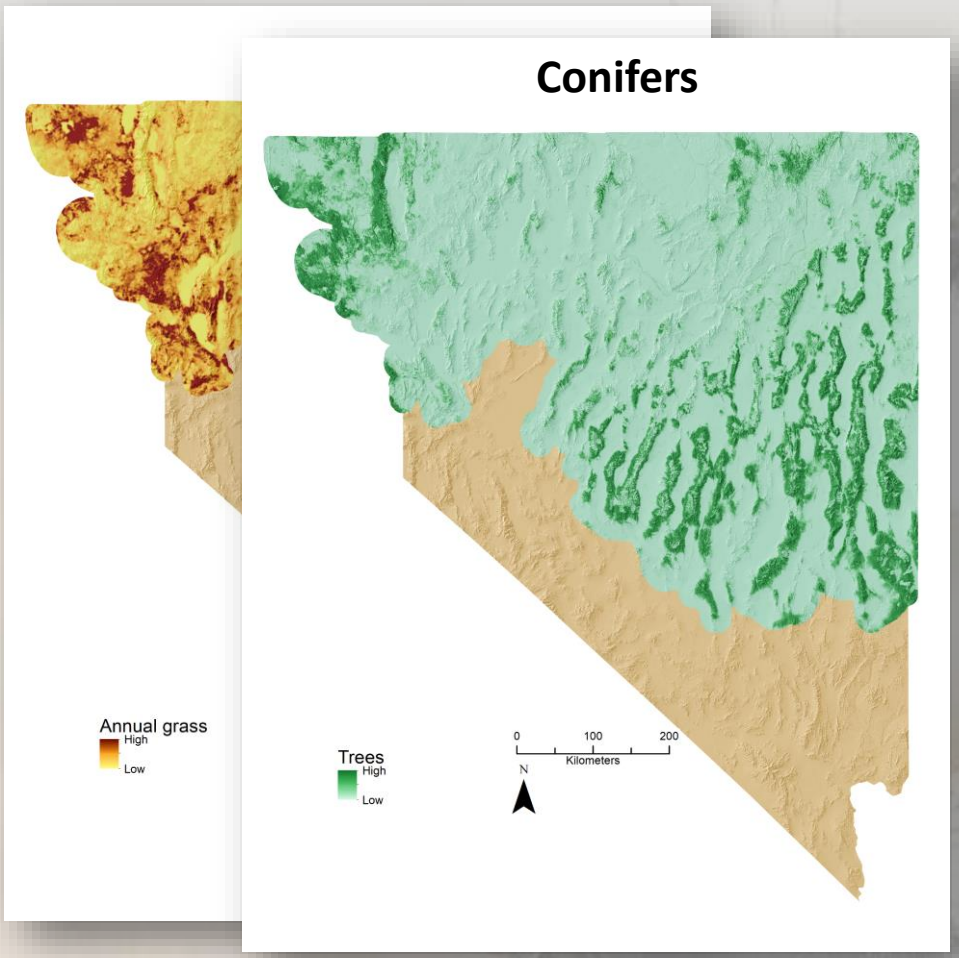

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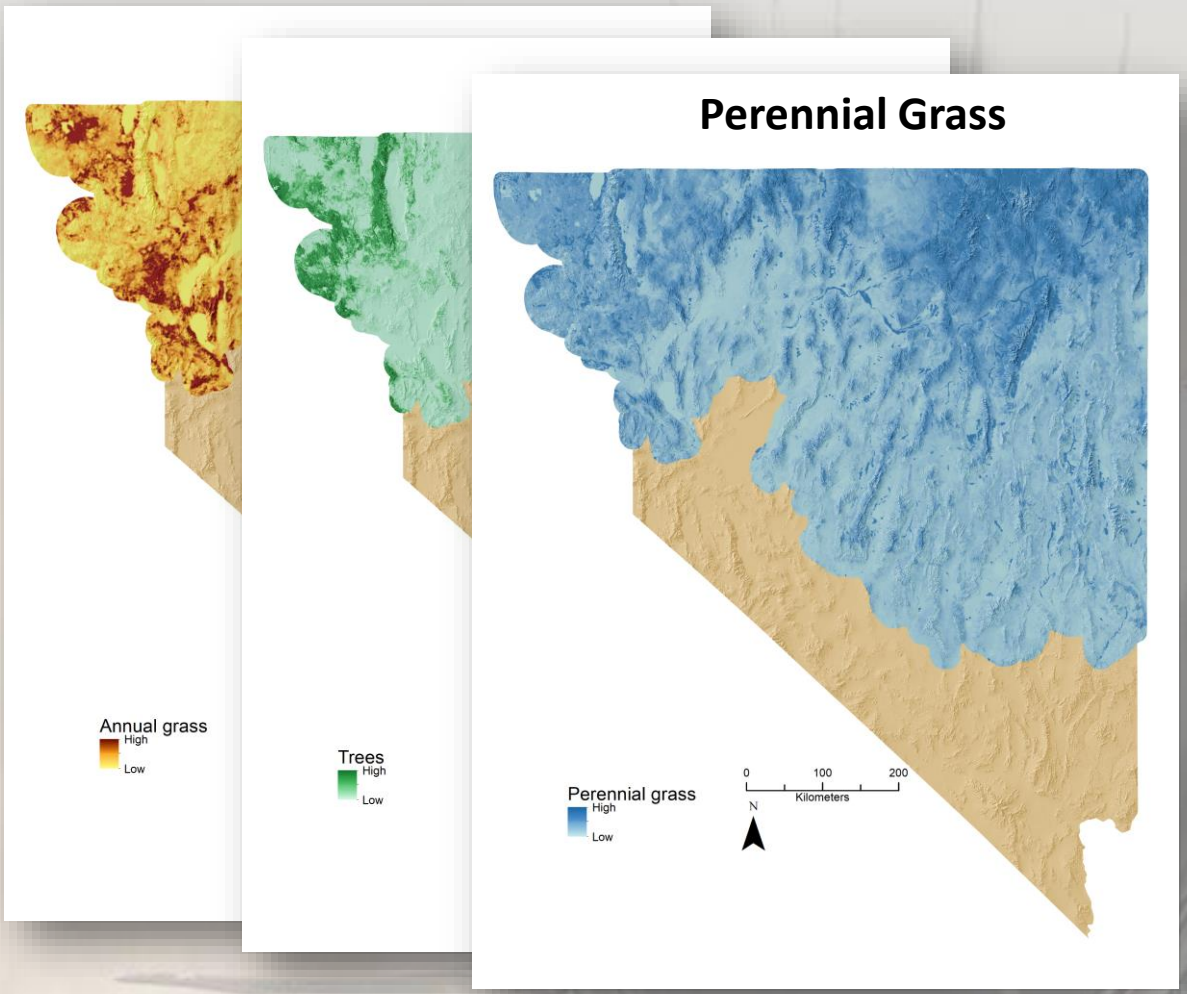

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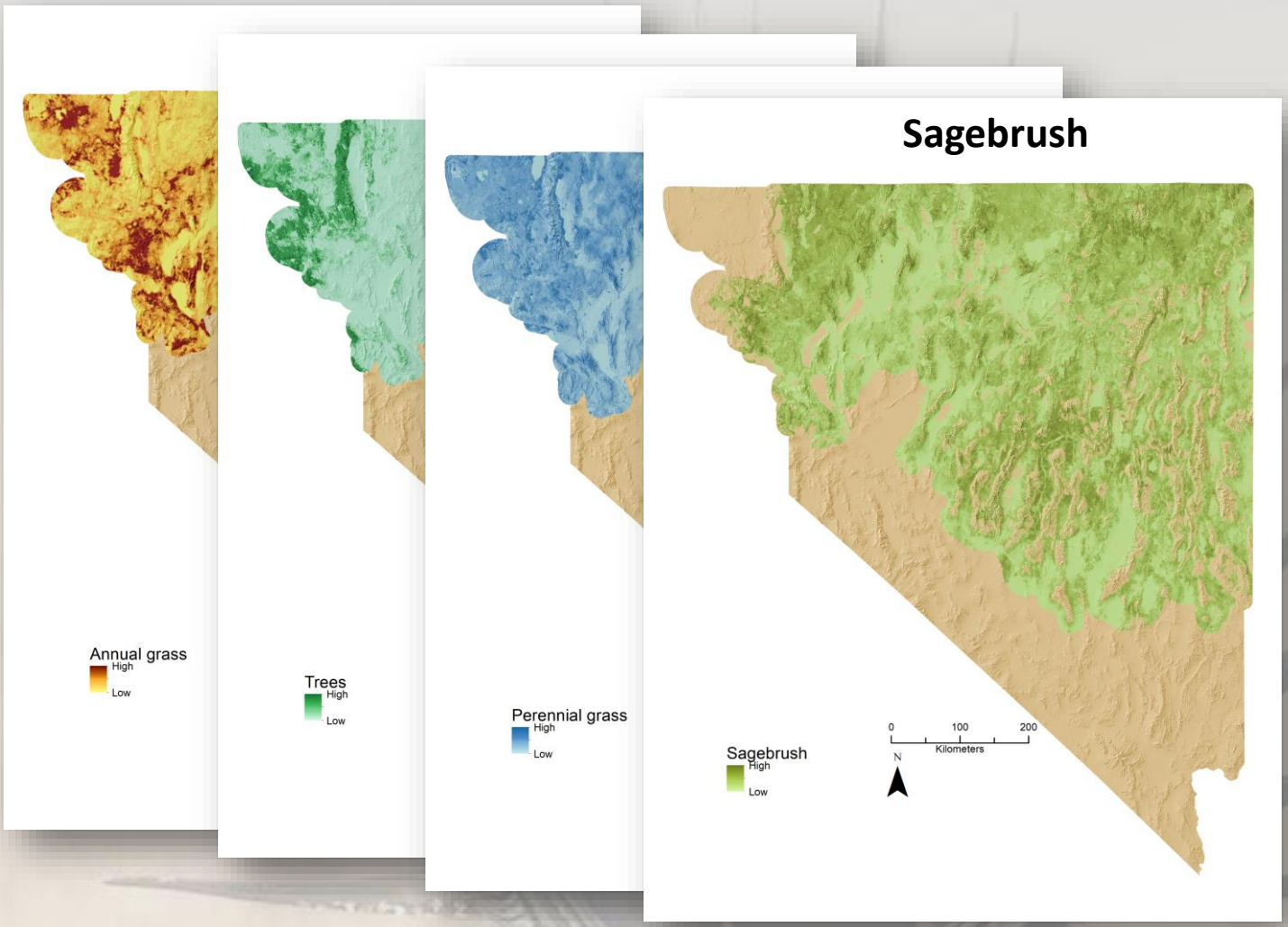

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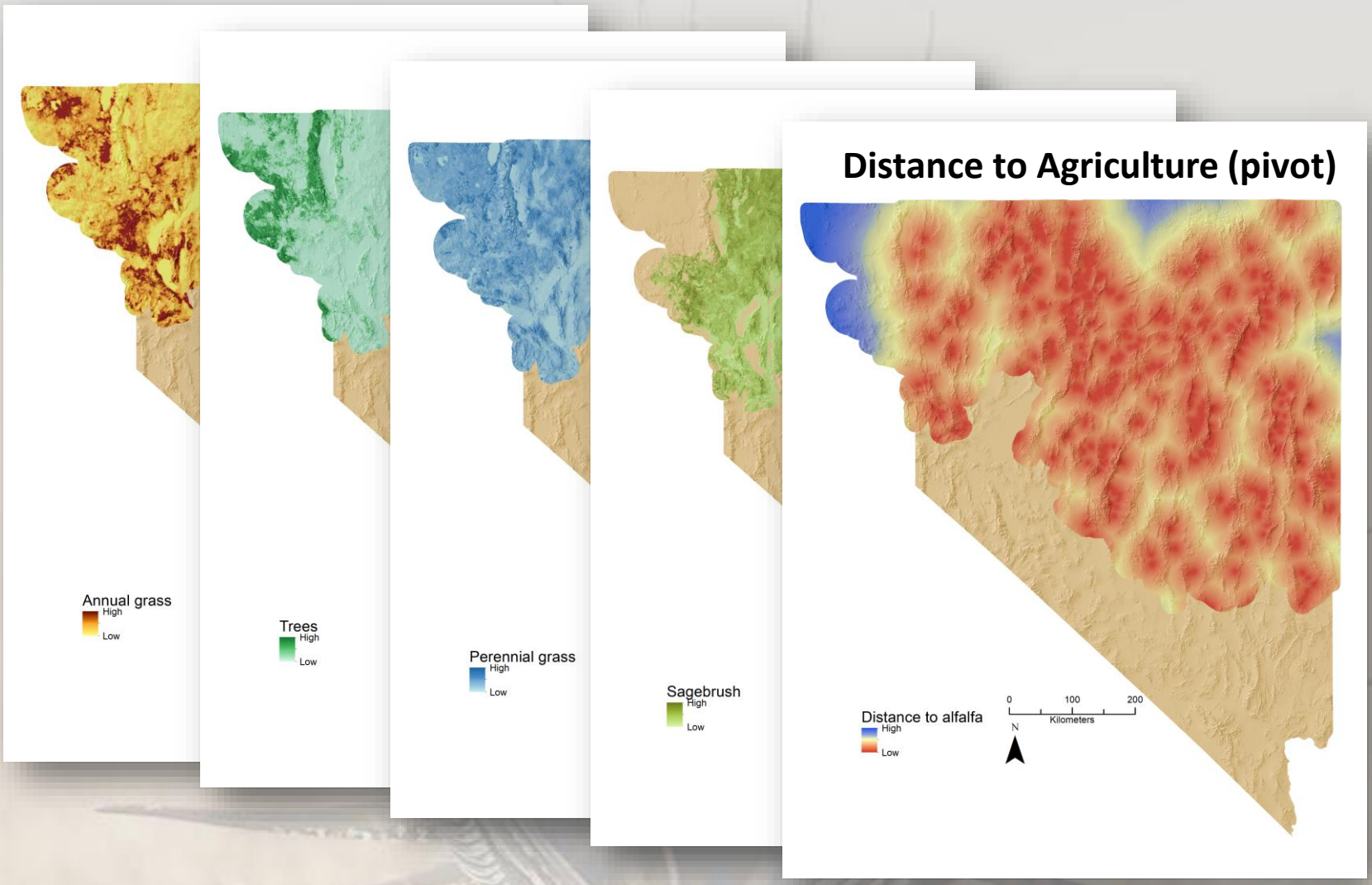

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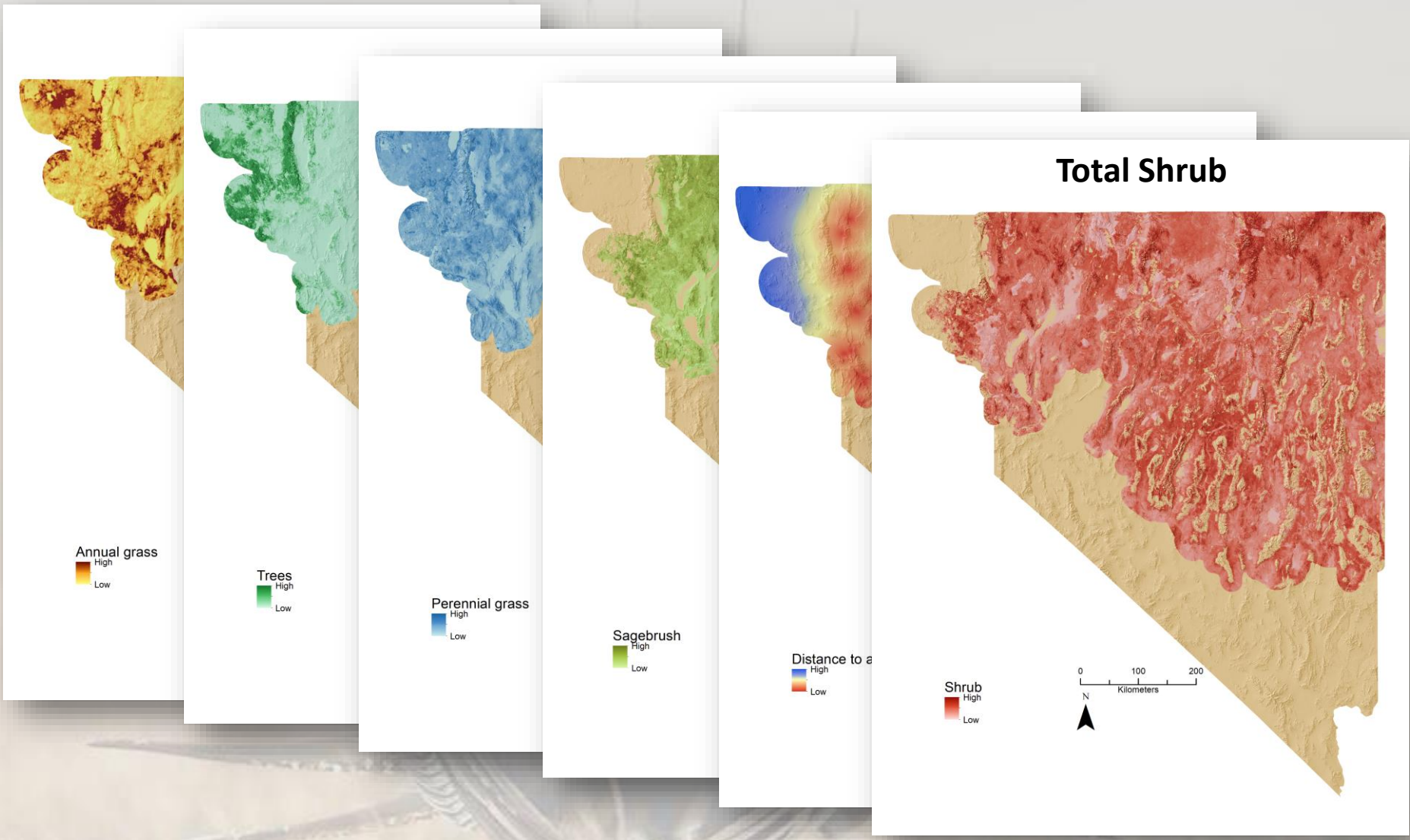

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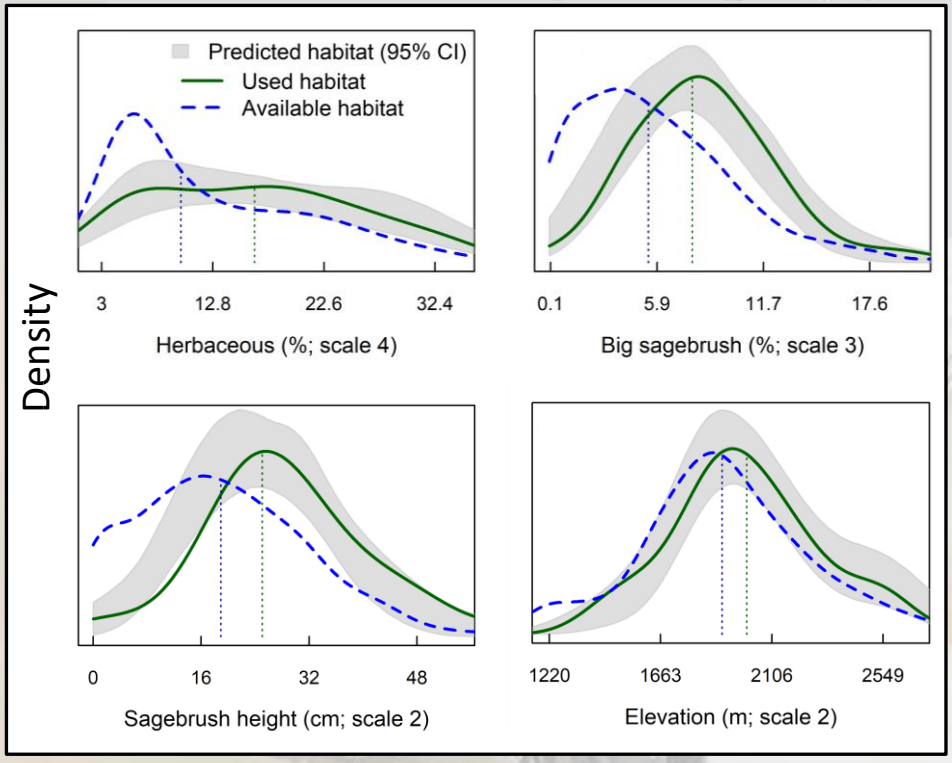
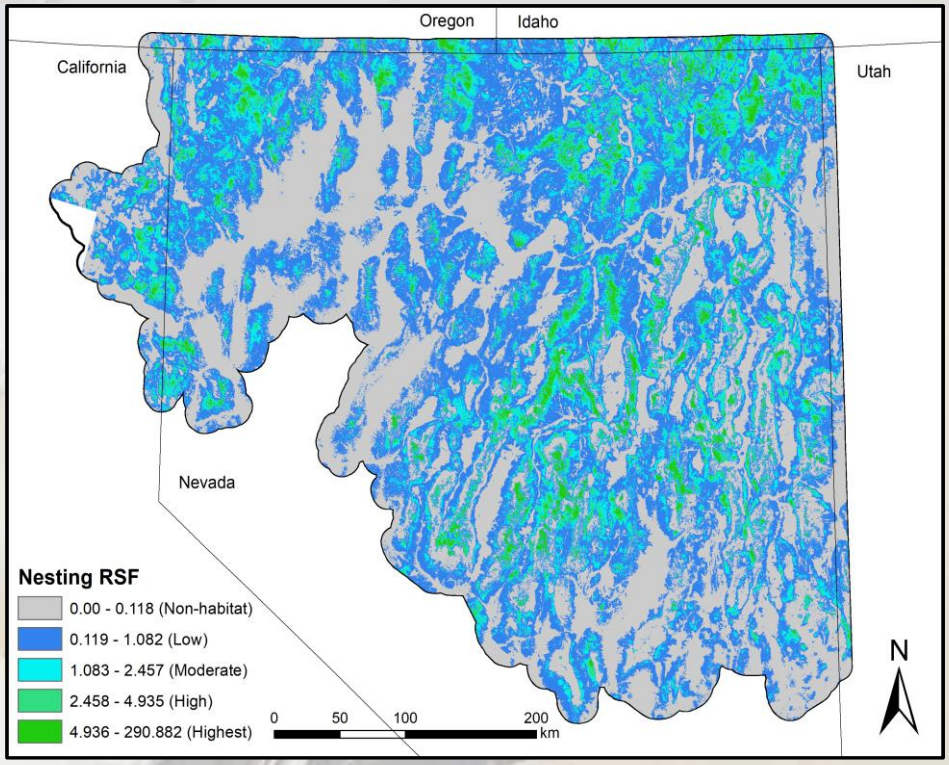
Nest Selection Index

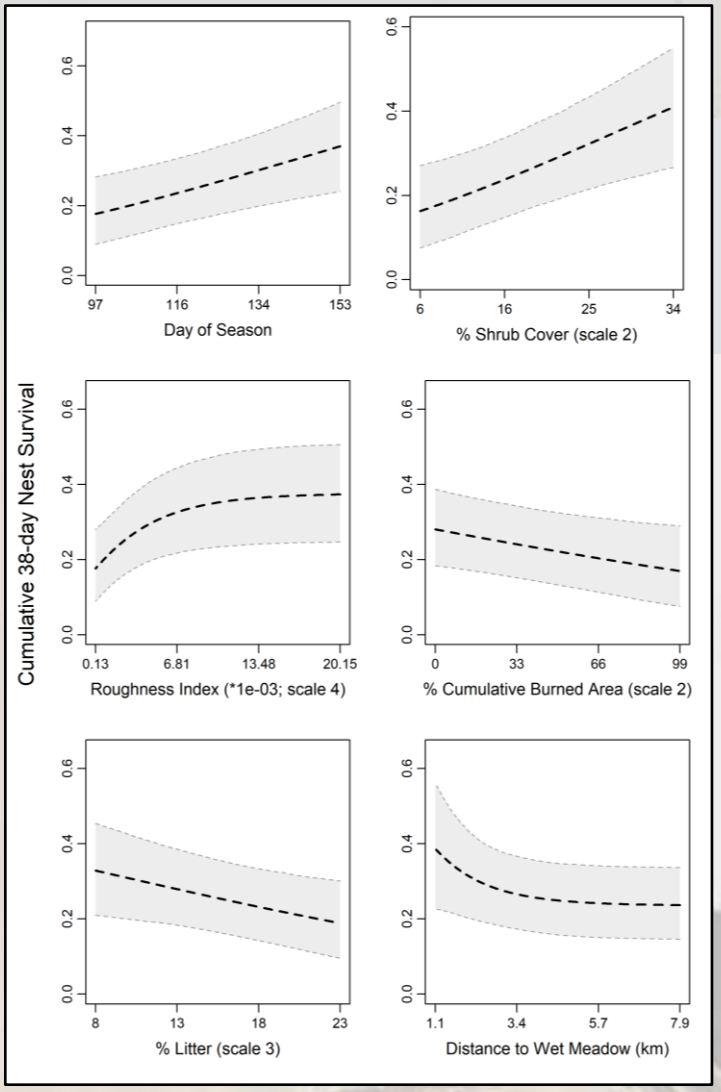


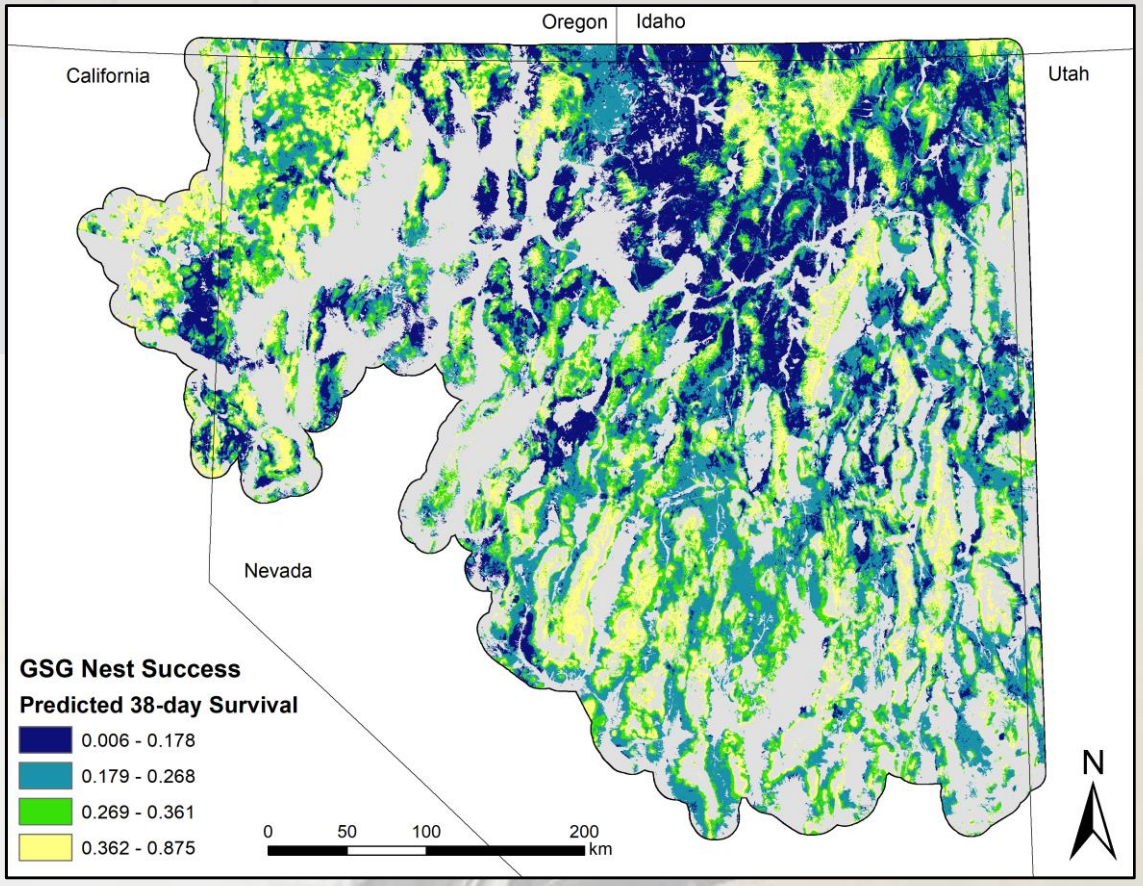


Selection for greater herbaceous cover, sagebrush cover, sagebrush height, and higher elevation

O'Neil et al. 2020, Journal of Applied Ecology; Brussee et al. 2022, Global Ecology and Conservation

Nest Survival Index



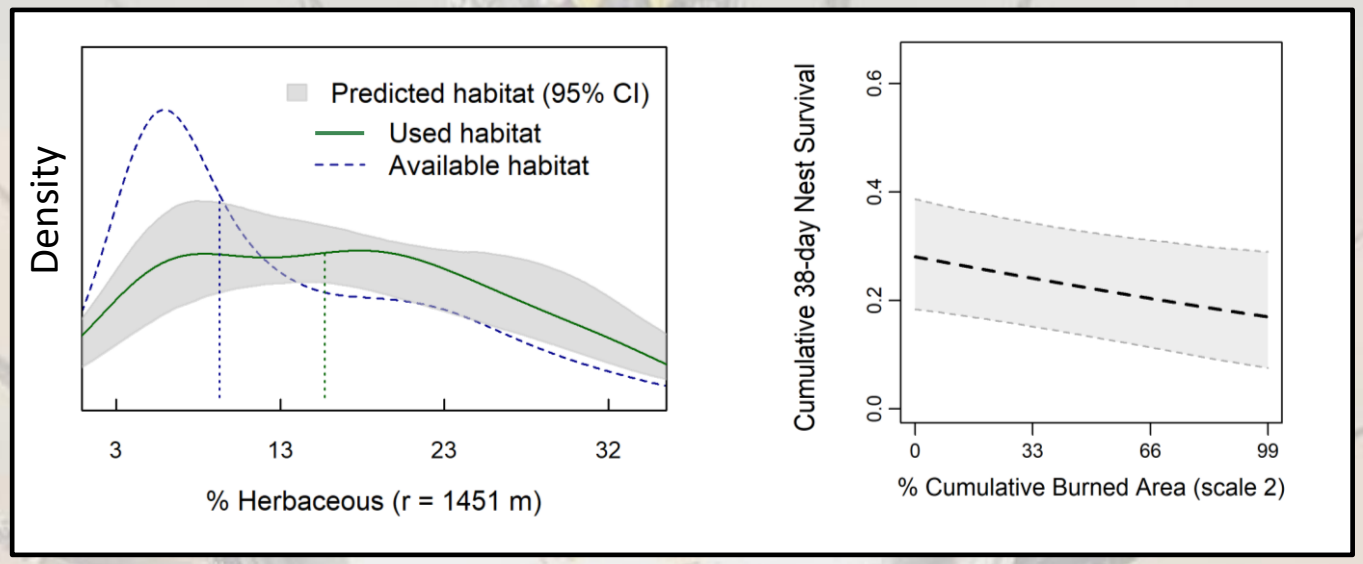


Greater shrub cover and lower cumulative burned area in more topographically rugged landscapes resulted in higher nest survival

O'Neil et al. 2020, Journal of Applied Ecology; Brussee et al. 2022, Global Ecology and Conservation

Example of Selection and Survival Misalignment

Decoupling between nest site selection and nest survival for environmental factors



- Selection for increased herbaceous cover led to poor nest success in areas with more % area burned (i.e. more cheatgrass *Bromus tectorum*)
- Possible "maladaptive" nest site selection

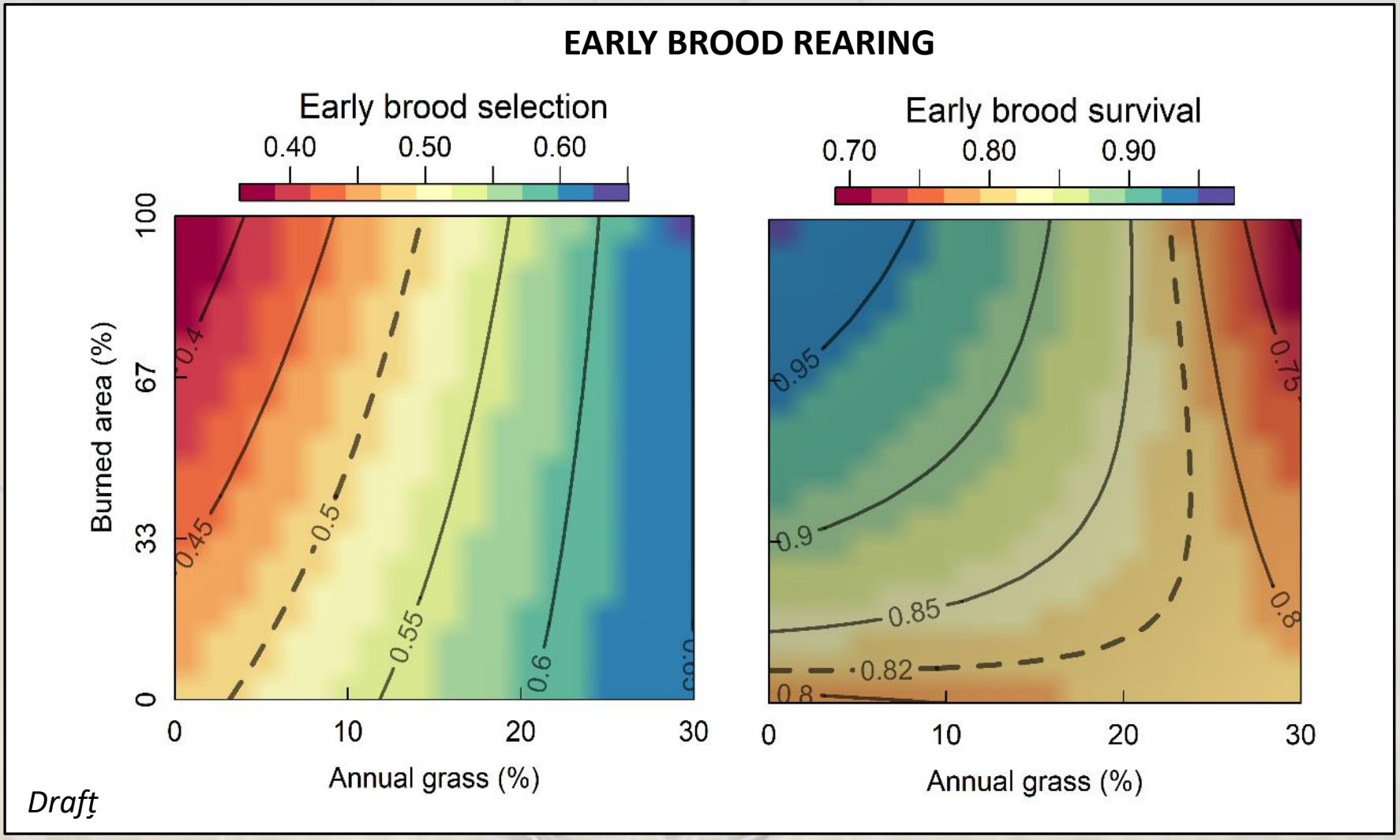
O'Neil et al. 2020, Journal of Applied Ecology; Brussee et al. 2022, Global Ecology and Conservation

Example of Selection and Survival Misalignment

Evidence for high nest site selection and low survival, resulting in relatively lower habitat suitability

O'Neil et al. 2020, Journal of Applied Ecology; Brussee et al. 2022, Global Ecology and Conservation

Evidence of maladaptive brood site selection in burned areas



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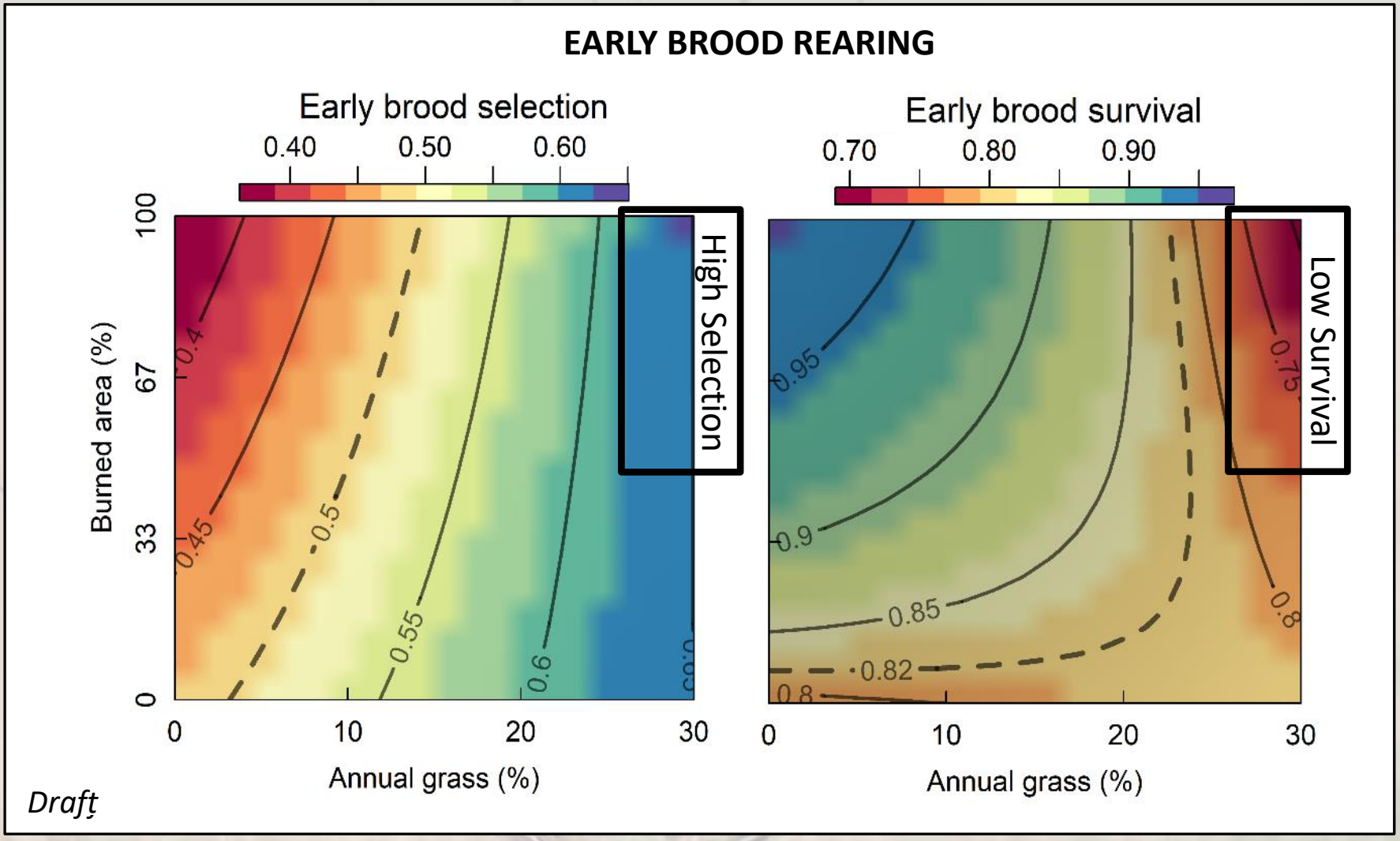

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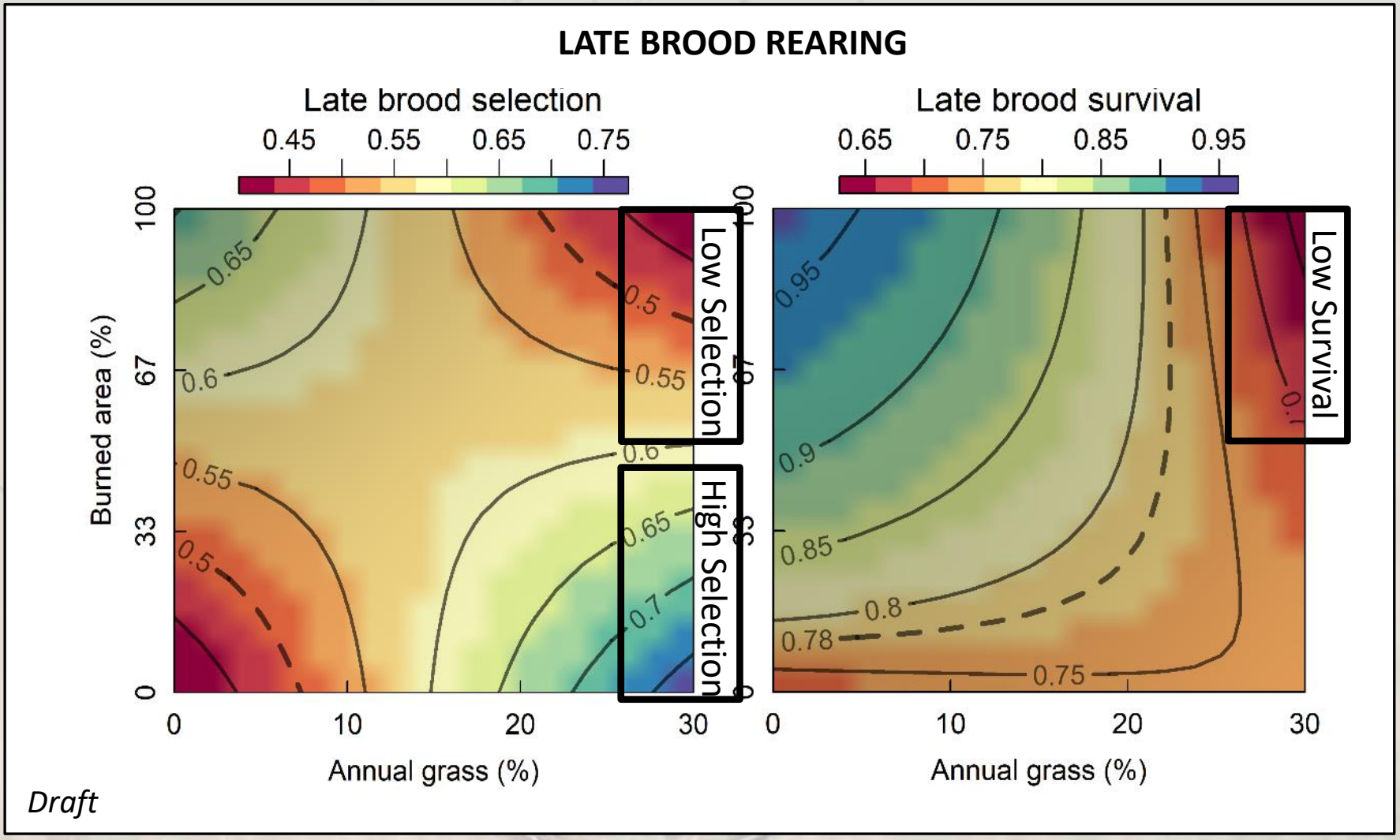
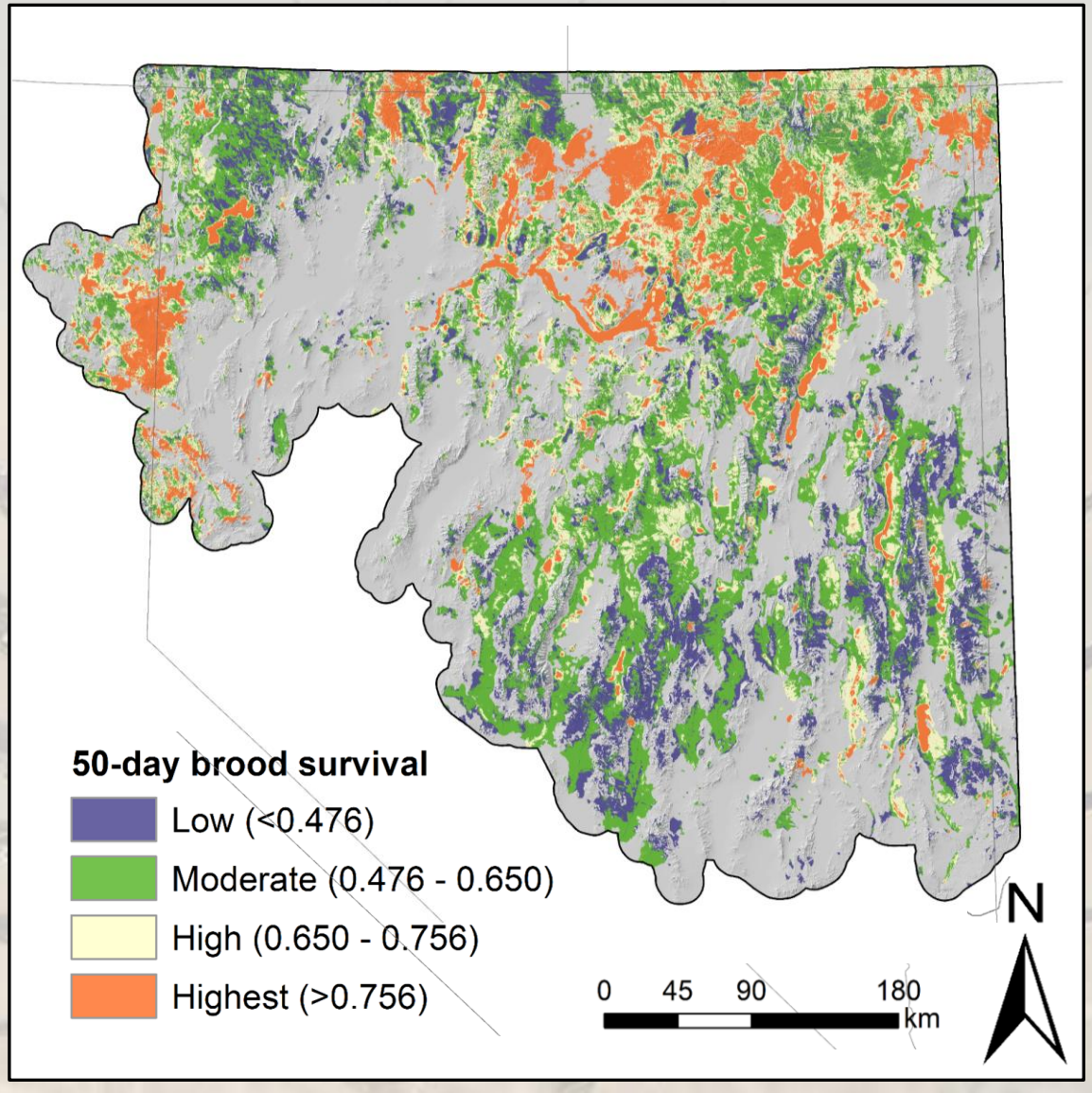


Brood Survival Map



Brussee et al. 2022, Global Ecology and Conservation

Nesting “Source-Sink” Map

SOURCE

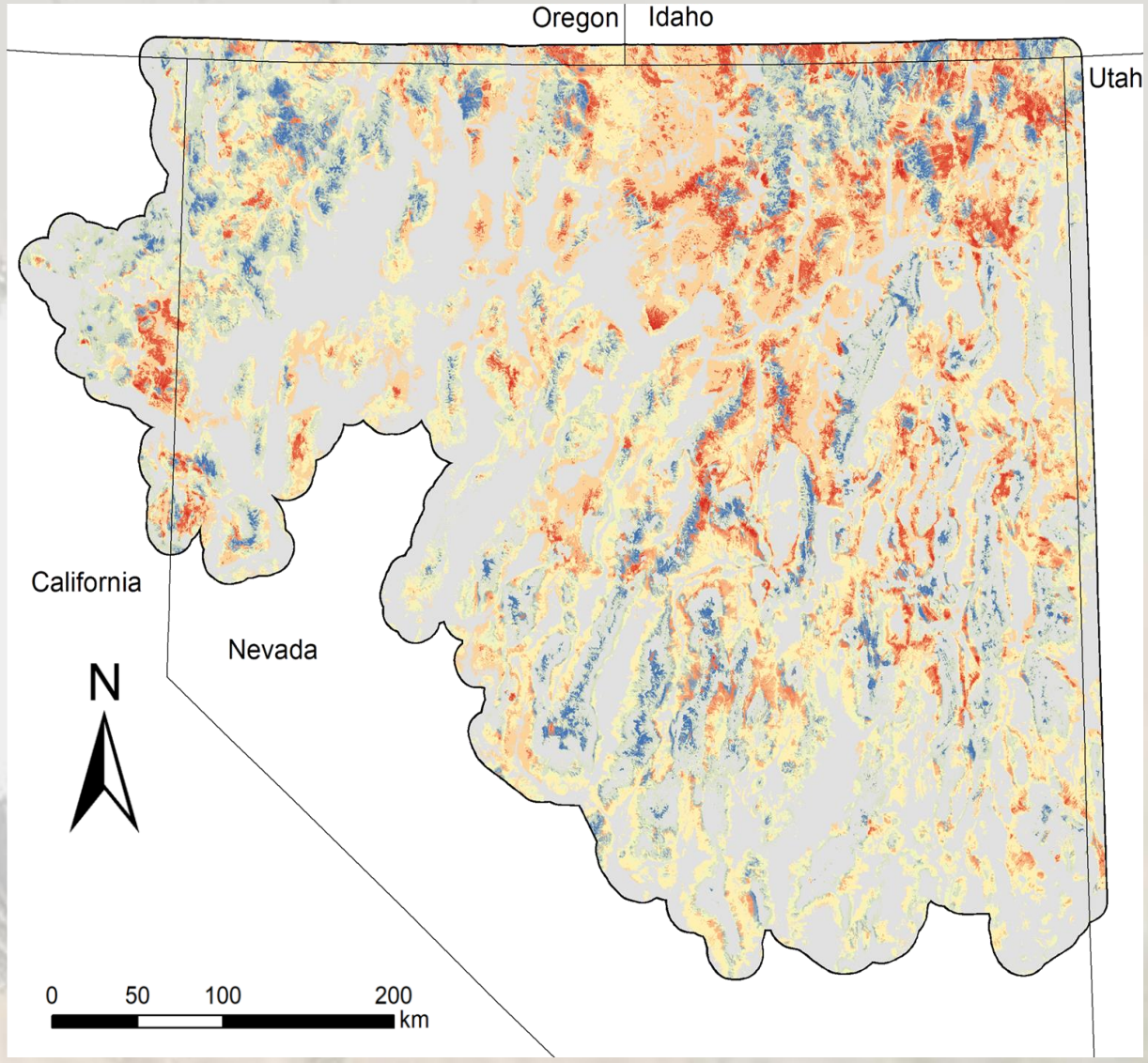
Selection = high
Survival = high

SINK

Selection = high
Survival = low

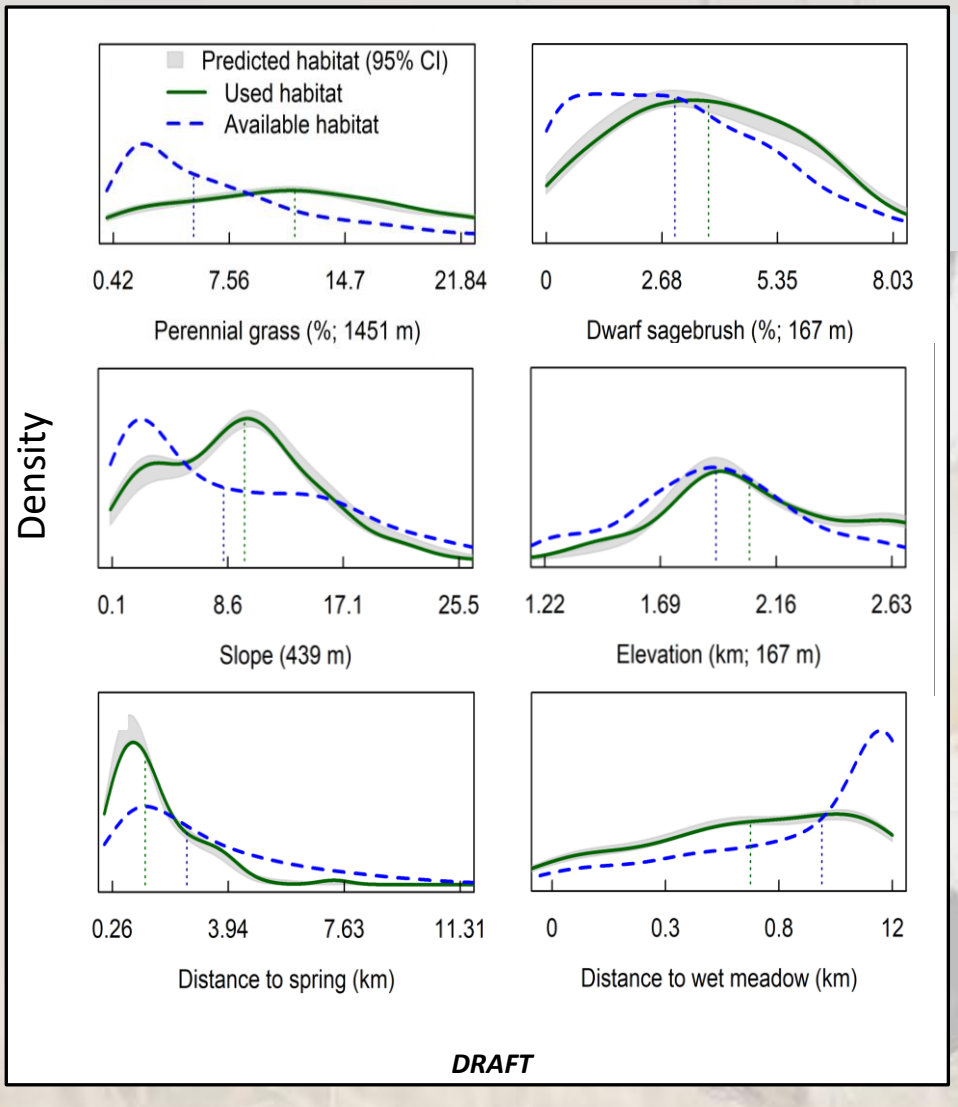
Selection = low
Survival = low

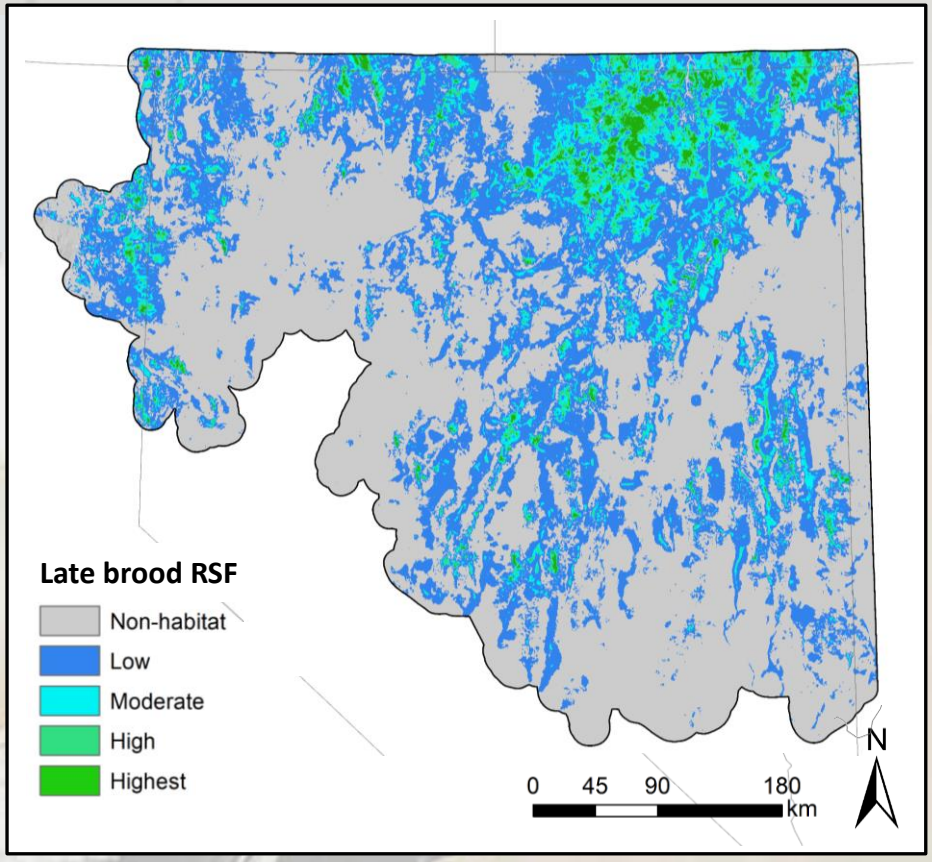
Selection = low
Survival = high



O’Neil et al. 2020, Journal of Applied Ecology; Brussee et al. 2022, Global Ecology and Conservation

Late Brood Habitat Selection Index





Select perennial grass and dwarf sagebrush at high slopes and elevations. Closer to springs and wet meadows.

O'Neil et al. 2020, Journal of Applied Ecology; Brussee et al. 2022, Global Ecology and Conservation

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Annual habitat maps

Life stage habitat maps

Seasonal habitat maps

Seasonal Habitat Suitability Mapping

Global Change Biology

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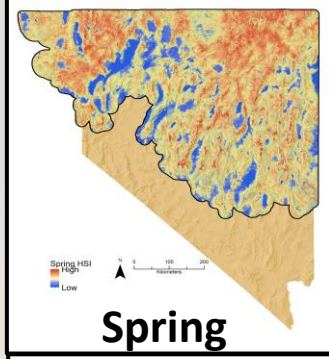
First published: 02 August 2020 | https://doi.org/10.1111/gcb.15300 | Citations: 6

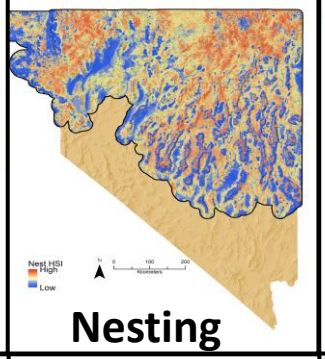
Updating Seasonal Habitat Suitability Indices

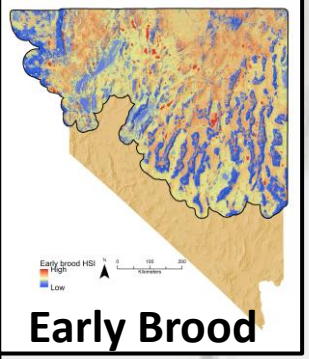
Selection Indices

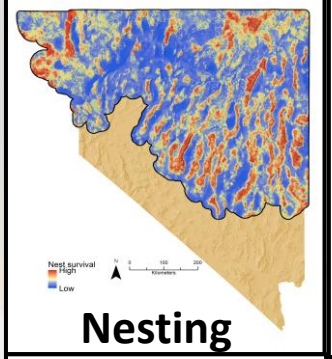
Survival Indices

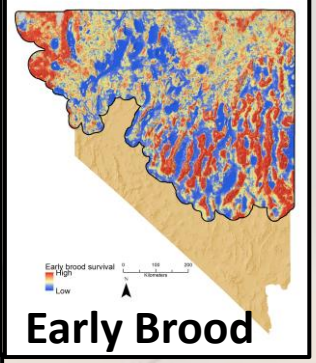
Spring



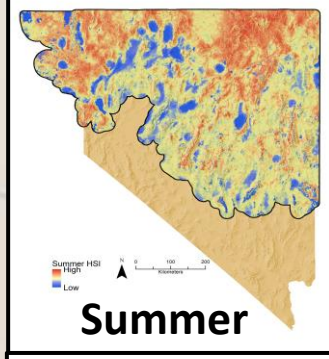


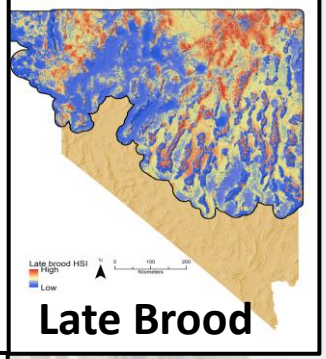


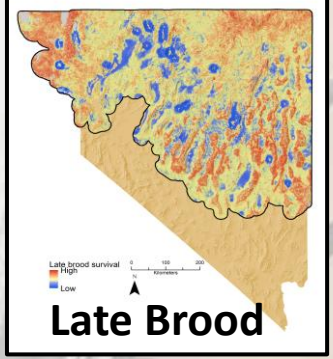




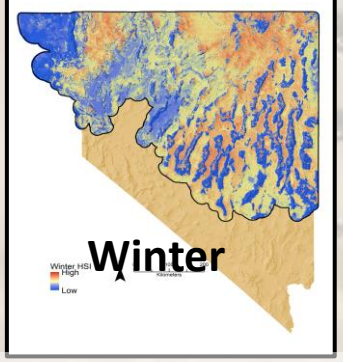
Summer





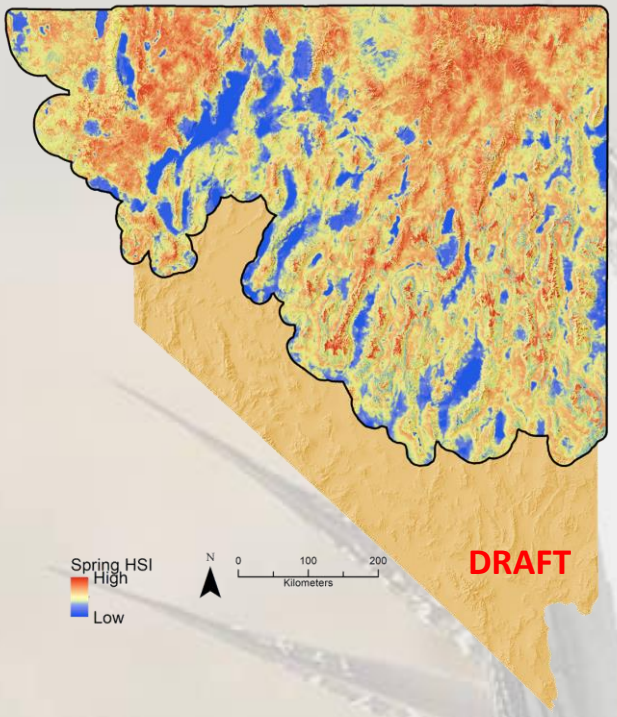


Winter

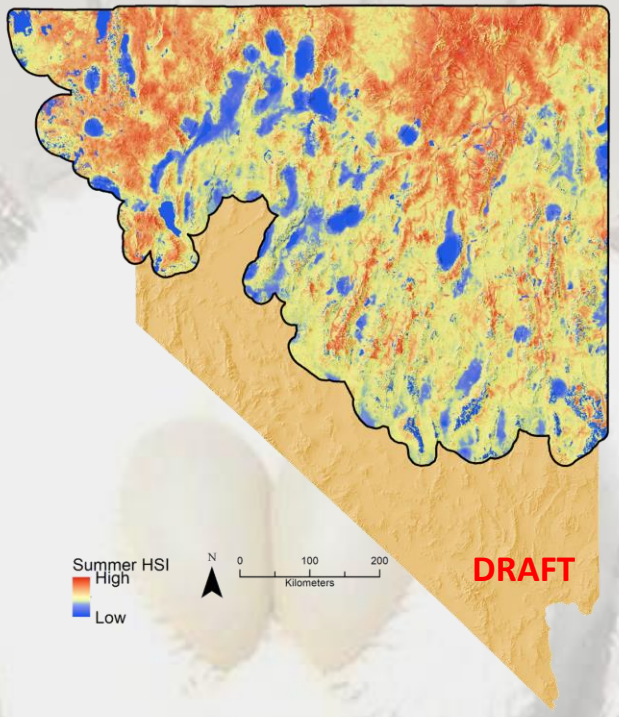


Updating Seasonal Habitat Suitability Indices

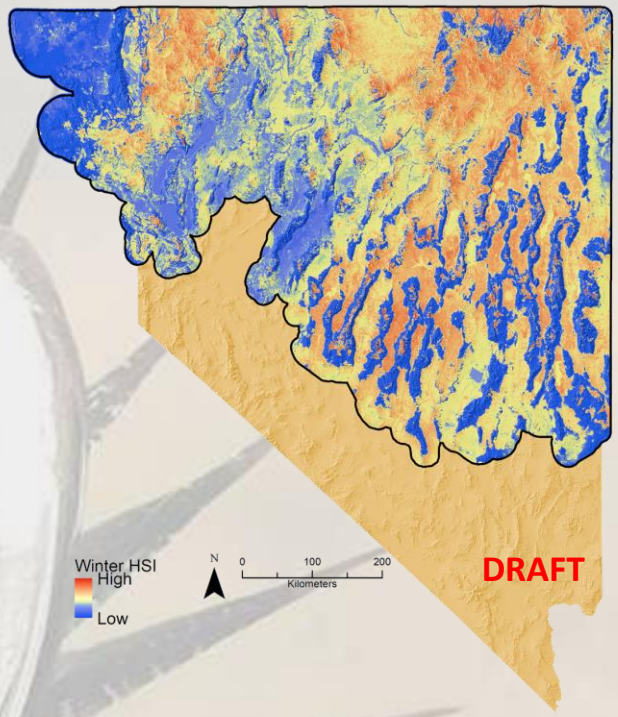
Spring



Summer



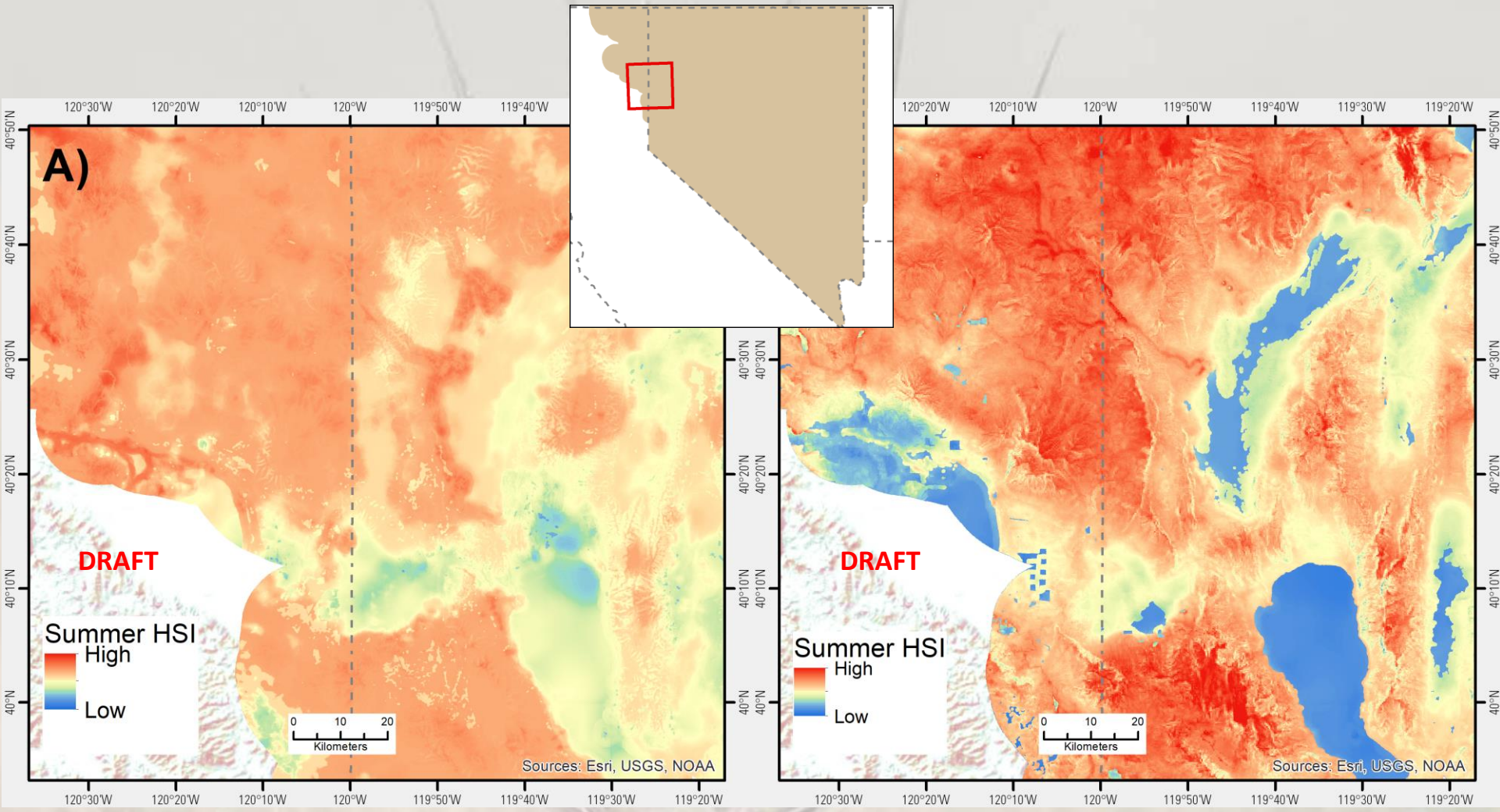
Winter



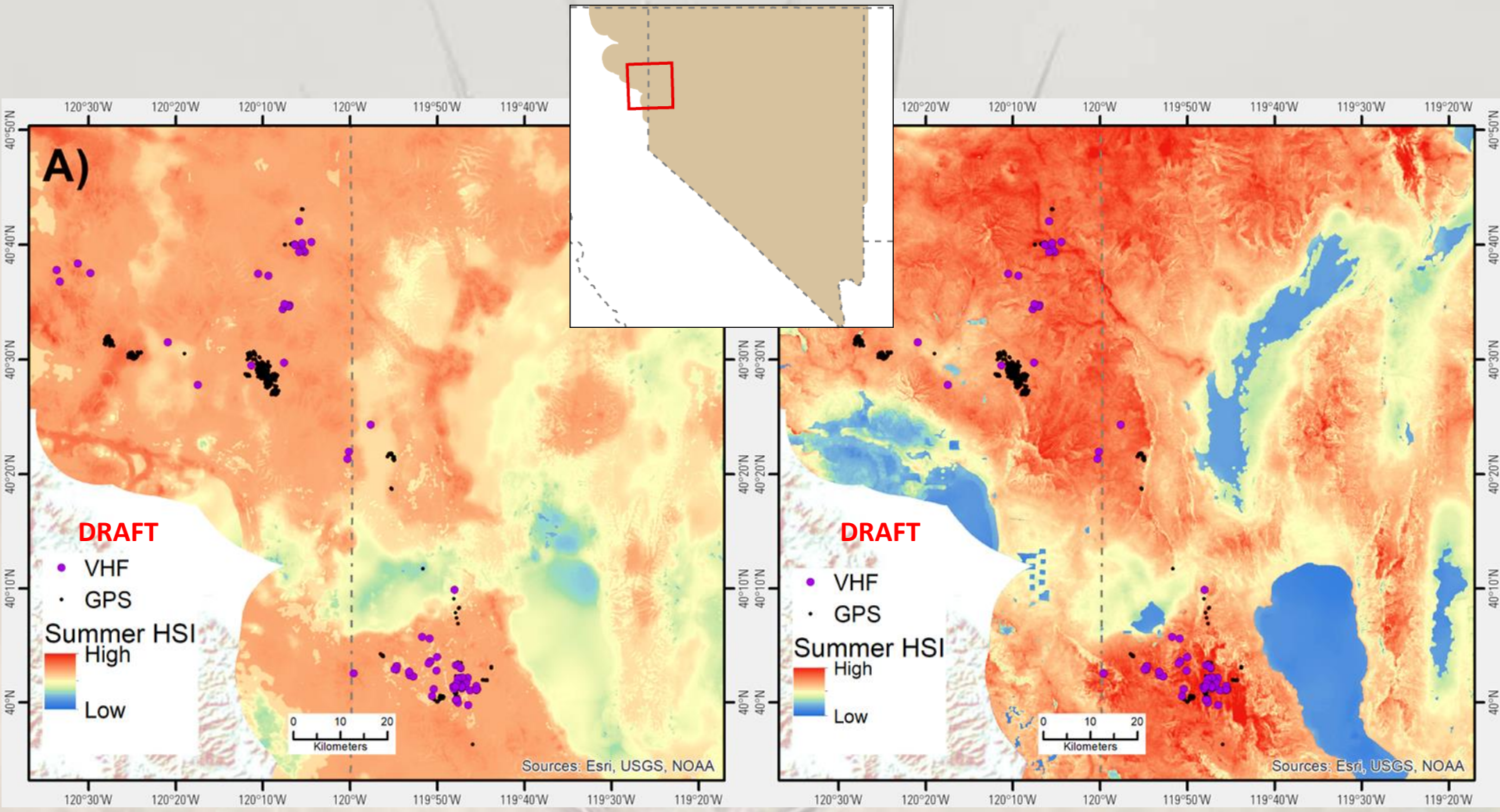
New HSI includes:

- Spring, summer, and winter selection models for all sage-grouse including non-reproductive females and males
- Nesting and brood-rearing selection models
- Nesting and brood-rearing survival models
- Indexes source areas as highest values

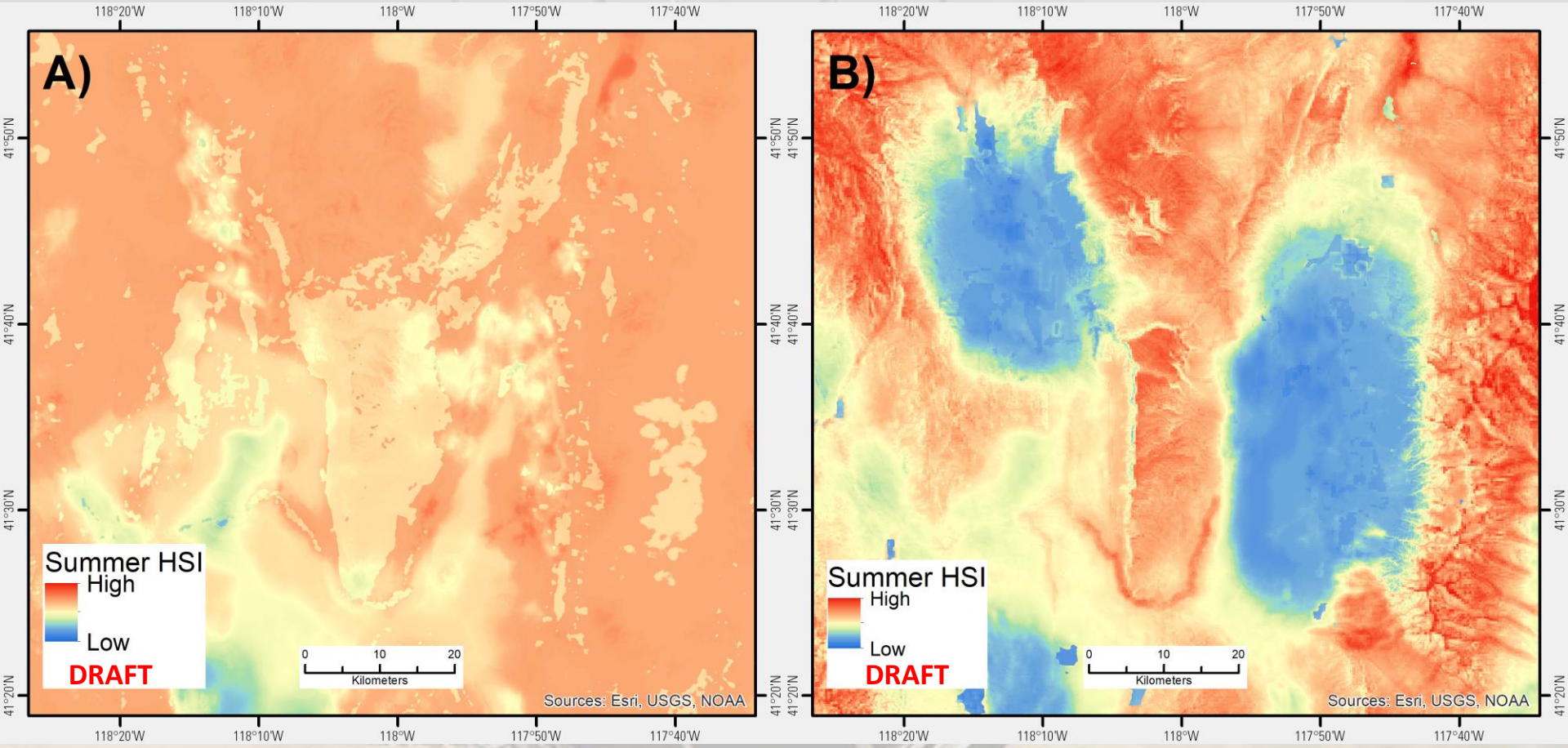
Example of Improvement to HSI Indices



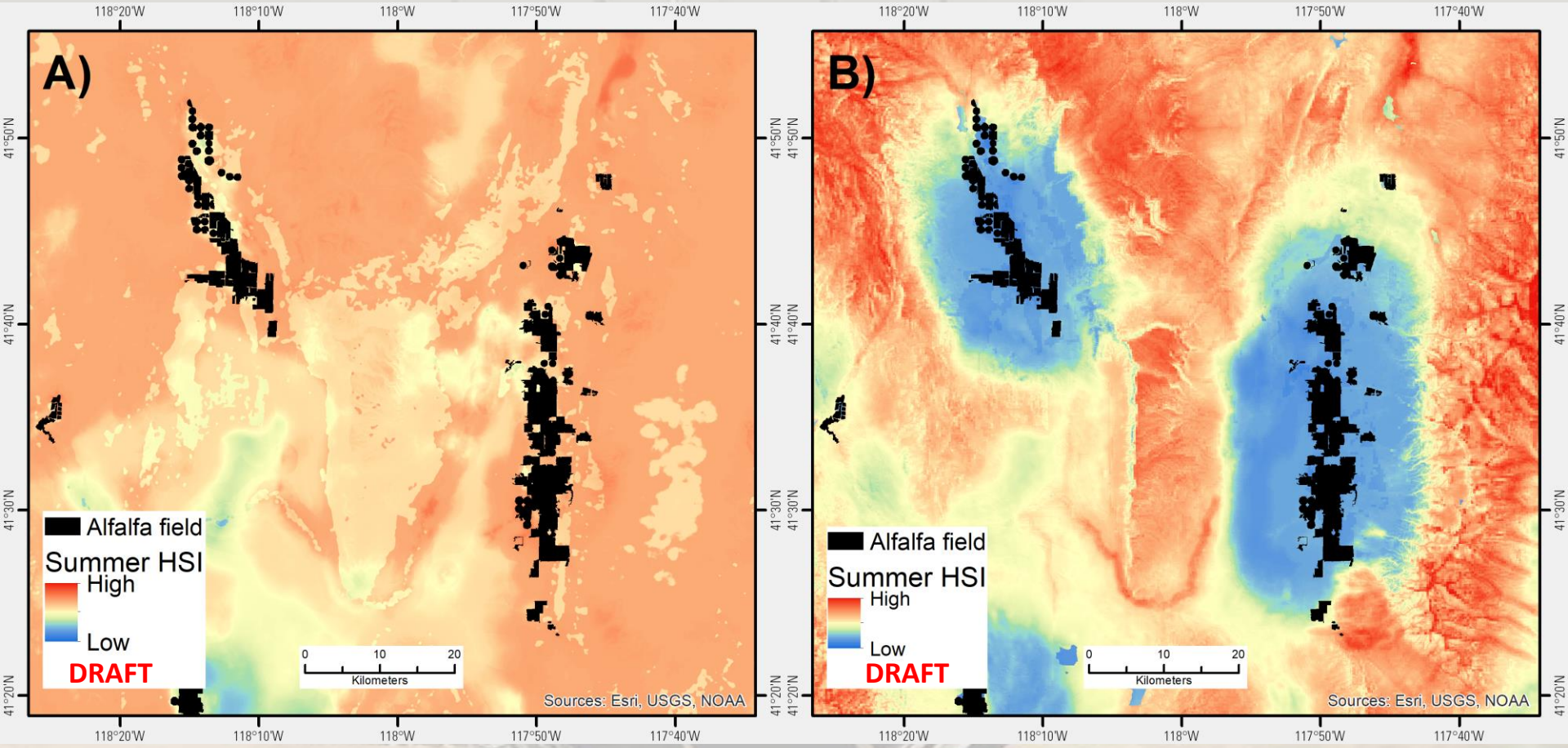
Example of Improvement to HSI Indices



Example of Improvement to HSI Indices

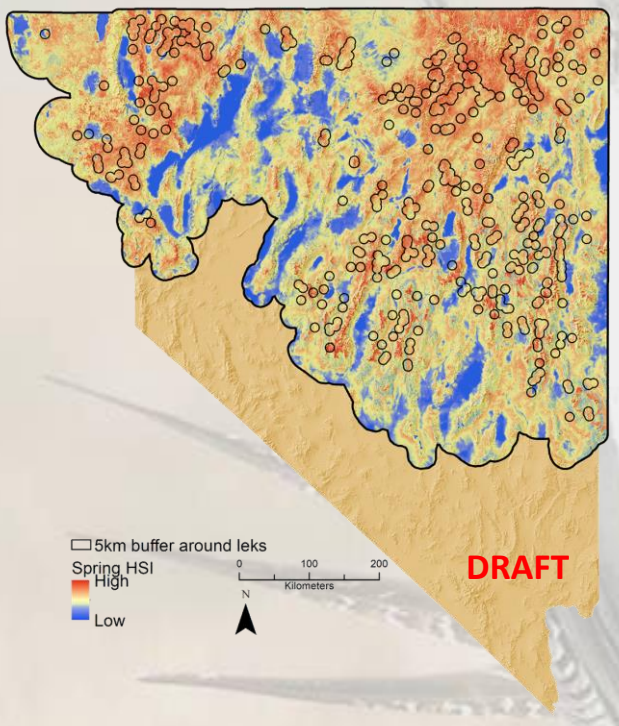


Example of Improvement to HSI Indices

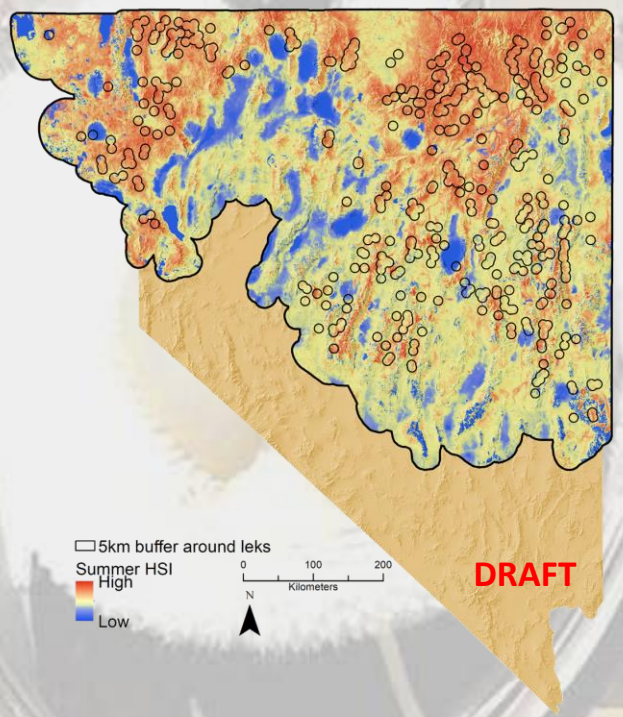


Accounting for Potential Effects on GrSG Populations

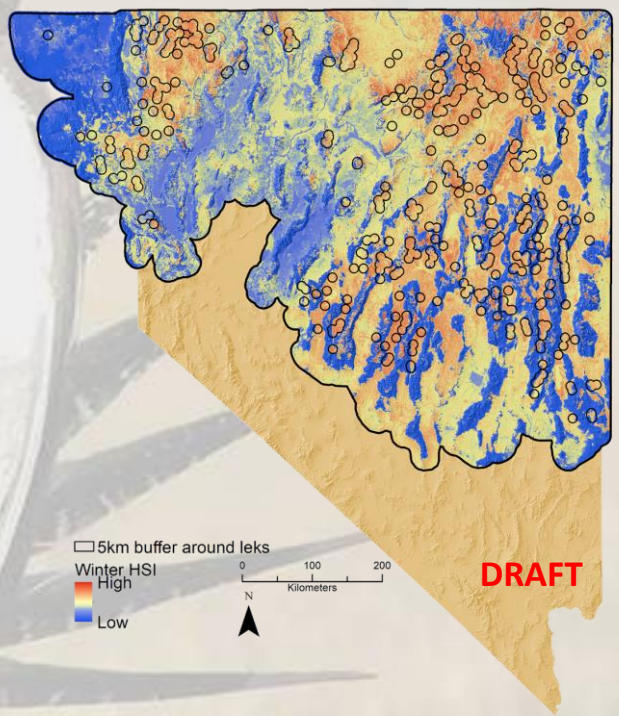
Spring



Summer

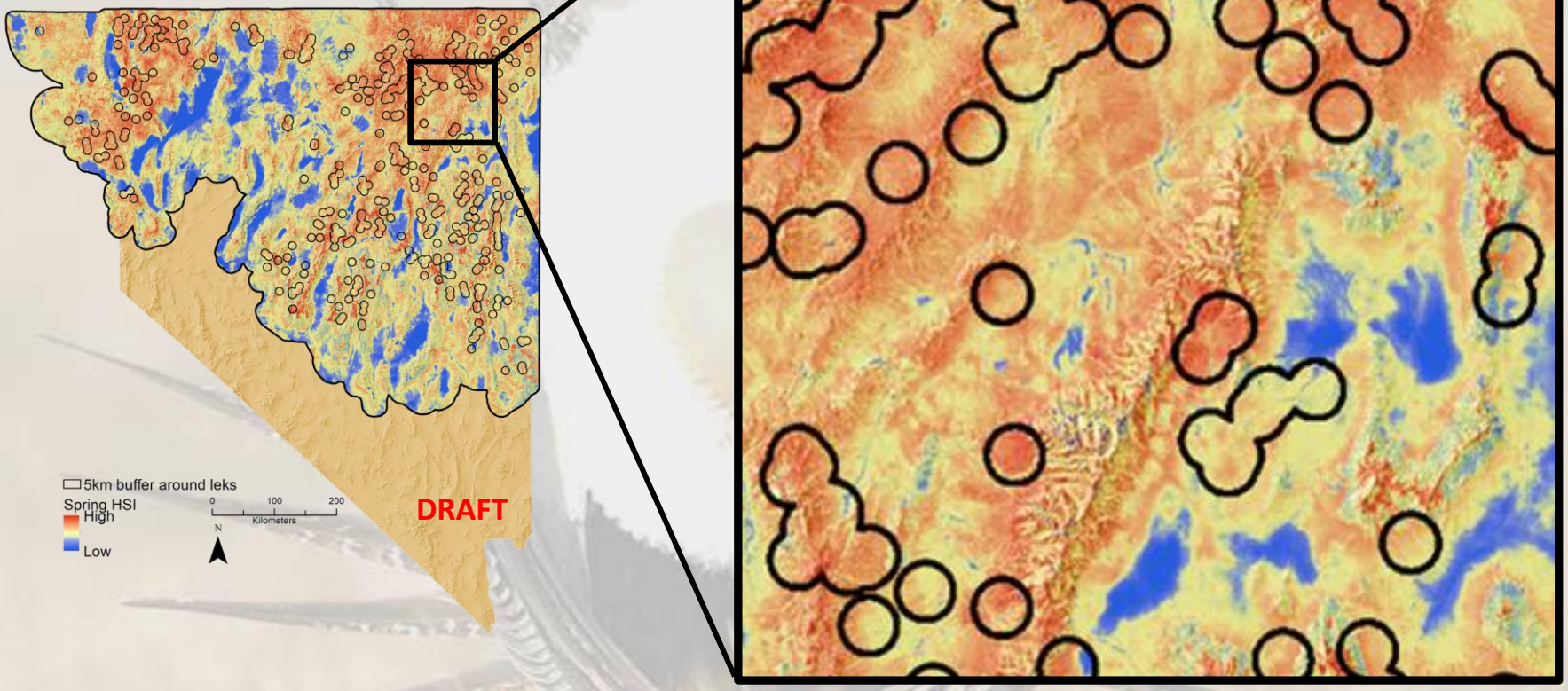


Winter



Accounting for Potential Effects on GrSG Populations

Spring



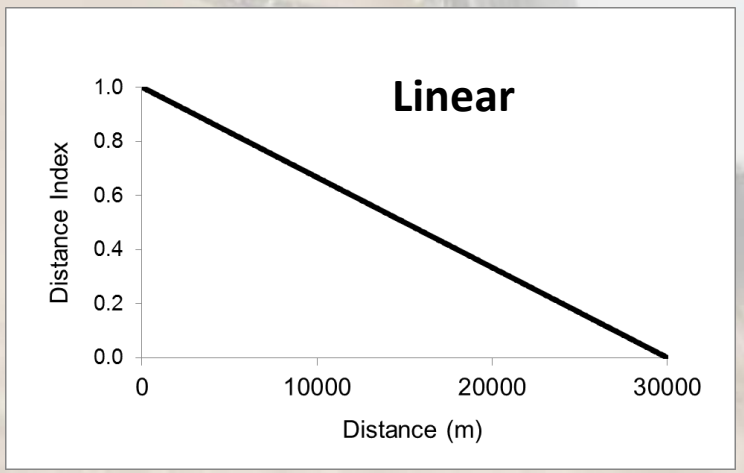
Accounting for Potential Effects on GrSG Populations

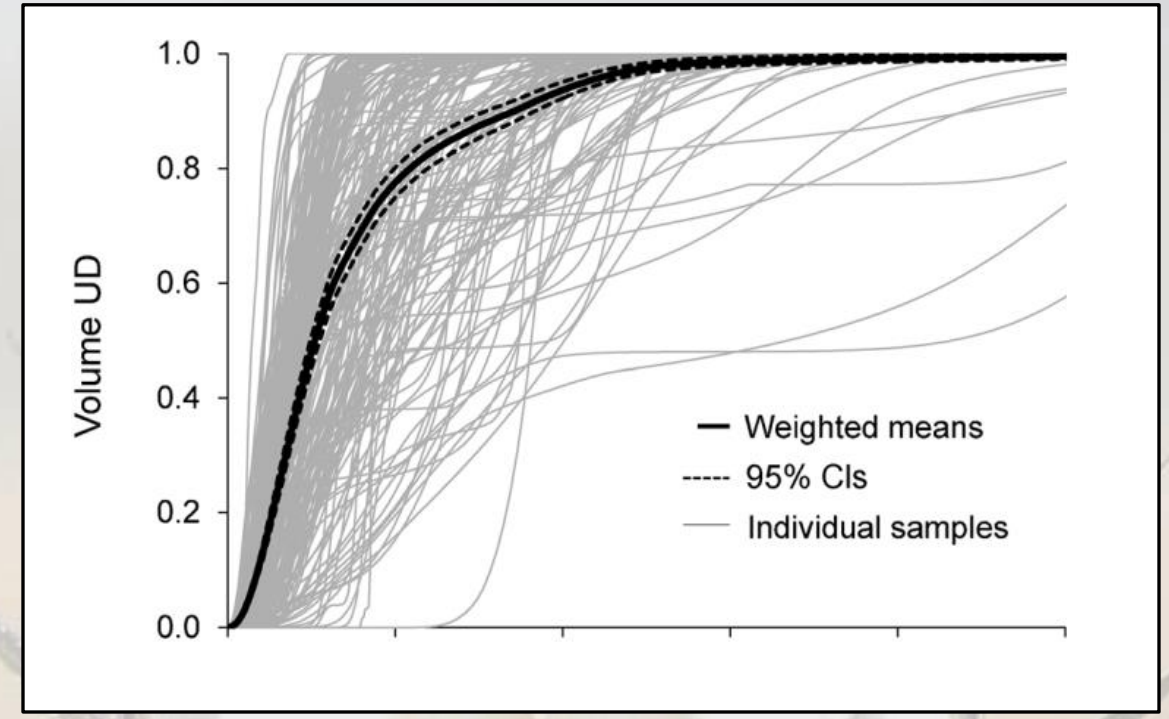
Abundance and Space Use Index (ASUI)

Density Index
(Lek Density)

Proximity Index
(Distance to Lek)

Proximity Index





The Journal of Wildlife Management 77(8):1598–1609; 2013; DOI: 10.1002/jwmg.618

Management and Conservation

Evaluating Greater Sage-Grouse Seasonal Space Use Relative to Leks: Implications for Surface Use Designations in Sagebrush Ecosystems

PETER S. COATES,[1] *U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 800 Business Park Drive, Suite D, Dixon, CA 95620, USA*

MICHAEL L. CASAZZA, *U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 800 Business Park Drive, Suite D, Dixon, CA 95620, USA*

ERIK J. BLOMBERG, *U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 800 Business Park Drive, Suite D, Dixon, CA 95620, USA*

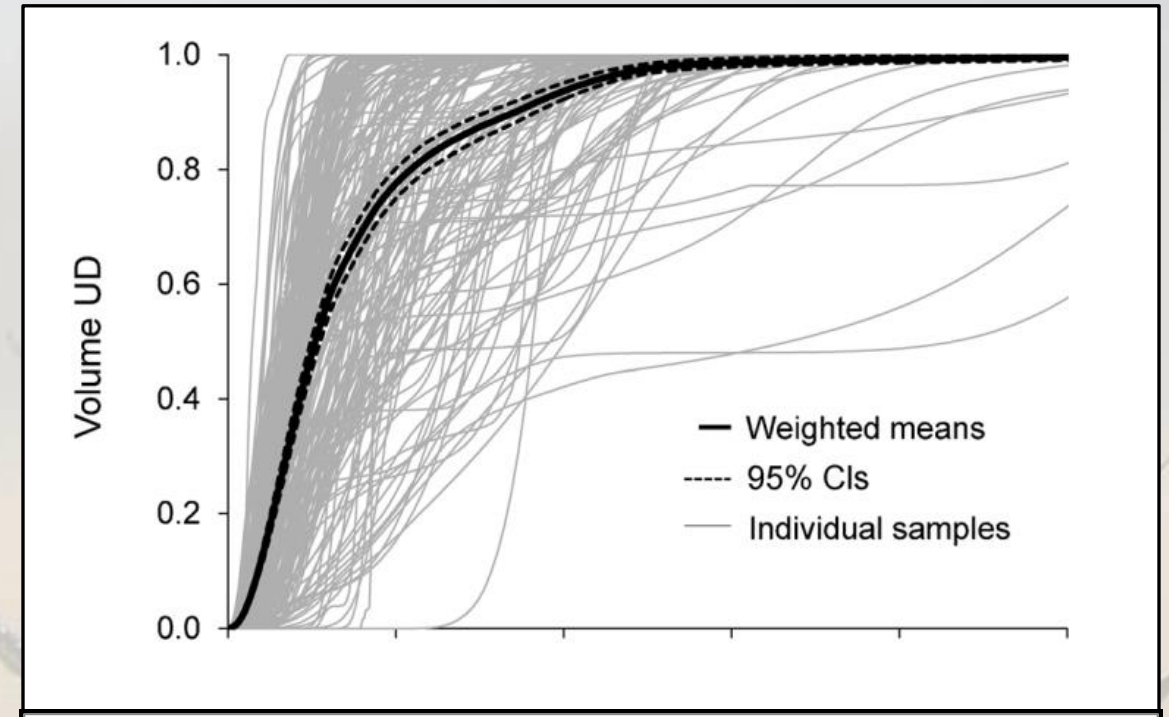
SCOTT C. GARDNER, *California Department of Fish and Wildlife, 1416 9th Street, 12th Floor, Sacramento, CA 95814, USA*

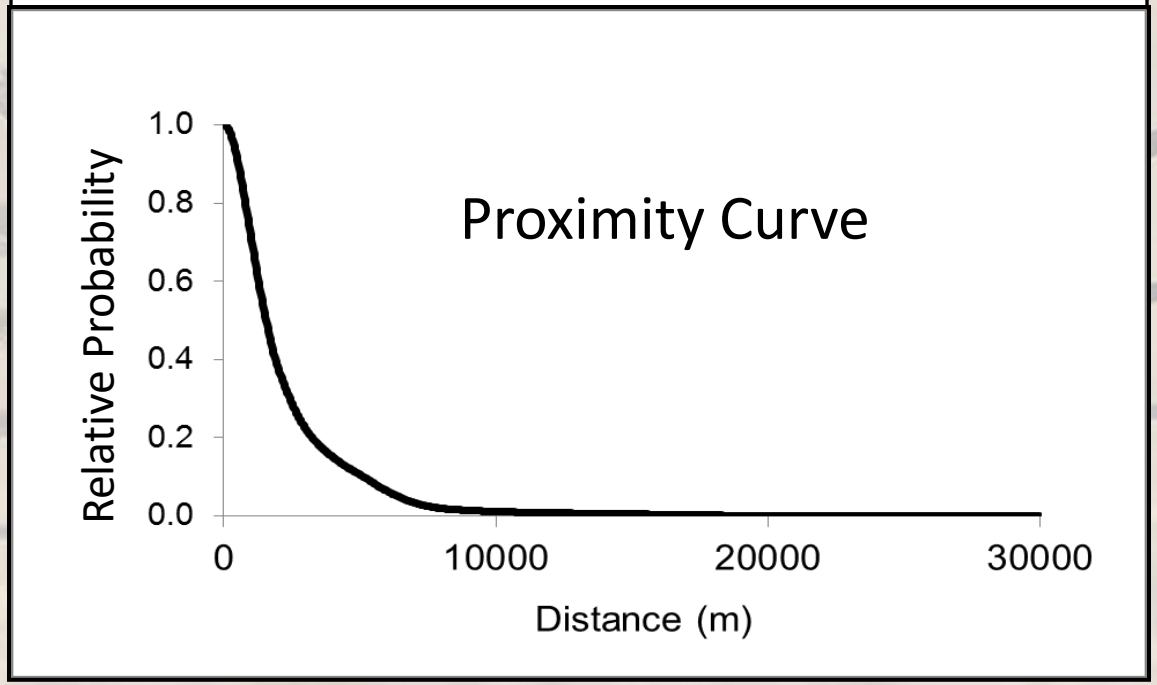
SHAWN P. ESPINOSA, *Nevada Department of Wildlife, 1100 Valley Road, Reno, NV 89512, USA*

JULIE L. YEE, *U.S. Geological Survey, Western Ecological Research Center, 3020 State University Drive East, Modoc Hall, Suite 3006, Sacramento, CA 95819, USA*

LIEF WIECHMAN, *Department of Fish and Wildlife Resources and Statistics, University of Idaho, P.O. Box 441136, Moscow, ID 83844, USA*

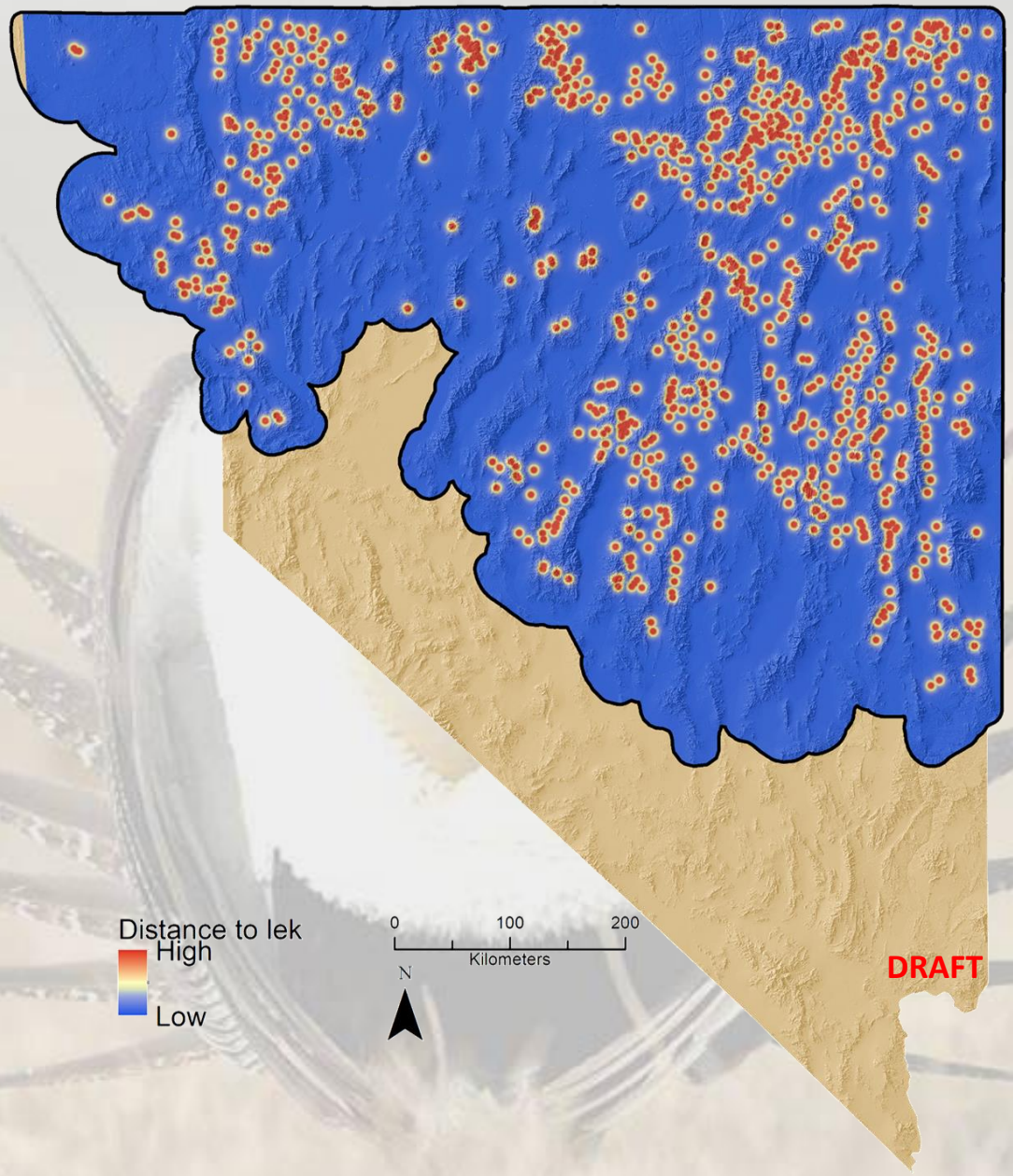
BRIAN J. HALSTEAD, *U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 800 Business Park Drive, Suite D, Dixon, CA 95620, USA*



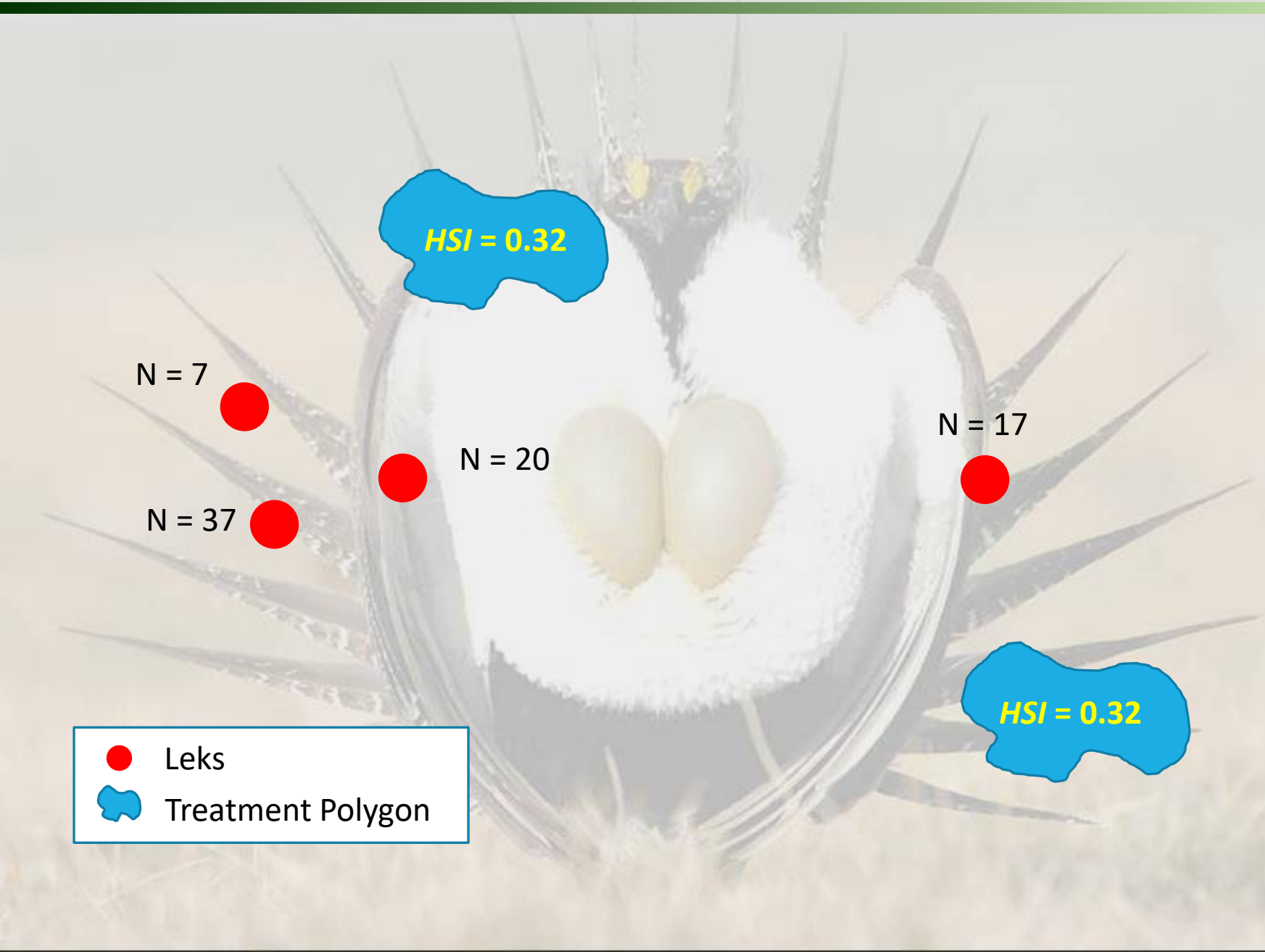


Coates et al. 2013, Journal of Wildlife Management 77: 1598-1609

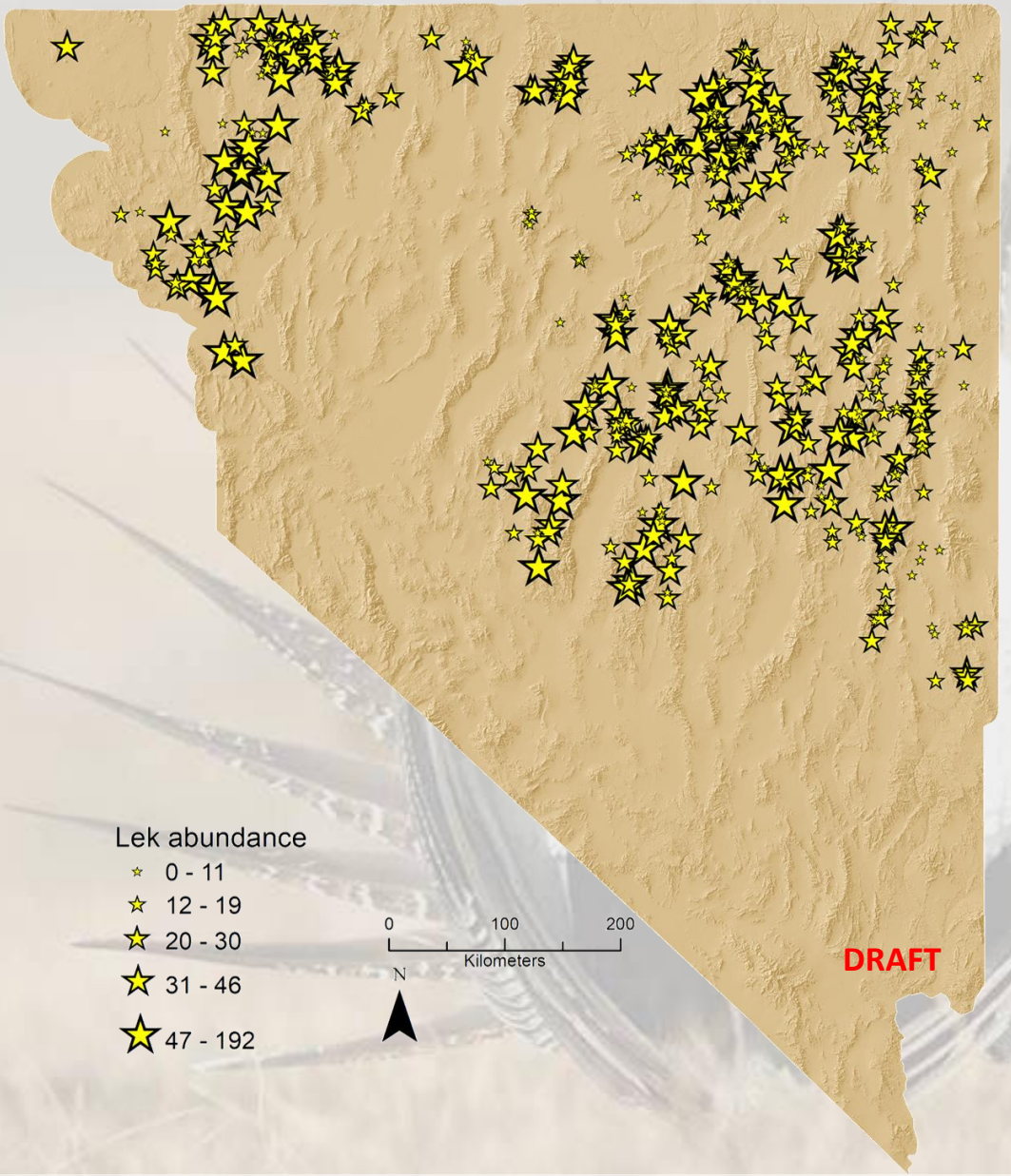
Proximity Index



Density Index

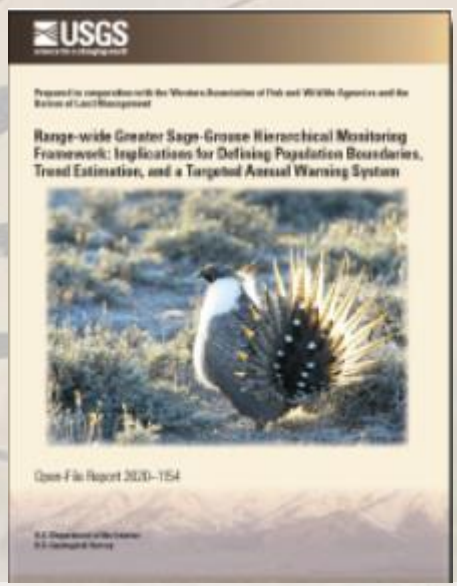


Density Index



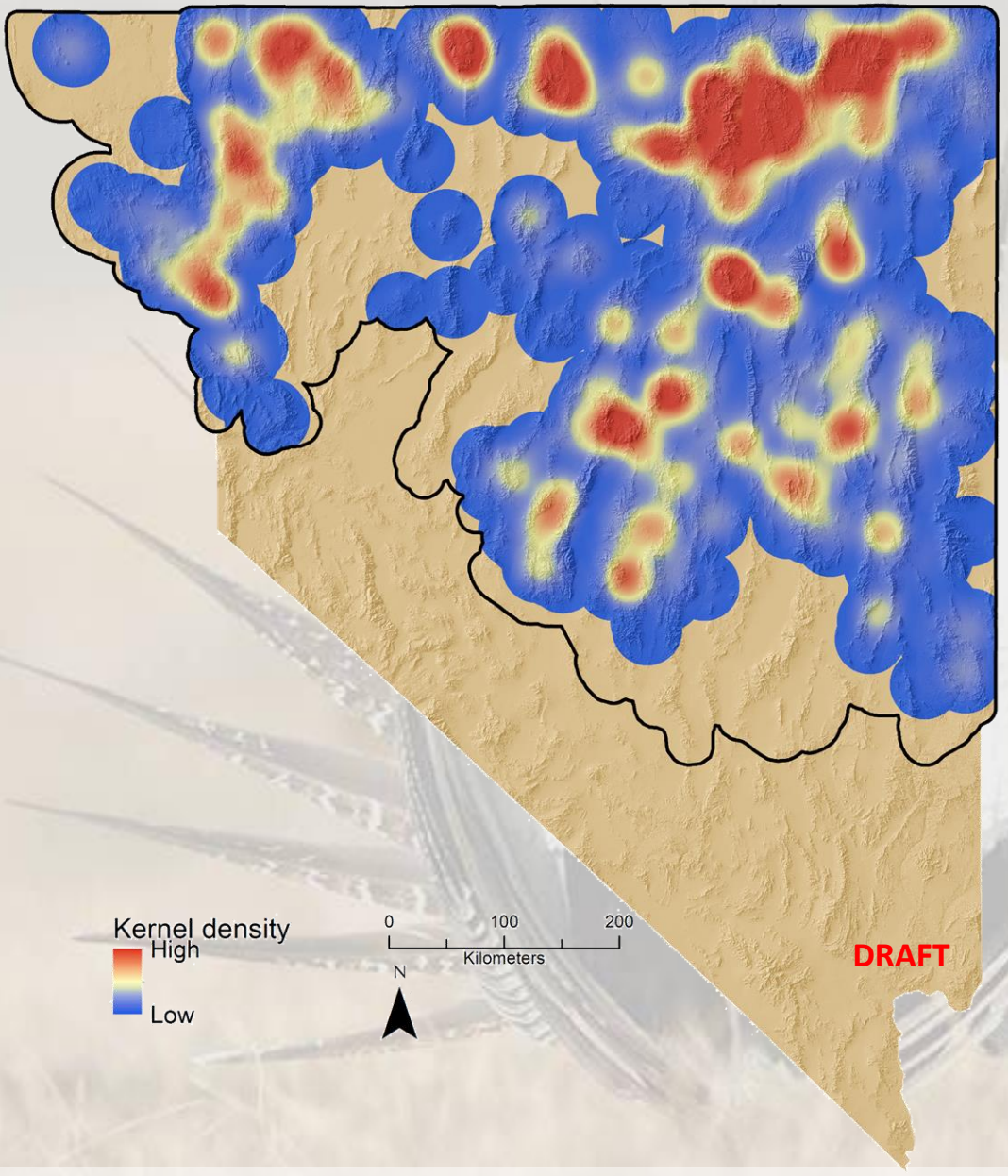
Lek Locations and Male Apparent Abundance

- Lek Count Data – NDOW
- Abundance estimated using hierarchical state-space model



Coates et al. 2021, Open-File Report 2020-1154; https://doi.org/10.3133/ofr20201154

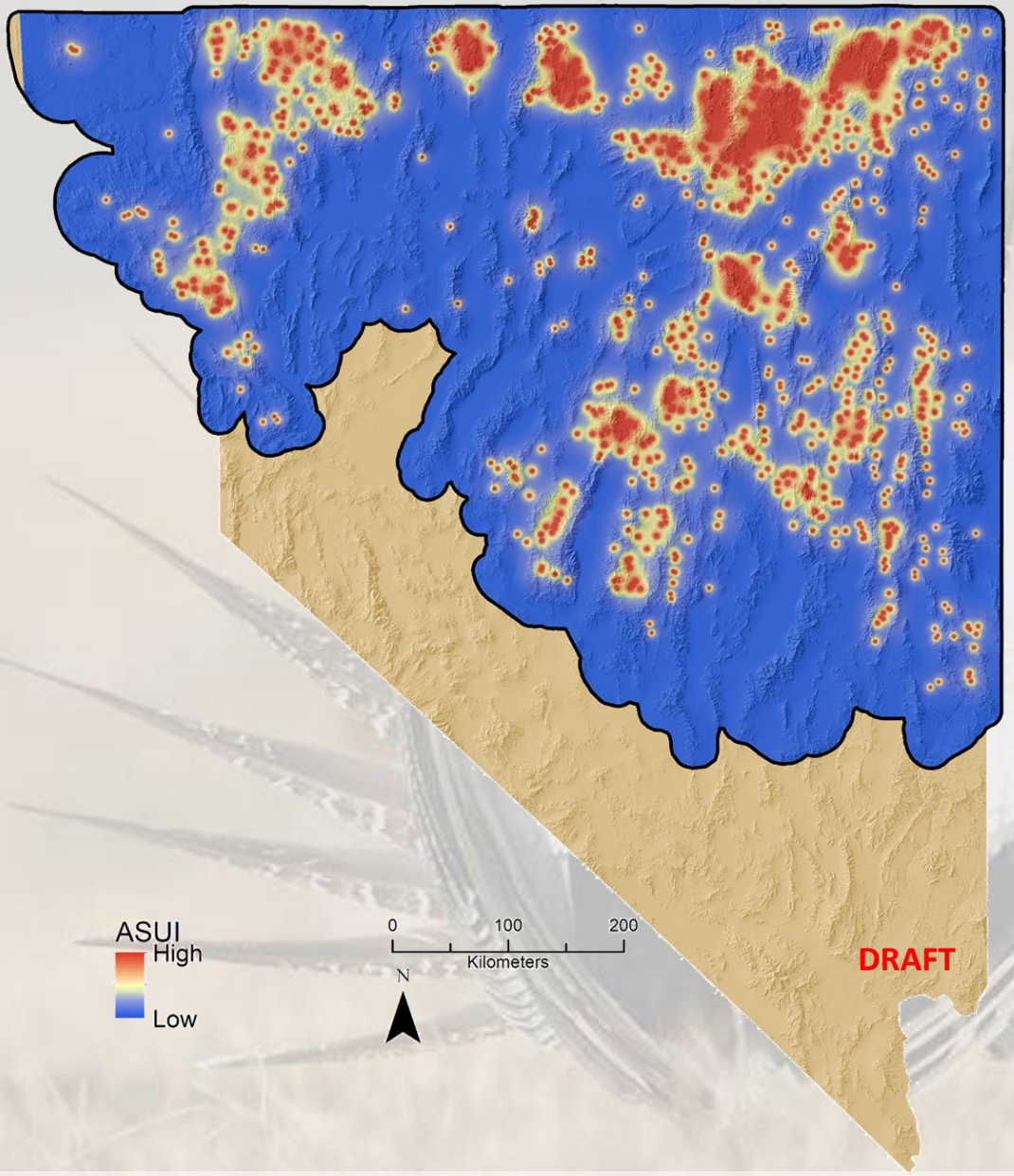
Density Index



Kernel Estimator

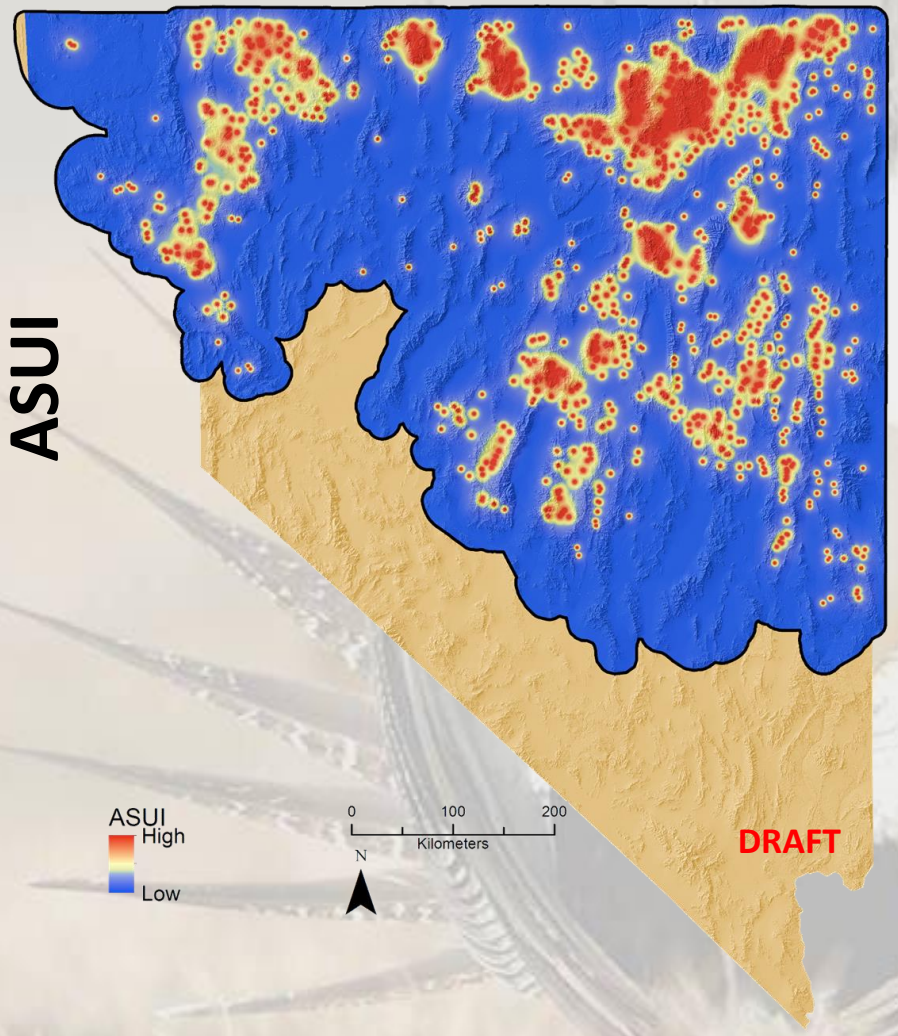
- **Bandwidth informed by movement sage-grouse movement parameters**

Abundance and Space Use Index

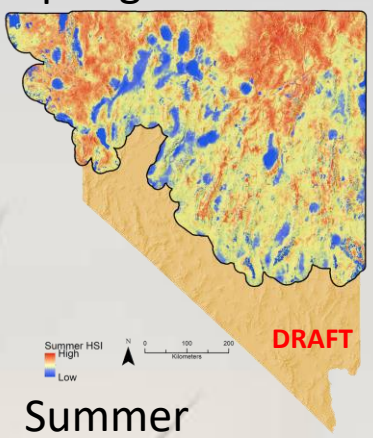


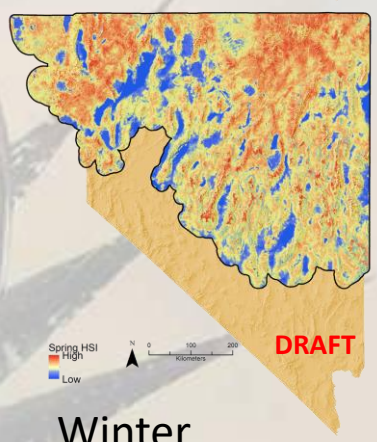
- Seasonal movements in relation to leks
- Configuration of leks

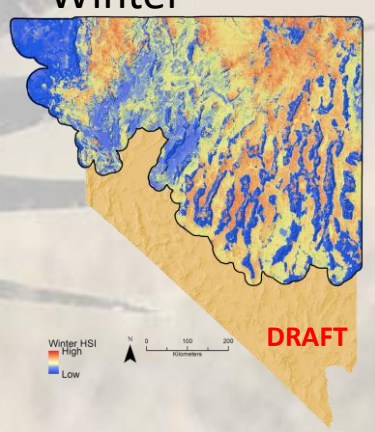
Combining ASUI and Seasonal HSIs



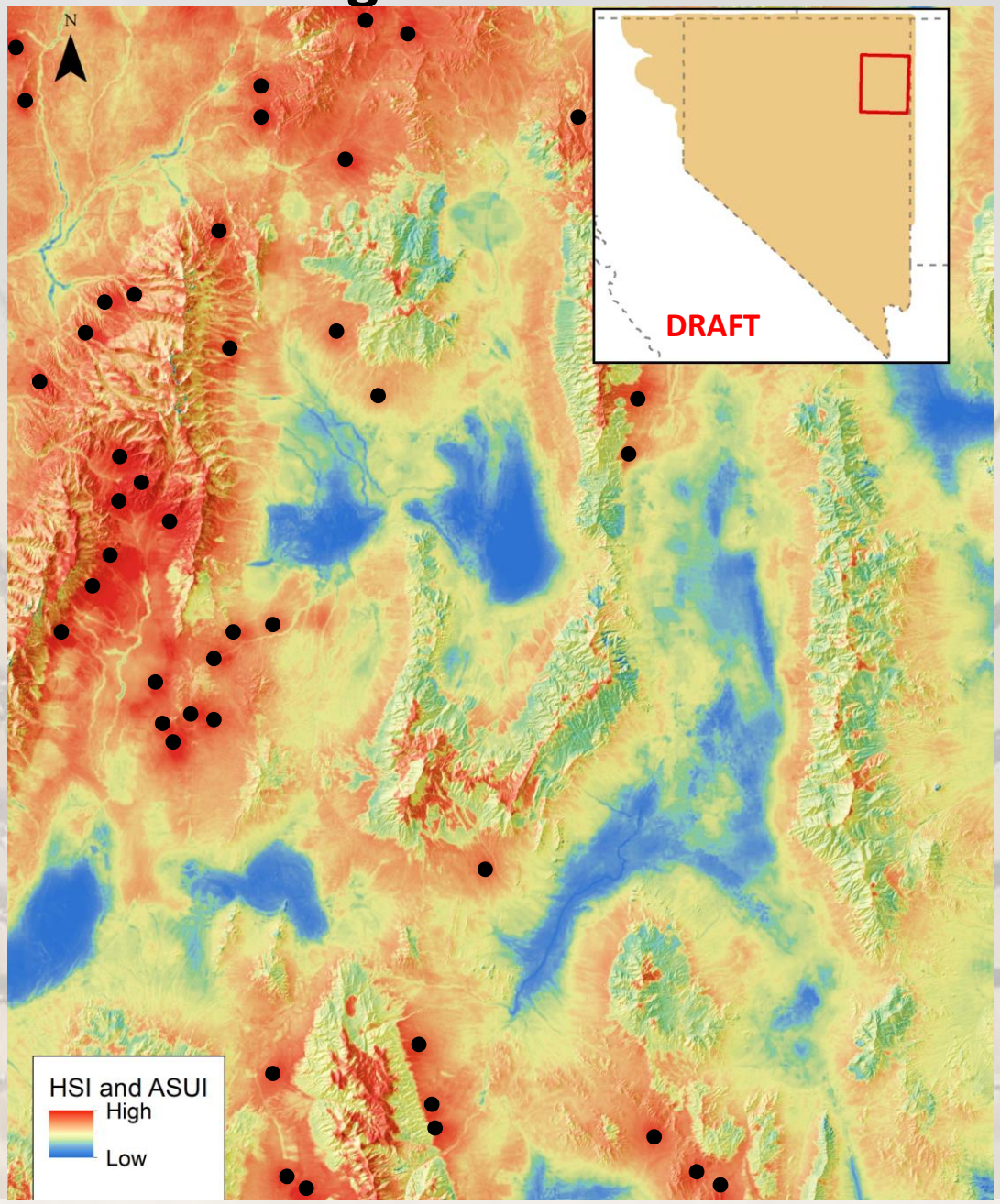
Seasonal HSIs



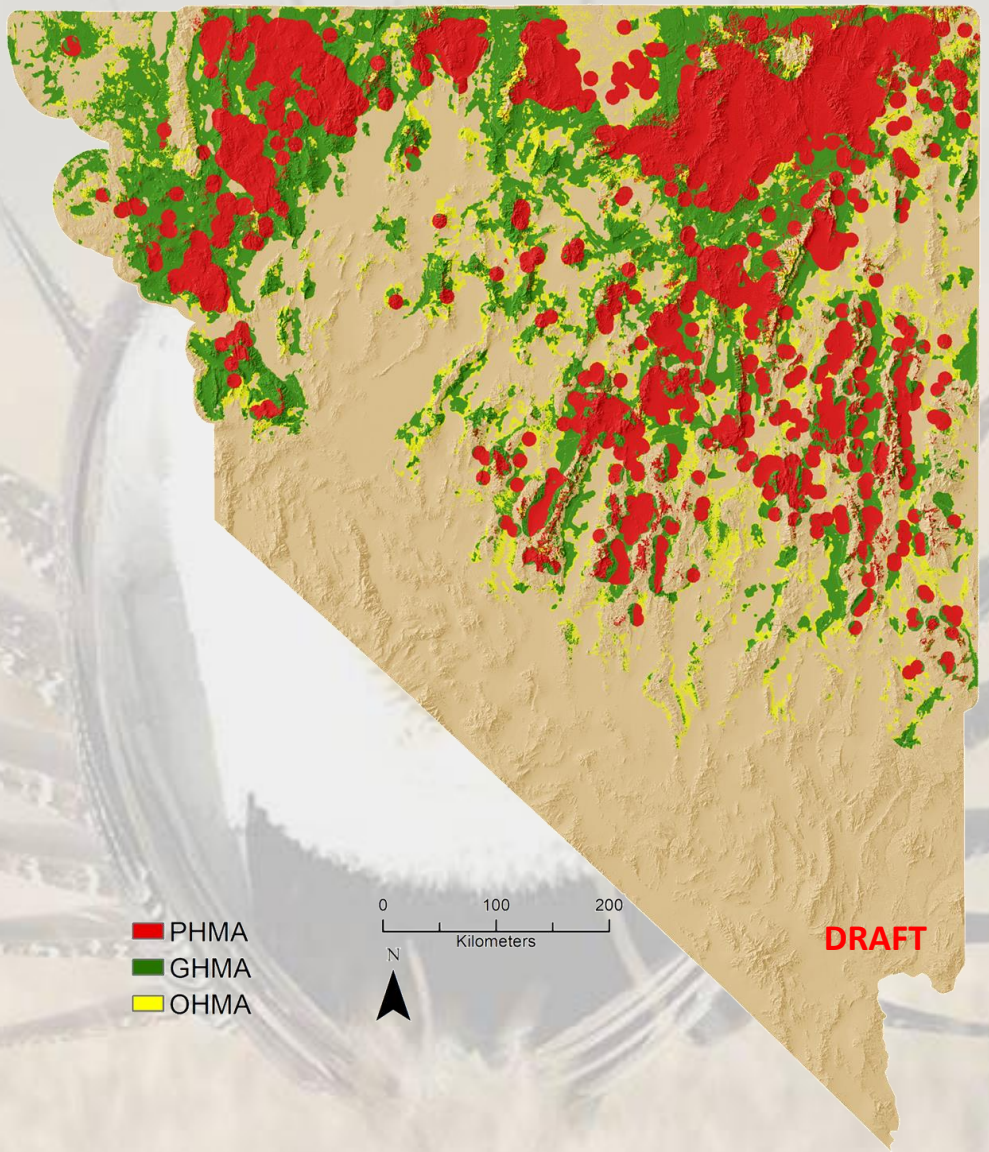




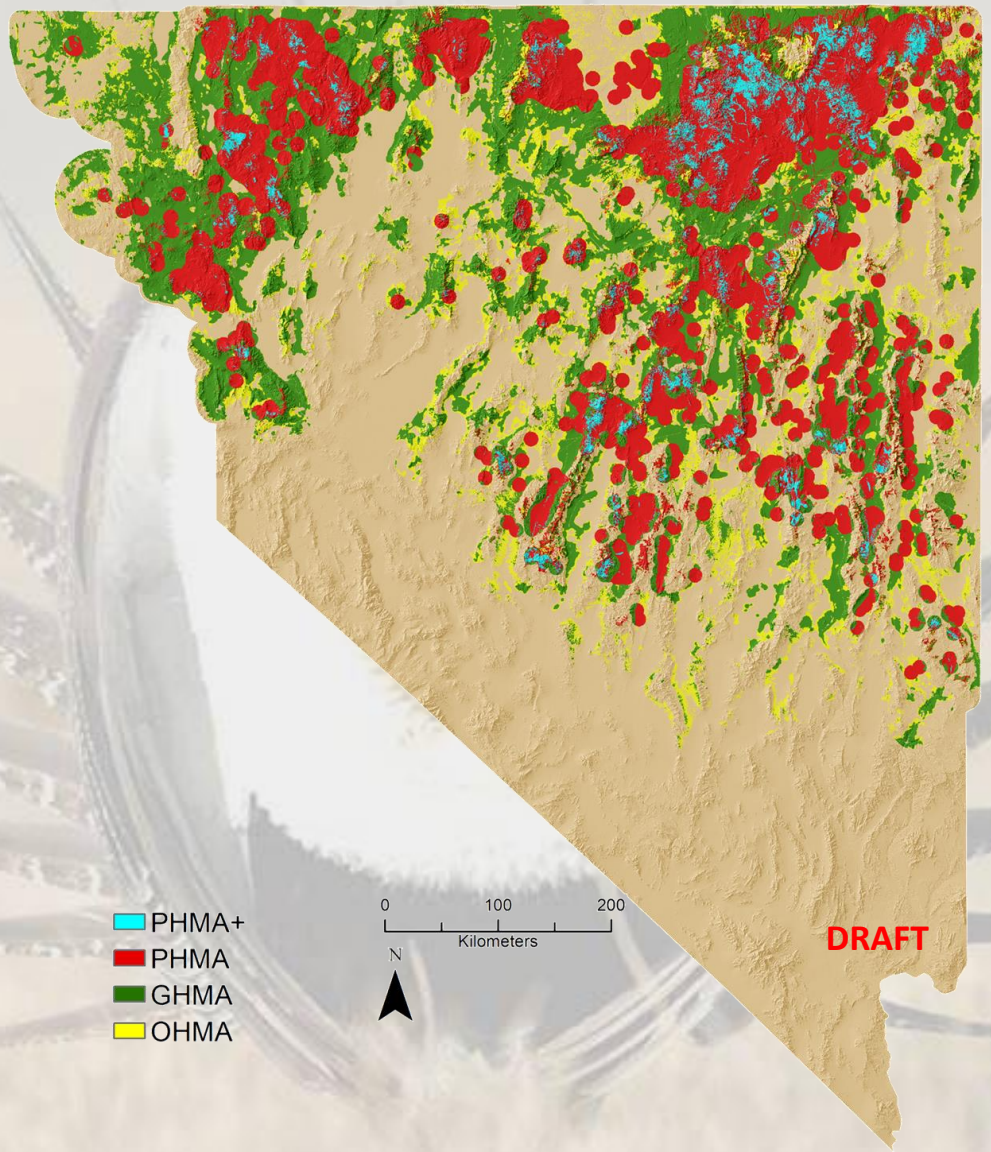
Combining ASUI and Seasonal



Preliminary Update to Sage-Grouse Management Areas



Preliminary Update to Sage-Grouse Management Areas



Acknowledgements

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University of Nevada Reno
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LS Power
NV Energy
Midway Gold
Noble Energy