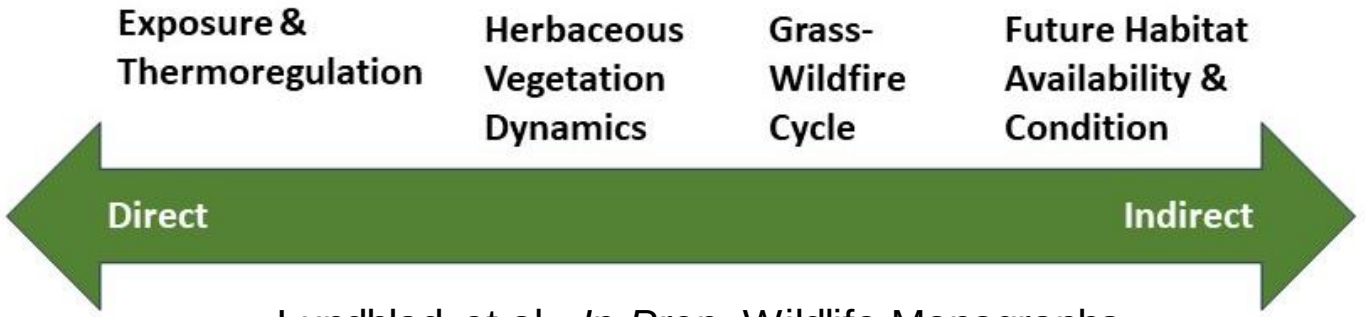
Sage-grouse Case Study

Greater Sage-grouse

Centrocercus urophasianus

Gunnison Sage-grouse

Centrocercus minimus



Lundblad et al. *In Prep.* Wildlife Monographs

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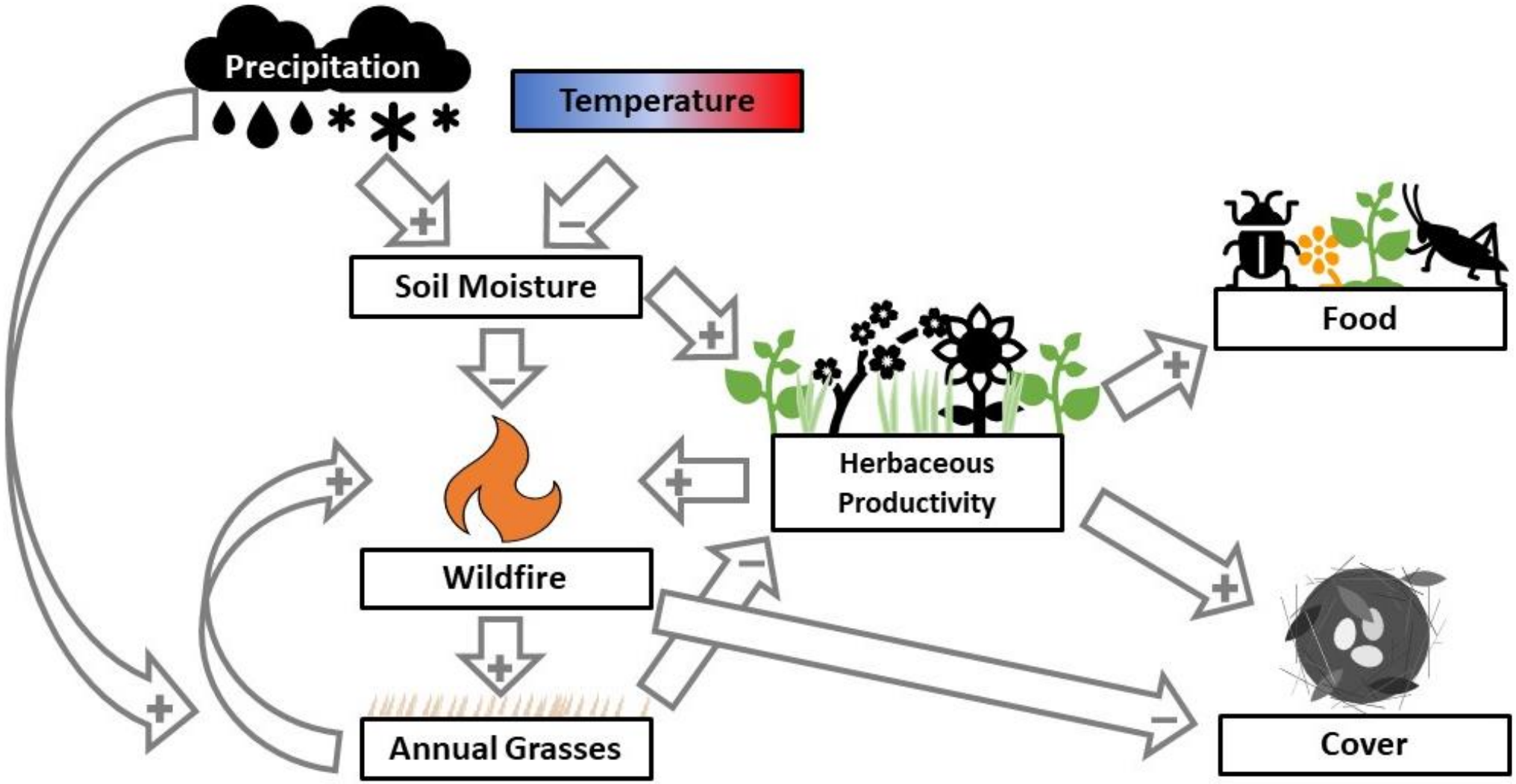
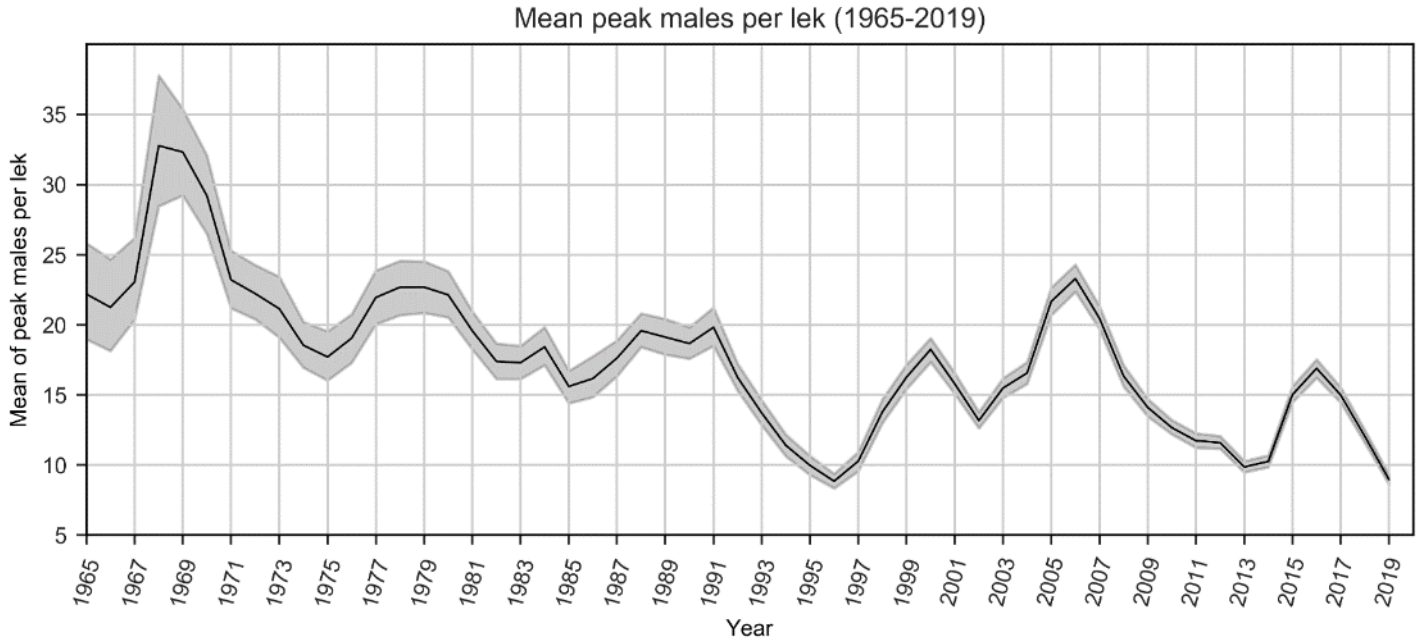
Indirect Effects

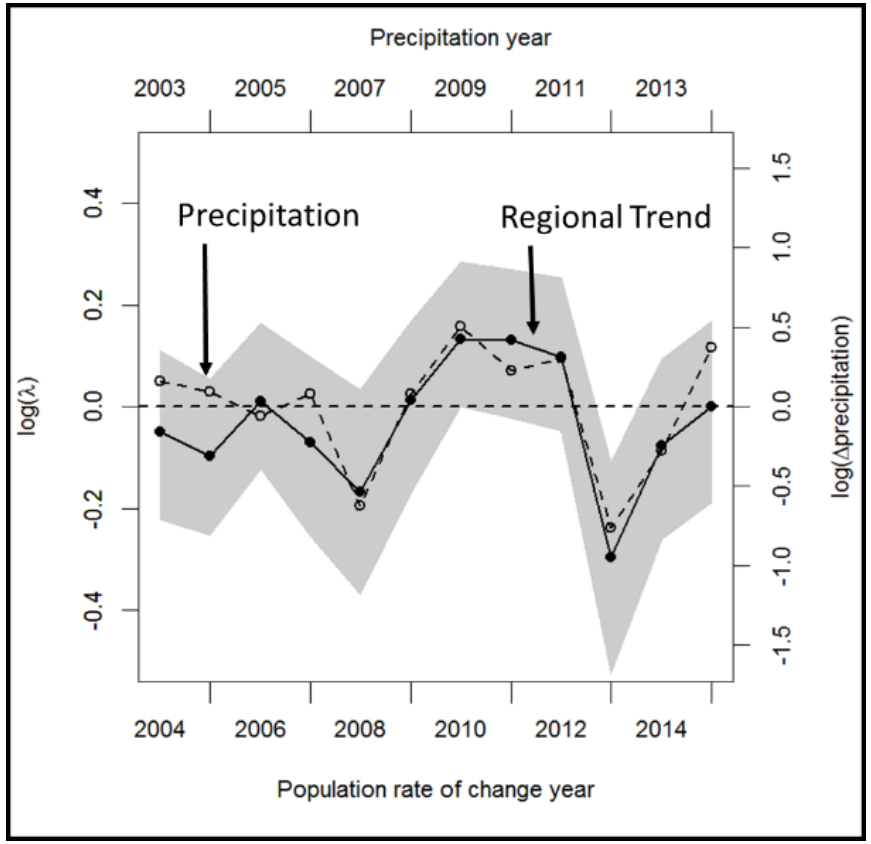


Lundblad et al. *In Prep.* Wildlife Monographs

Population Response

Greater Sage-grouse Population Monitoring Framework





The Auk
Ornithological Advances
AmericanOrnithology.org
Volume 135, 2018, pp. 240–261
DOI: 10.1642/AUK-17-137.1

RESEARCH ARTICLE

The relative importance of intrinsic and extrinsic drivers to population growth vary among local populations of Greater Sage-Grouse: An integrated population modeling approach

Peter S. Coates,[1]* Brian G. Prochazka,[1] Mark A. Ricca,[1] Brian J. Halstead,[1] Michael L. Casazza,[1] Erik J. Blomberg,[2] Brianne E. Brussee,[1] Lief Wiechman,[3] Joel Tebbenkamp,[4] Scott C. Gardner,[5] and Kerry P. Reese[4]

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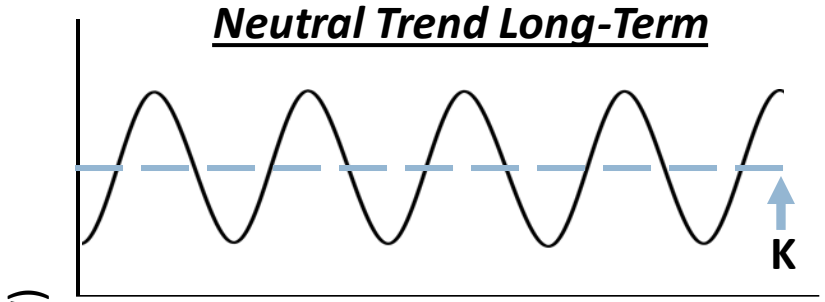
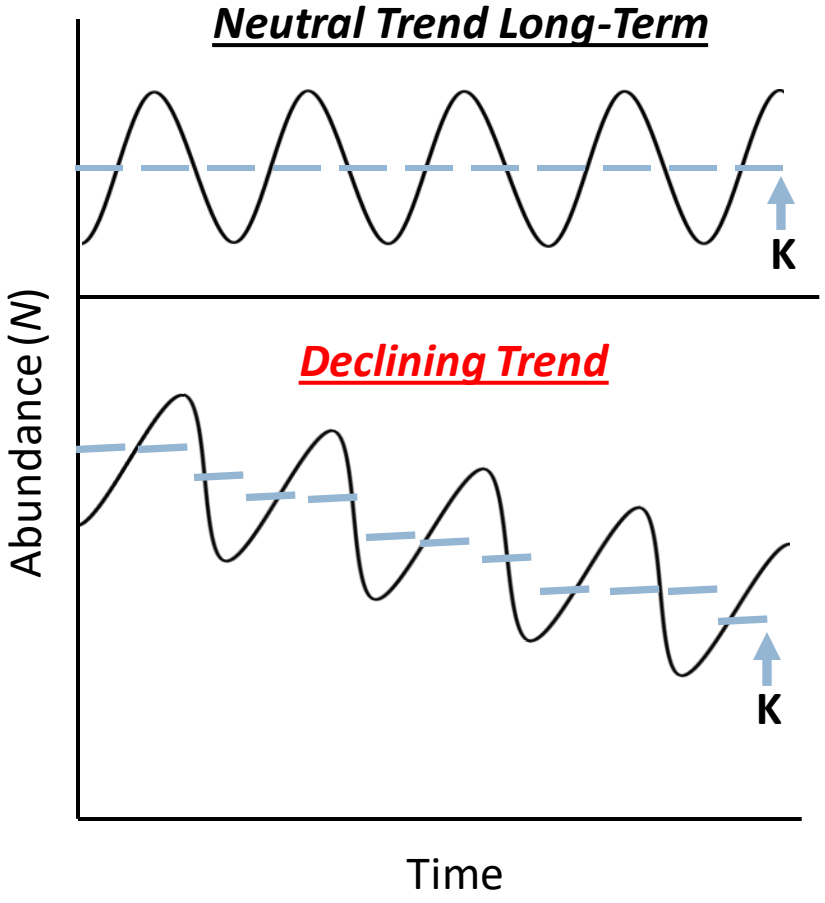
Greater Sage-grouse Population Monitoring Framework



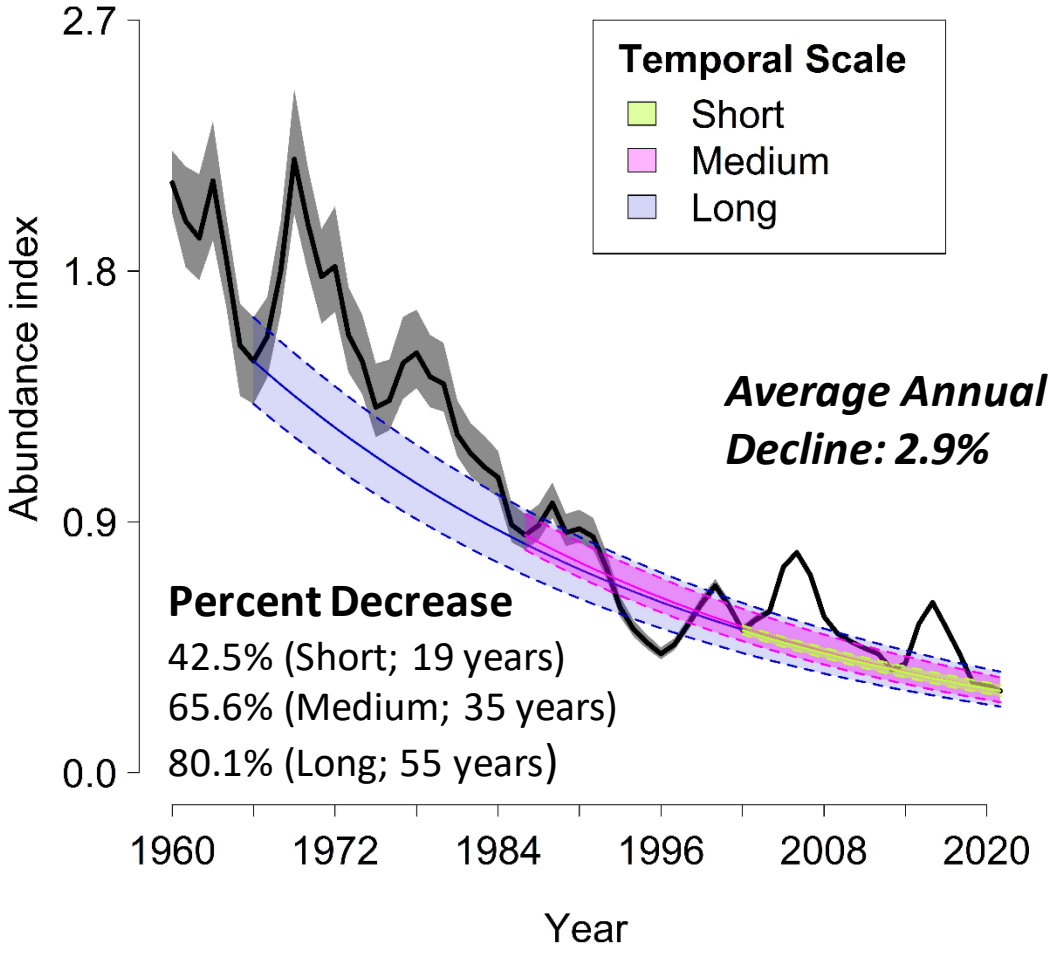
- Fluctuations driven by **stochastic** factors (**climatic conditions**)
- Consistent Carrying Capacity (K)

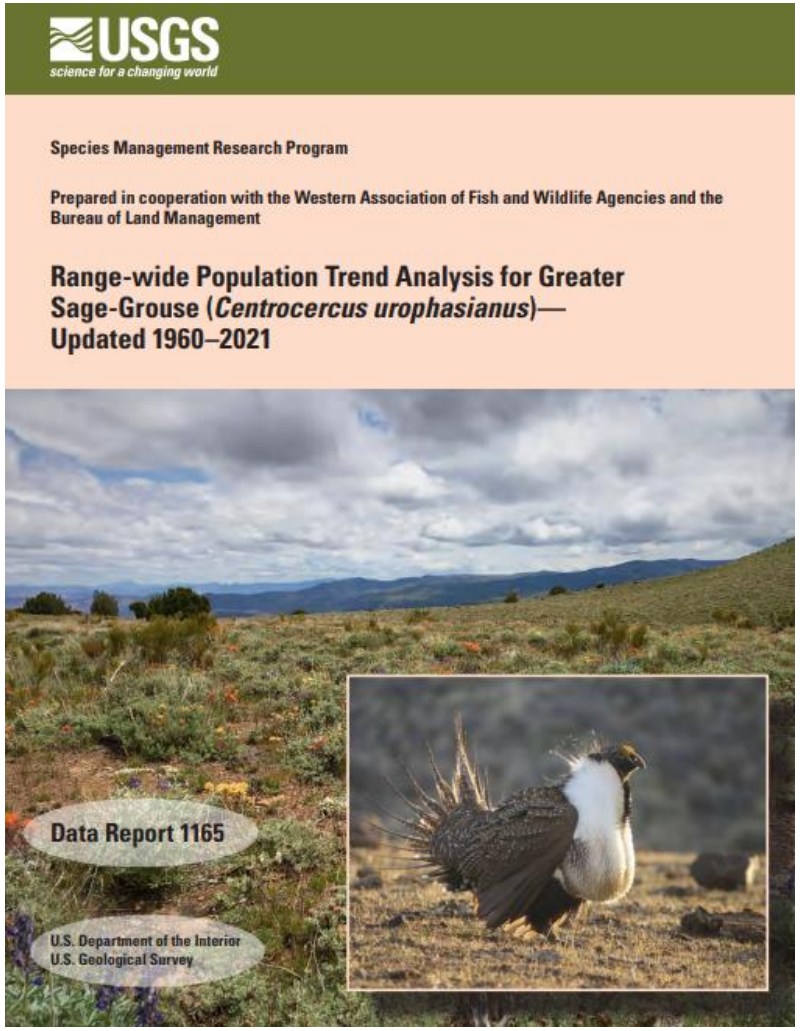
Greater Sage-grouse Population Monitoring Framework



- Fluctuations driven by **stochastic** factors (**climatic conditions**)
- Consistent Carrying Capacity (K)
- Fluctuations driven by **stochastic** factors (**climatic** conditions)
- Declining trajectory driven by **deterministic** stressors (loss of habitat) – could be climate related
- Reduction in K through time

Greater Sage-grouse Population Monitoring Framework





Coates, Prochazka, Aldridge, O'Donnell, Edmunds, Monroe, Hanser, Wiechman, & Chenaille. 2023. *U.S. Geological Survey Data Report*. https://pubs.er.usgs.gov/publication/dr1165

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Climate Vulnerability Assessment

Threats to Gunnison Sage-Grouse

Gunnison Sage-Grouse Species Status Assessment (USFWS 2019)

SSA describes three future scenarios: optimistic, continuation, & pes
(RPC 4.5, 8.5)

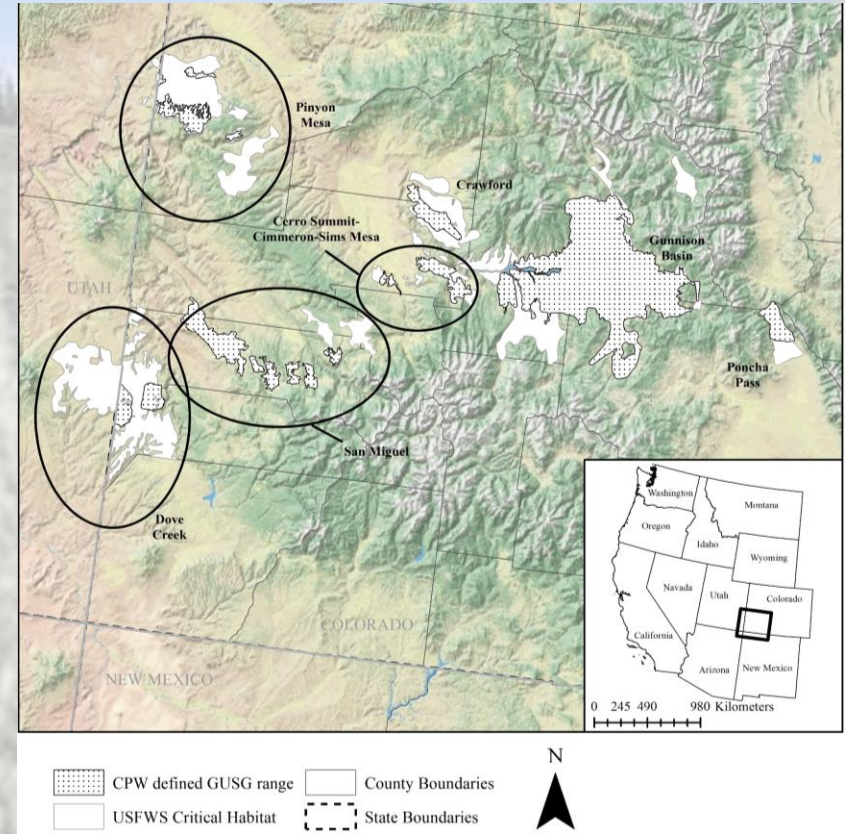
We created spatially explicit projections for each population based on ten datasets of current and projected (by 2070) threats to Gunnison Sage-Grouse habitat:

Climate change shifting vegetation patterns

a. Potential loss of sagebrush range
b. Drying of mesic habitats
c. Expanding pinyon-juniper encroachment
d. Expanding annual grass invasion

Development (agricultural or domestic)

Wildfire risk



Van Schmidt, Shyvers, Heinrichs, Saher, & Aldridge. 2024. *Ecosphere* https://doi.org/10.1002/ecs2.4768

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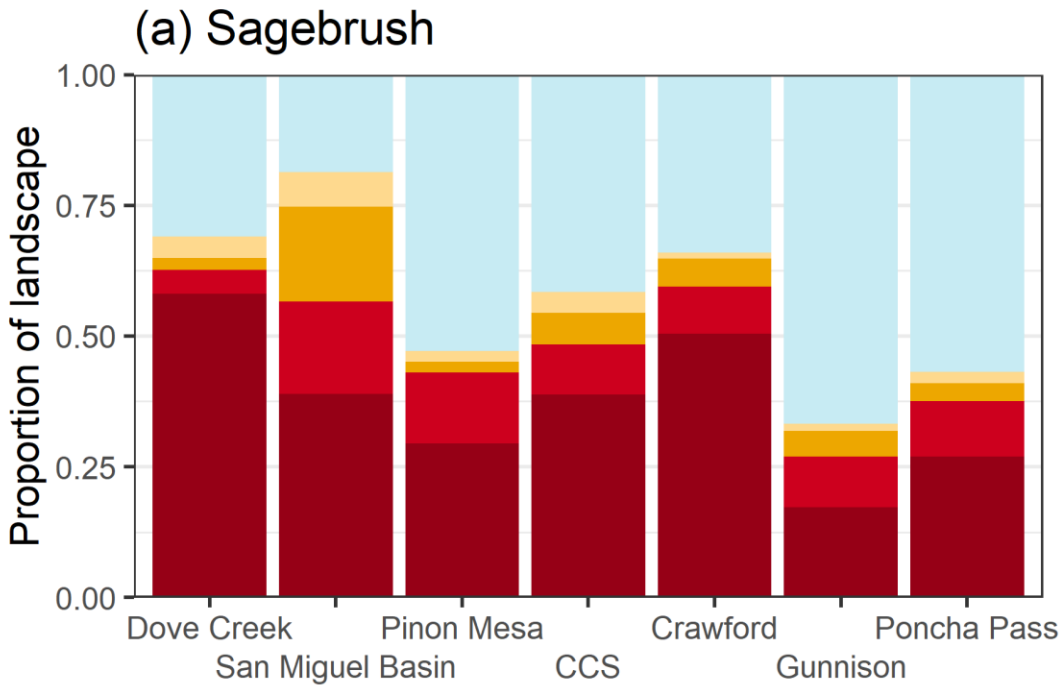
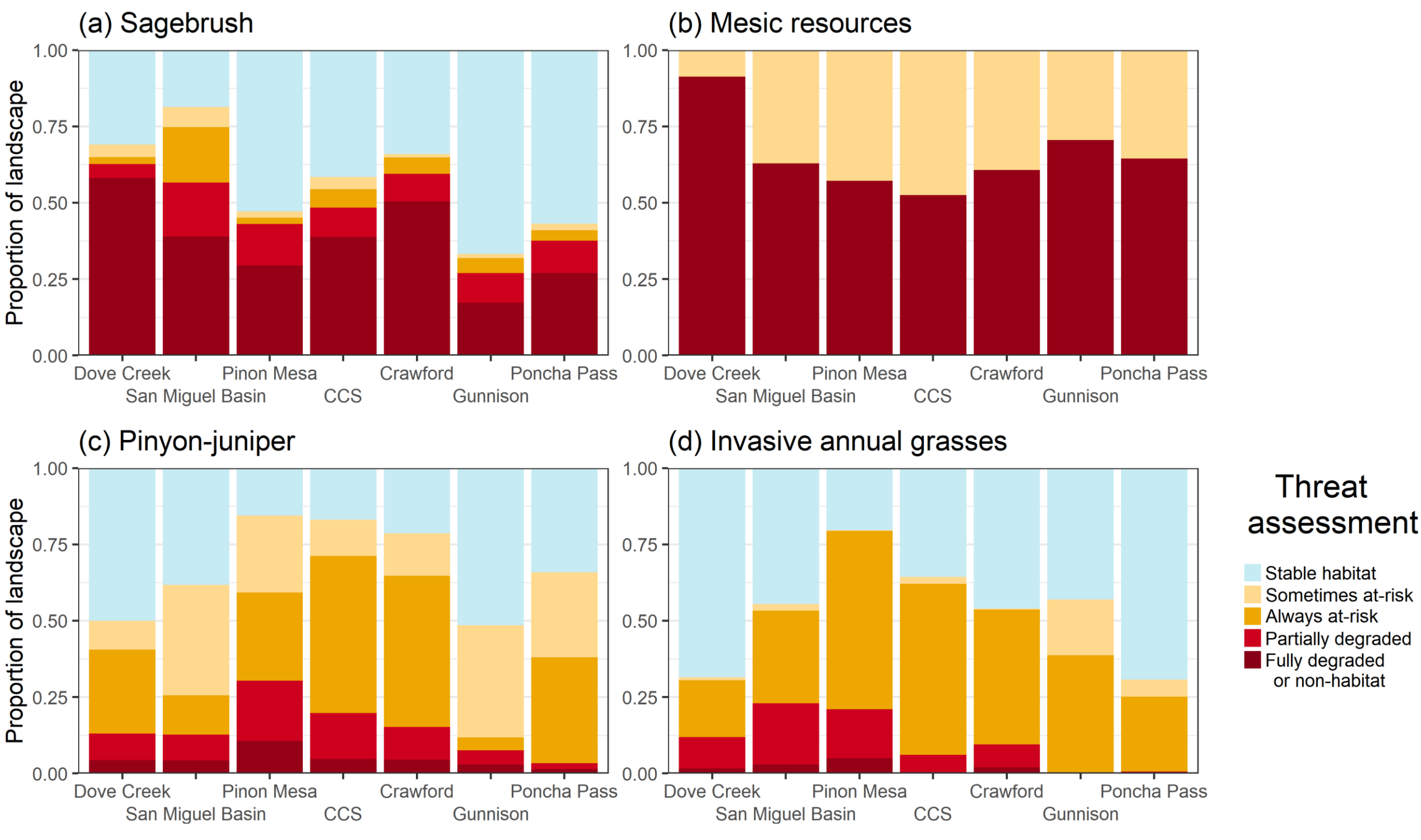


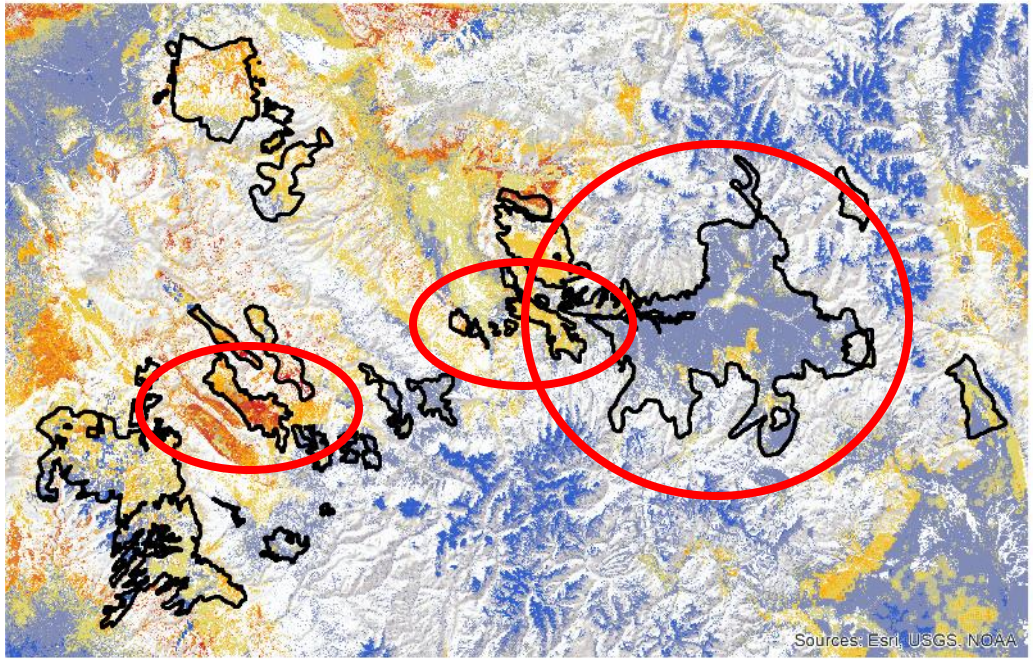
Threat assessment

- Stable habitat
- Sometimes at-risk
- Always at-risk
- Partially degraded
- Fully degraded or non-habitat


(a) Sagebrush
(b) Mesic resources
(c) Pinyon-juniper
(d) Invasive annual grasses
Proportion of landscape
1.00
0.75
0.50
0.25
0.00
Dove Creek
Pinon Mesa
Crawford
Poncha Pass
San Miguel Basin
CCS
Gunnison
Threat assessment
Stable habitat
Sometimes at-risk
Always at-risk
Partially degraded
Fully degraded or non-habitat

(a) Optimistic scenario

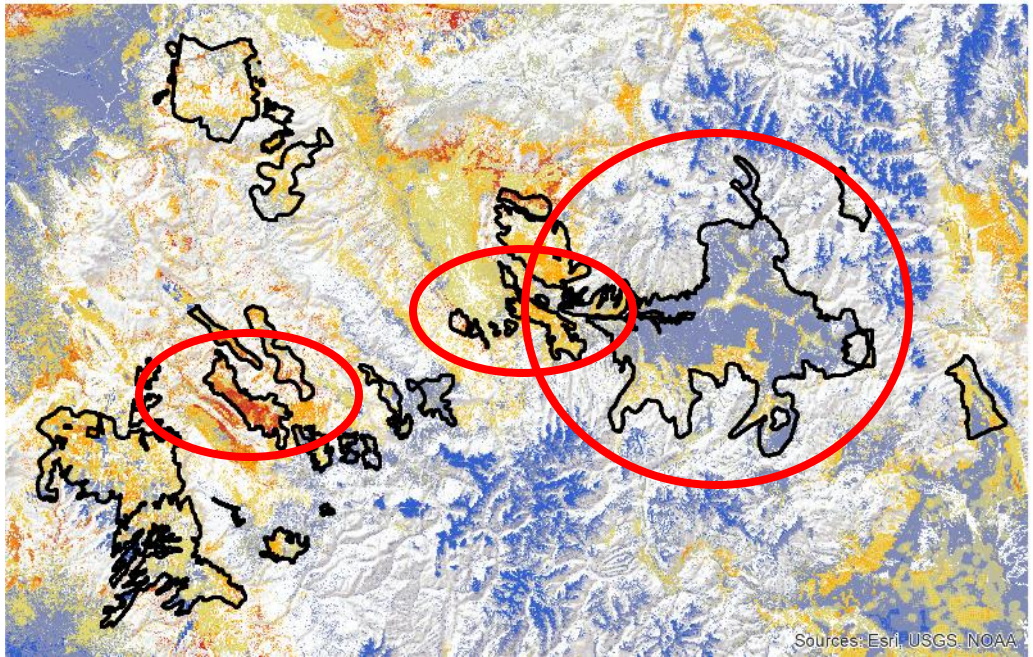
0 15 30 60 90 120 km



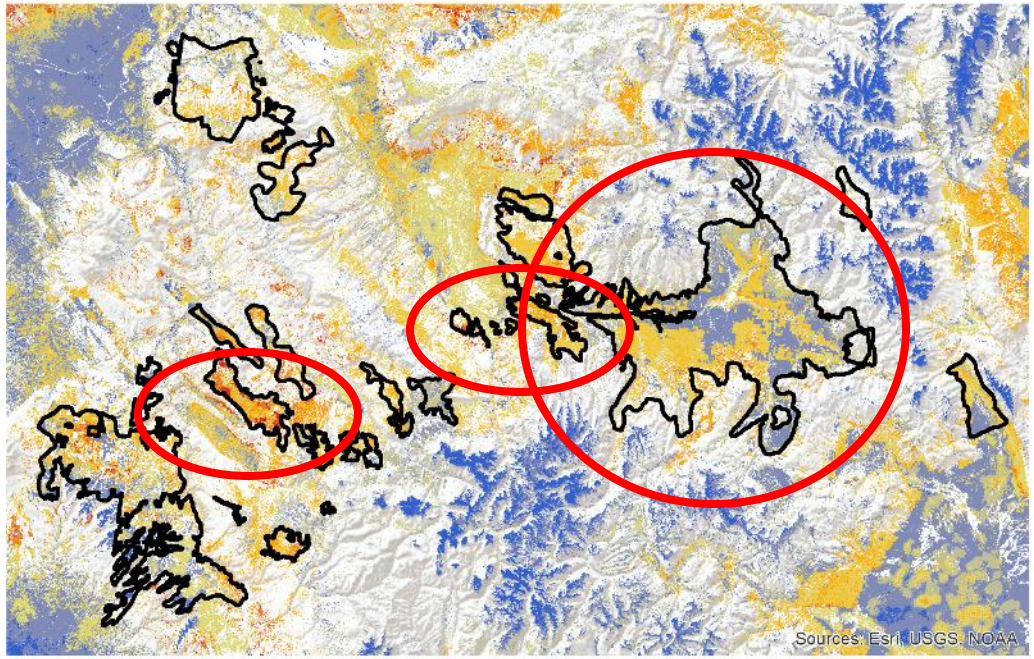
Mean overall vulnerability

- 0
- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1.0

(b) Continuation scenario



(c) Pessimistic scenario



Genome-wide Divergence for Greater Sage-Grouse

Shawna J Zimmerman, Cameron L Aldridge, and Sara J Oyler-McCance

[1]U.S. Geological Survey, Fort Collins Science Center

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Adaptive Capacity

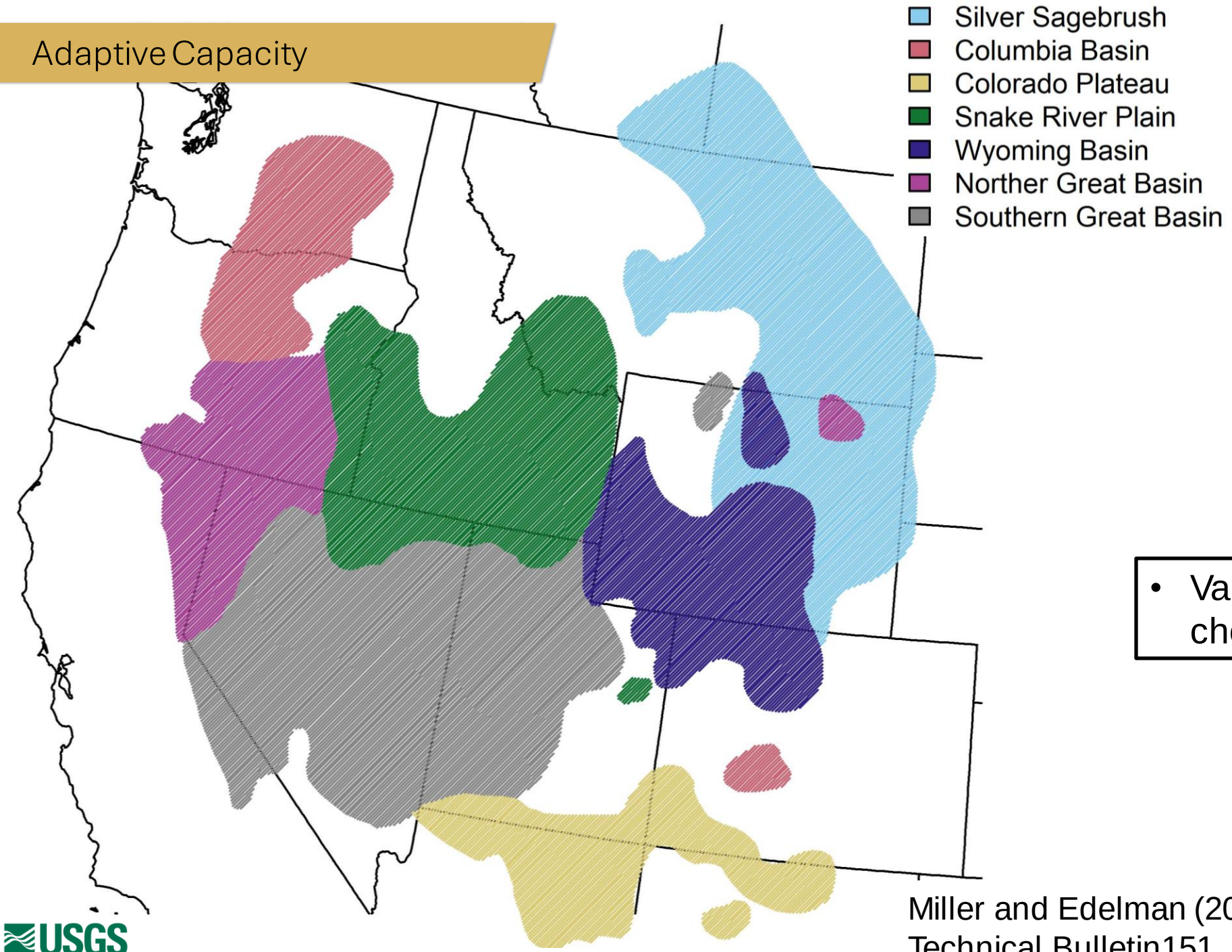

Photo: Matthew Pendleton | Macaulay Library

- Variation in sagebrush chemical community.

Miller and Edelman (2001). Oregon State University AES Technical Bulletin151.

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Adaptive Capacity

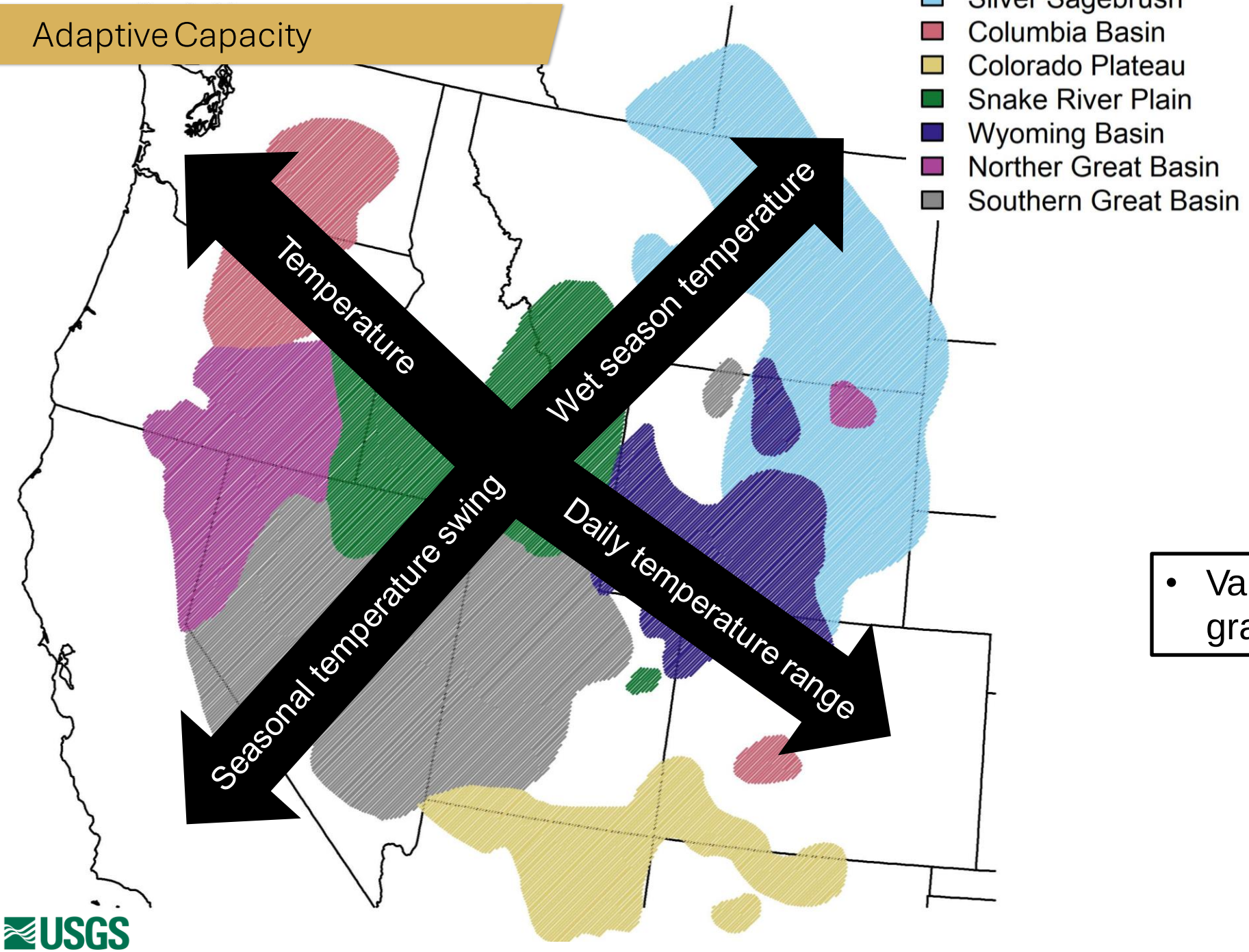

Photo: Matthew Pendleton | Macaulay Library

- Variation in environmental gradients.

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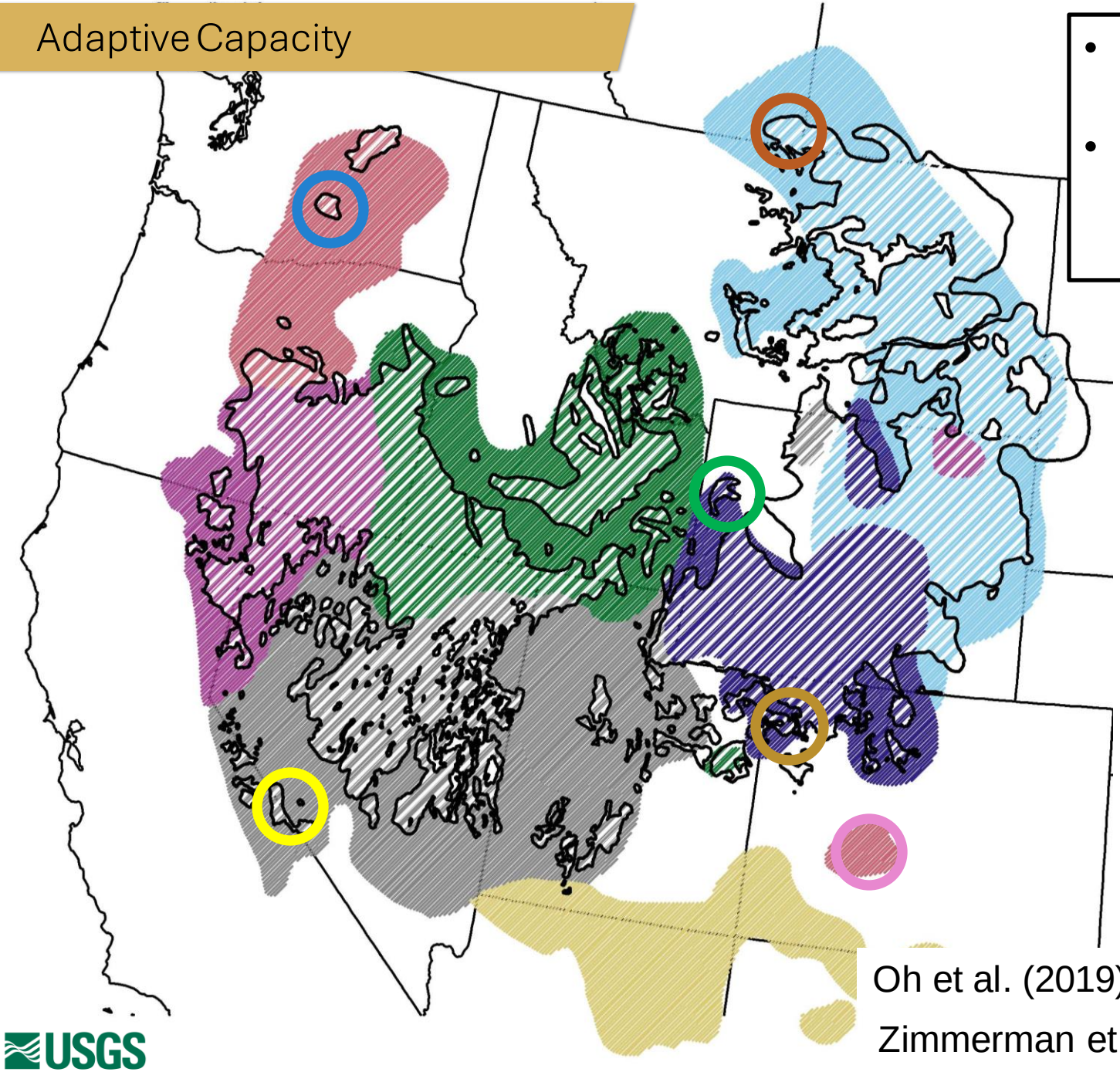
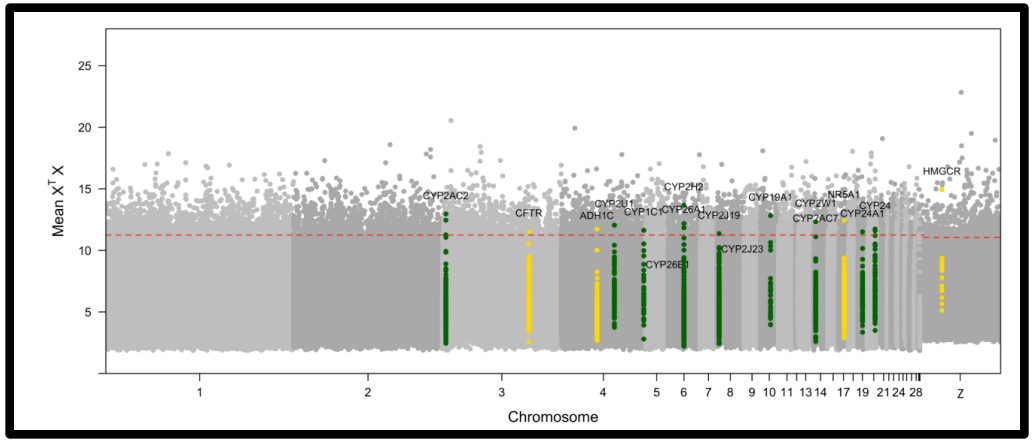
Adaptive Capacity



- First sage-grouse genome.
- Possible dietary adaptation for sage-grouse.

Photo: Matthew Pendleton | Macaulay Library



Oh et al. (2019). Genome Biology and Evolution 11(7): 2023-2034.

Zimmerman et al. (2019). Evolutionary Applications 12: 1661-1677.

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Adaptive Capacity

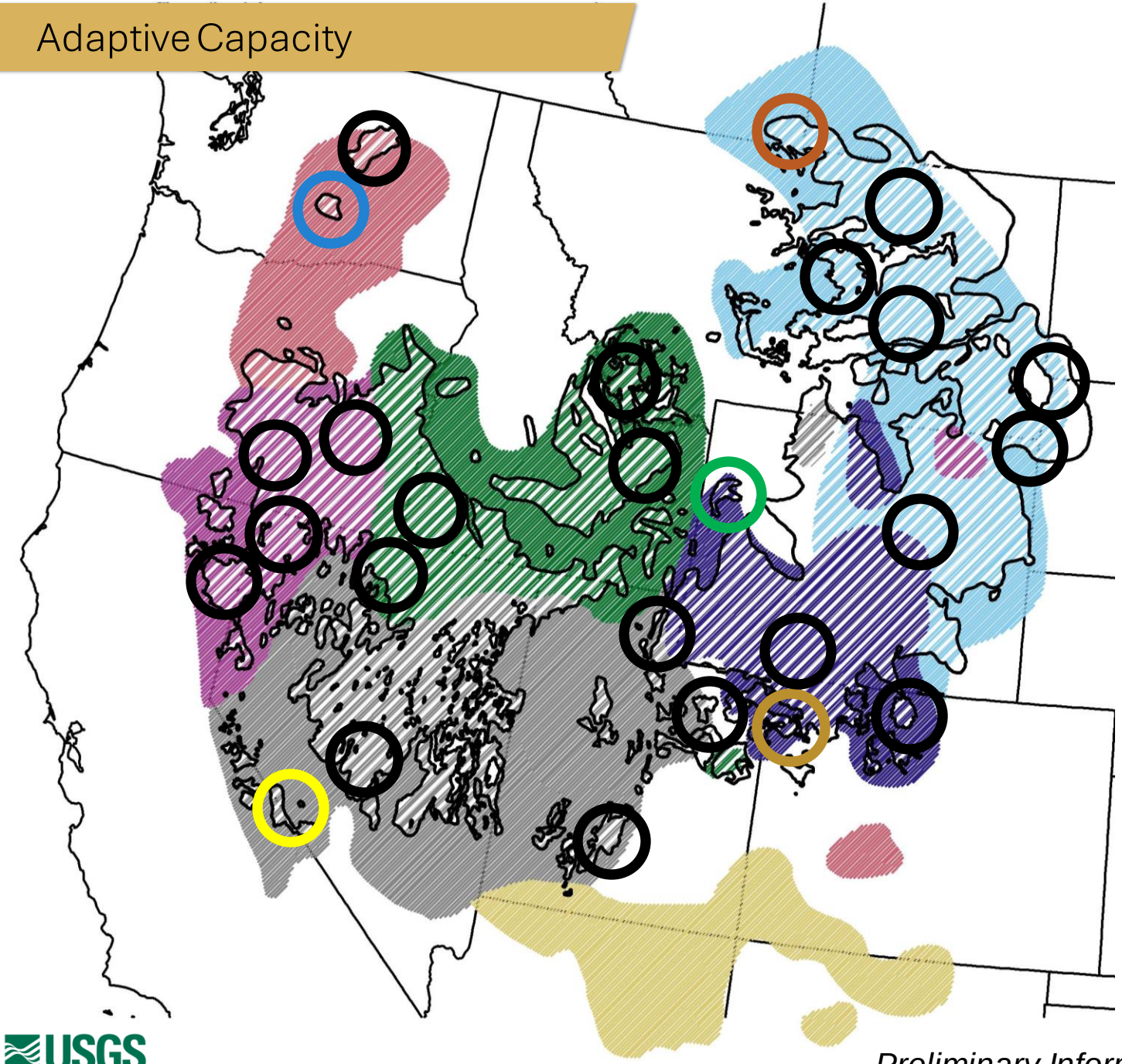

Photo: Matthew Pendleton | Macaulay Library

- We developed an annotated genome.
- We have expanded our genomic data set.

Adaptive Capacity

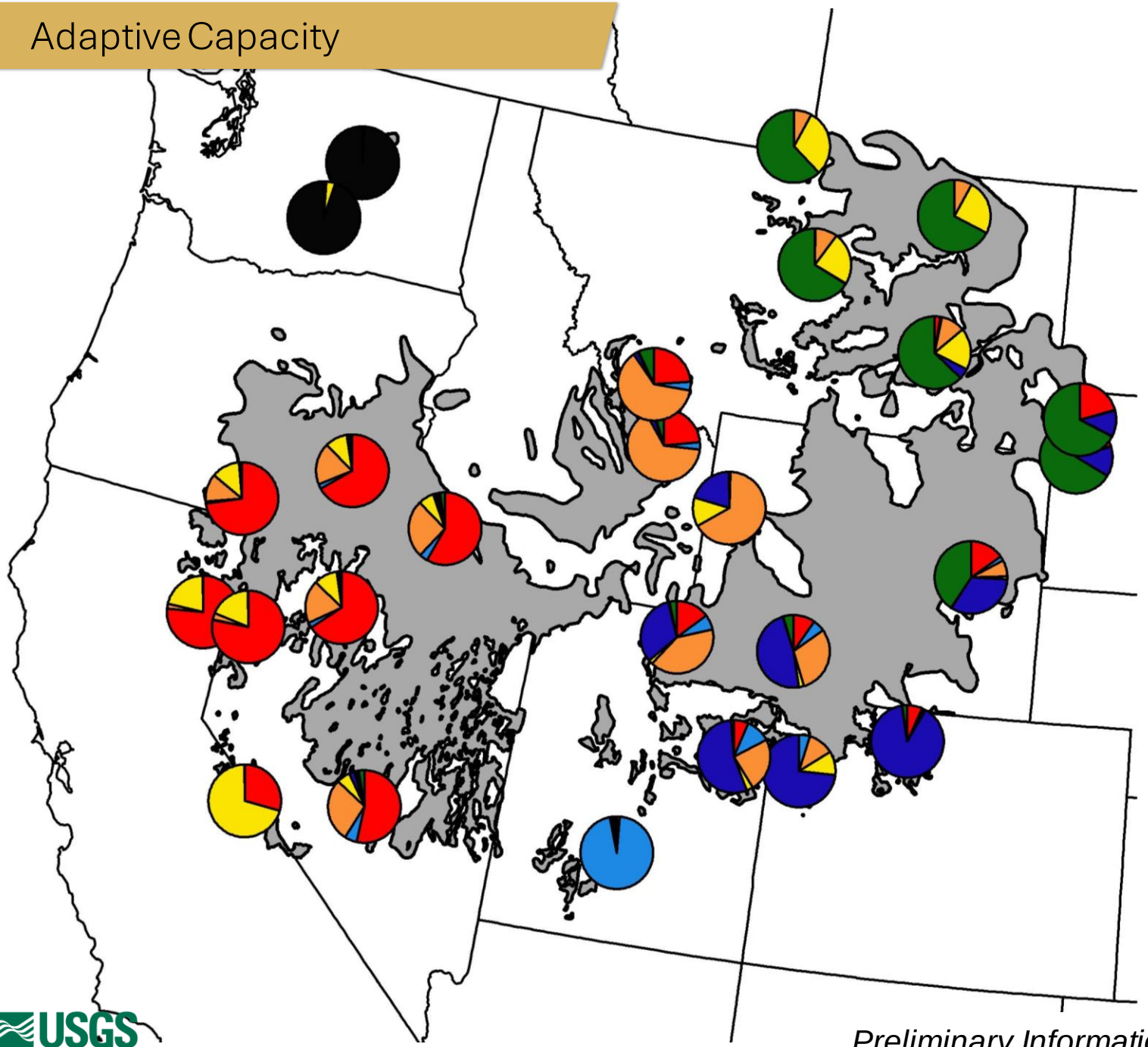

Photo: Matthew Pendleton | Macaulay Library

- Range-wide population structure.

Adaptive Capacity

- High seasonal temperature variation
- Cold dry seasons
- Warm wet seasons

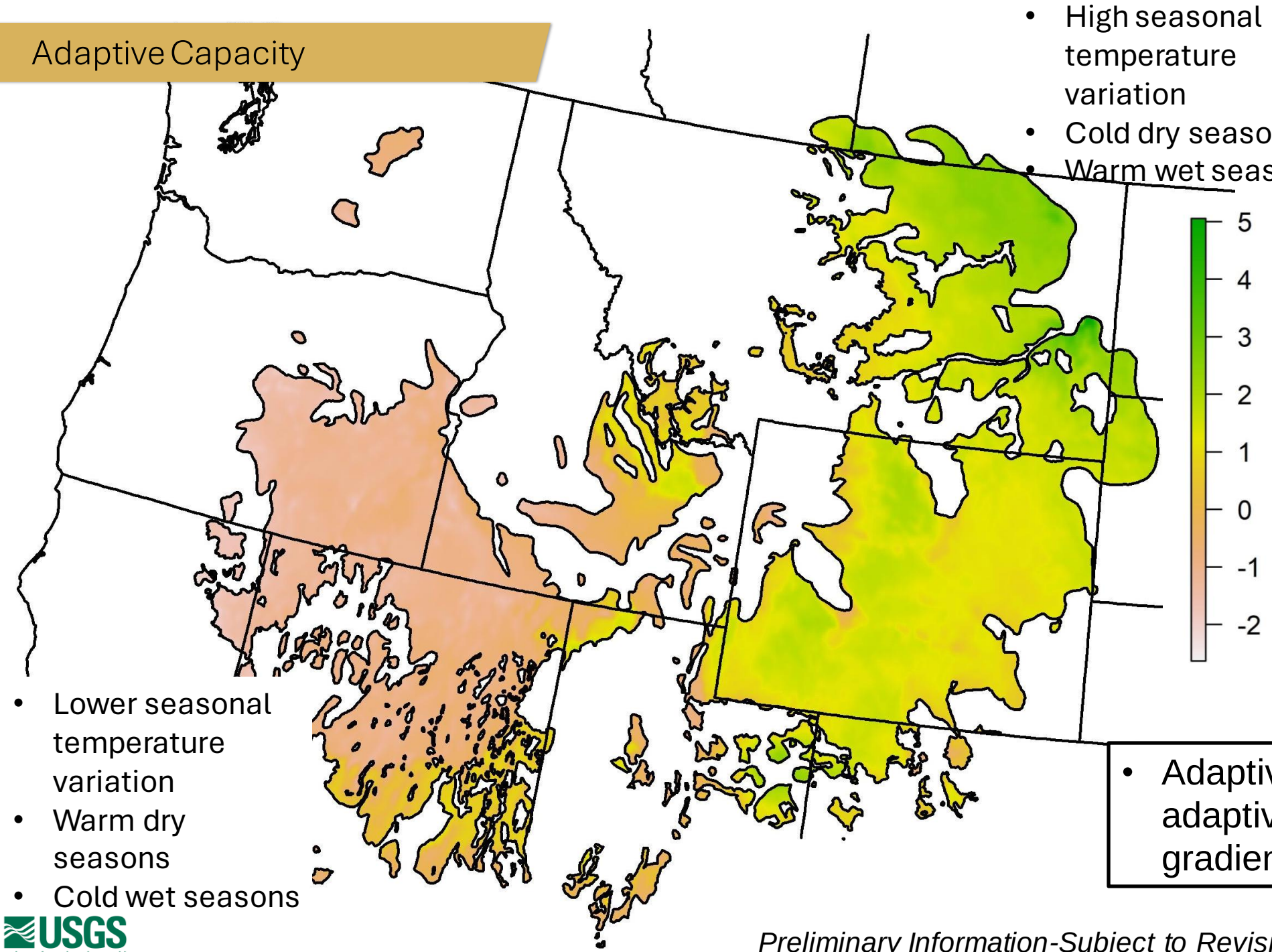

Photo: Matthew Pendleton | Macaulay Library

- Lower seasonal temperature variation
- Warm dry seasons
- Cold wet seasons

- Adaptive index along main adaptive environmental gradient.

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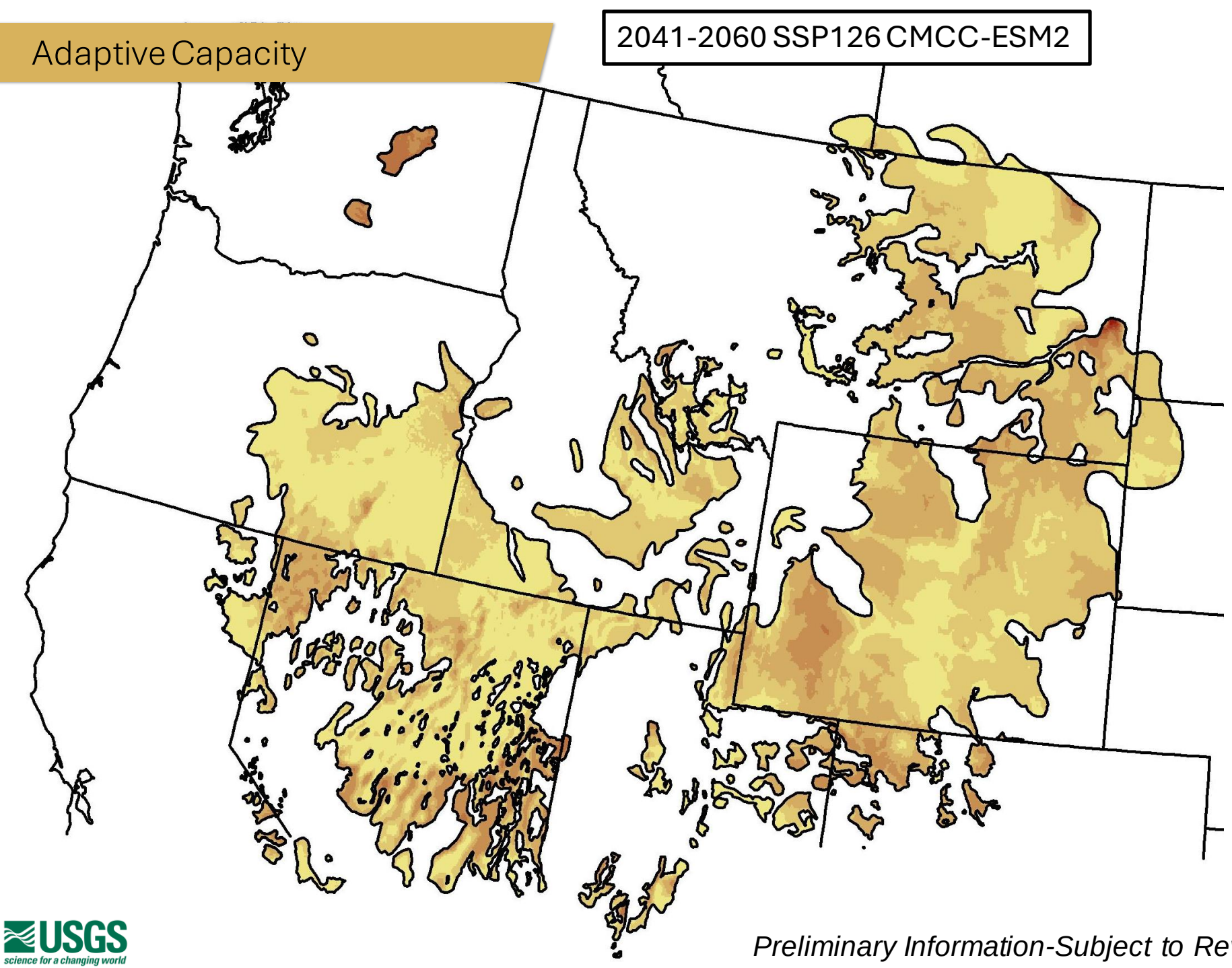
Adaptive Capacity

2041-2060 SSP126 CMCC-ESM2



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- Genomic offset along RDA1.

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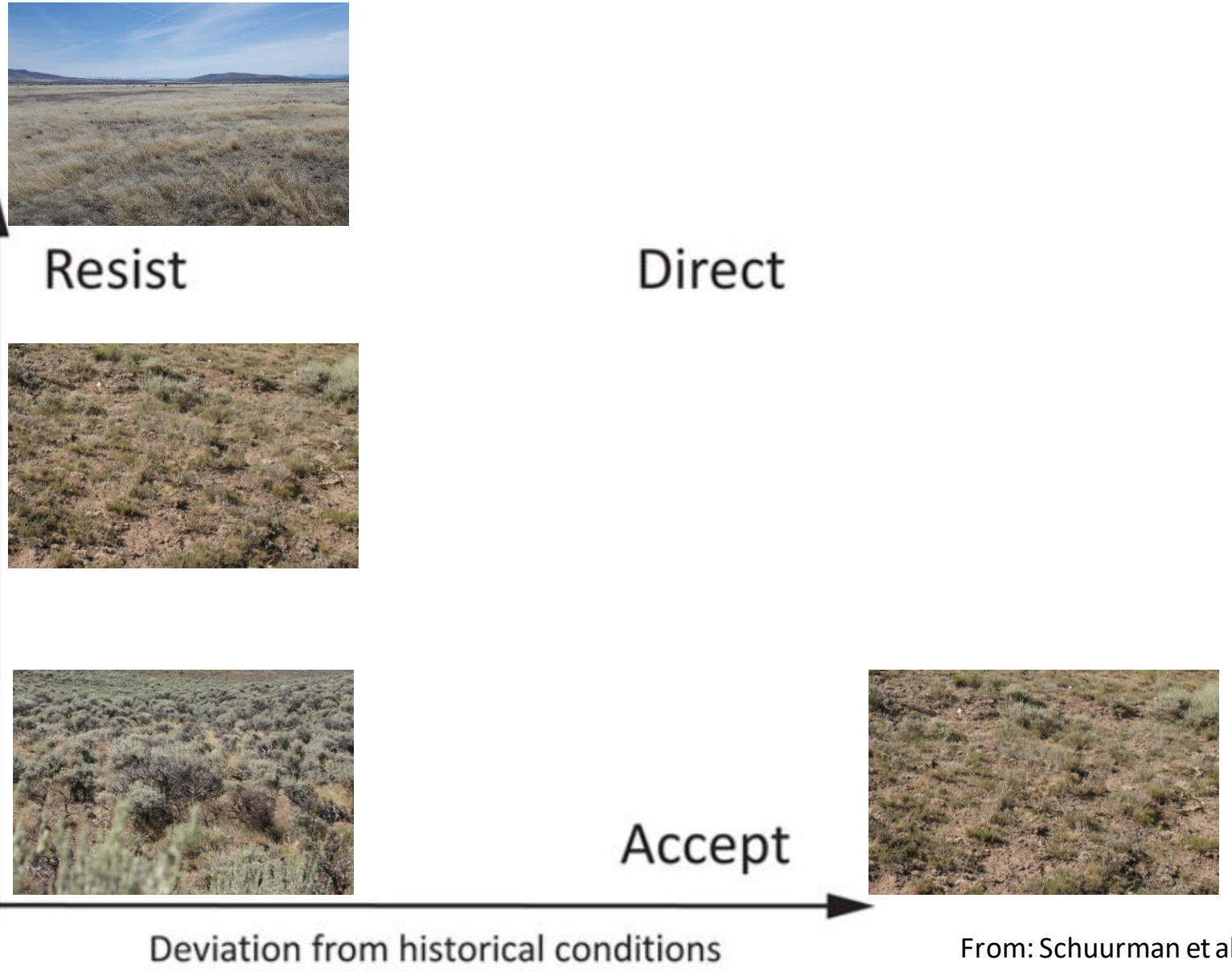
Resist – Accept – Direct (RAD Framework)



From: Schuurman et al. 2022, *BioScience*