Predicting the Influence of Restoration on Greater Sage-Grouse Lek Distribution


Katherine Zarn


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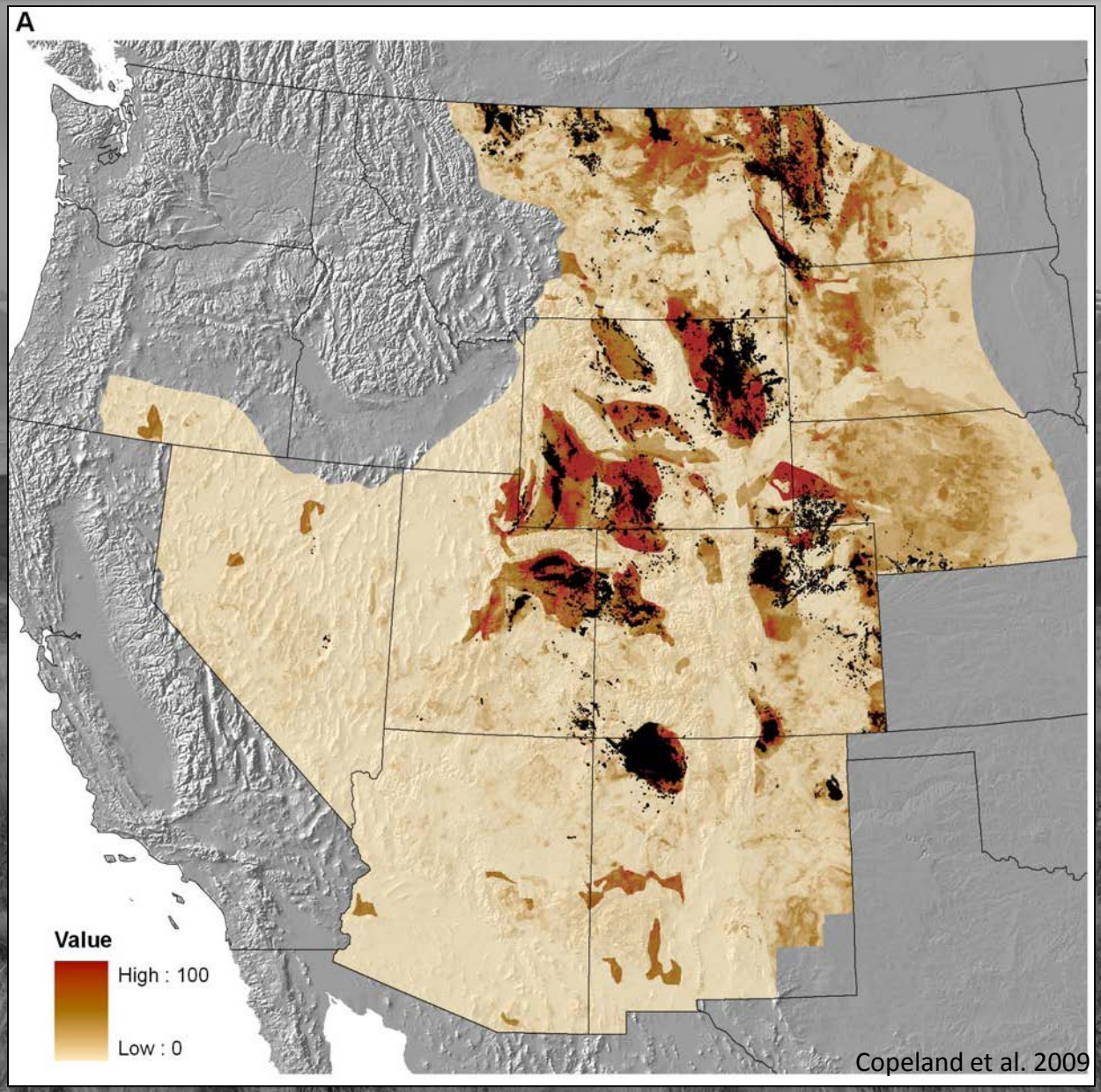
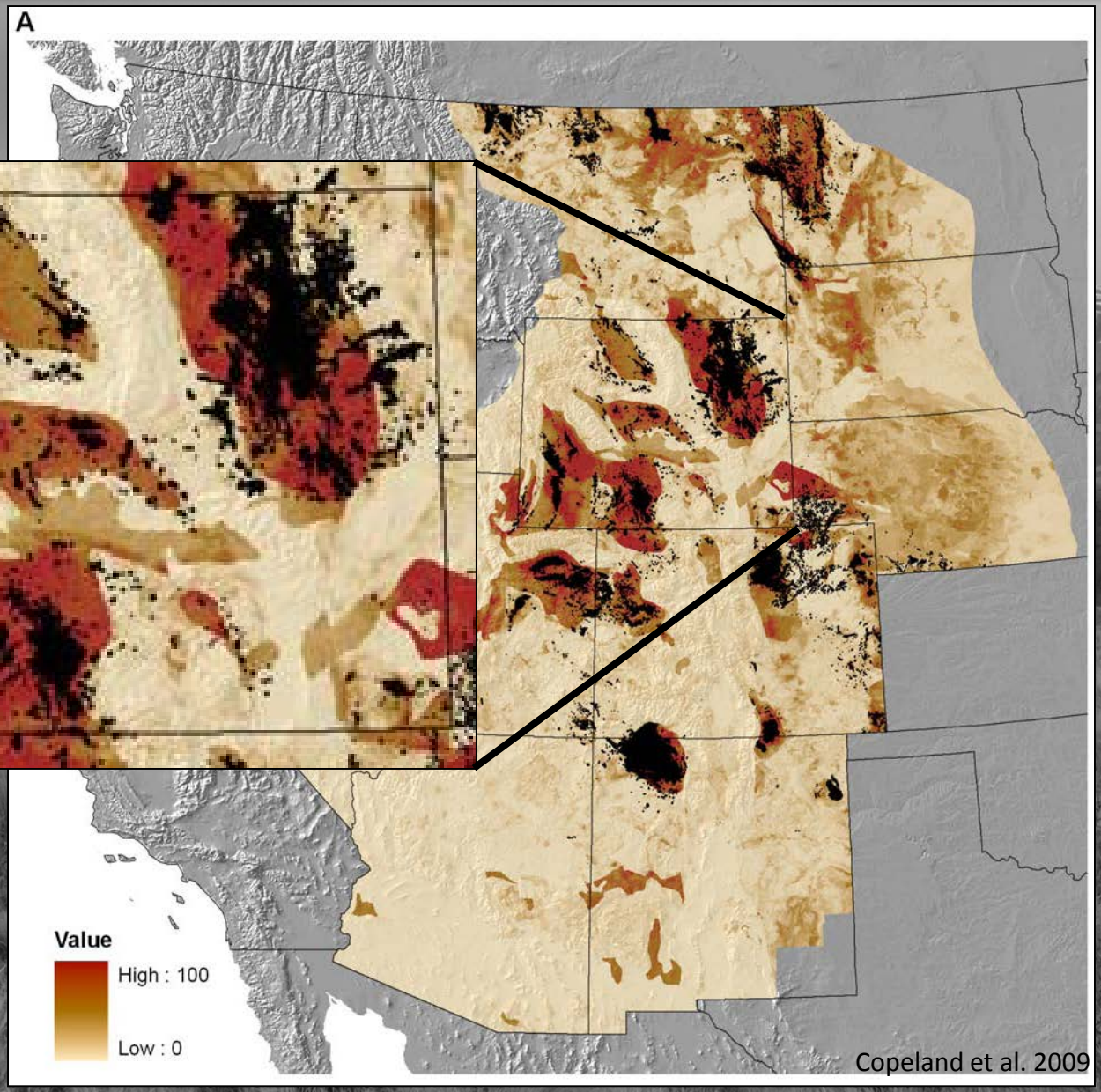
Greater Sage-Grouse

Historical and current distribution

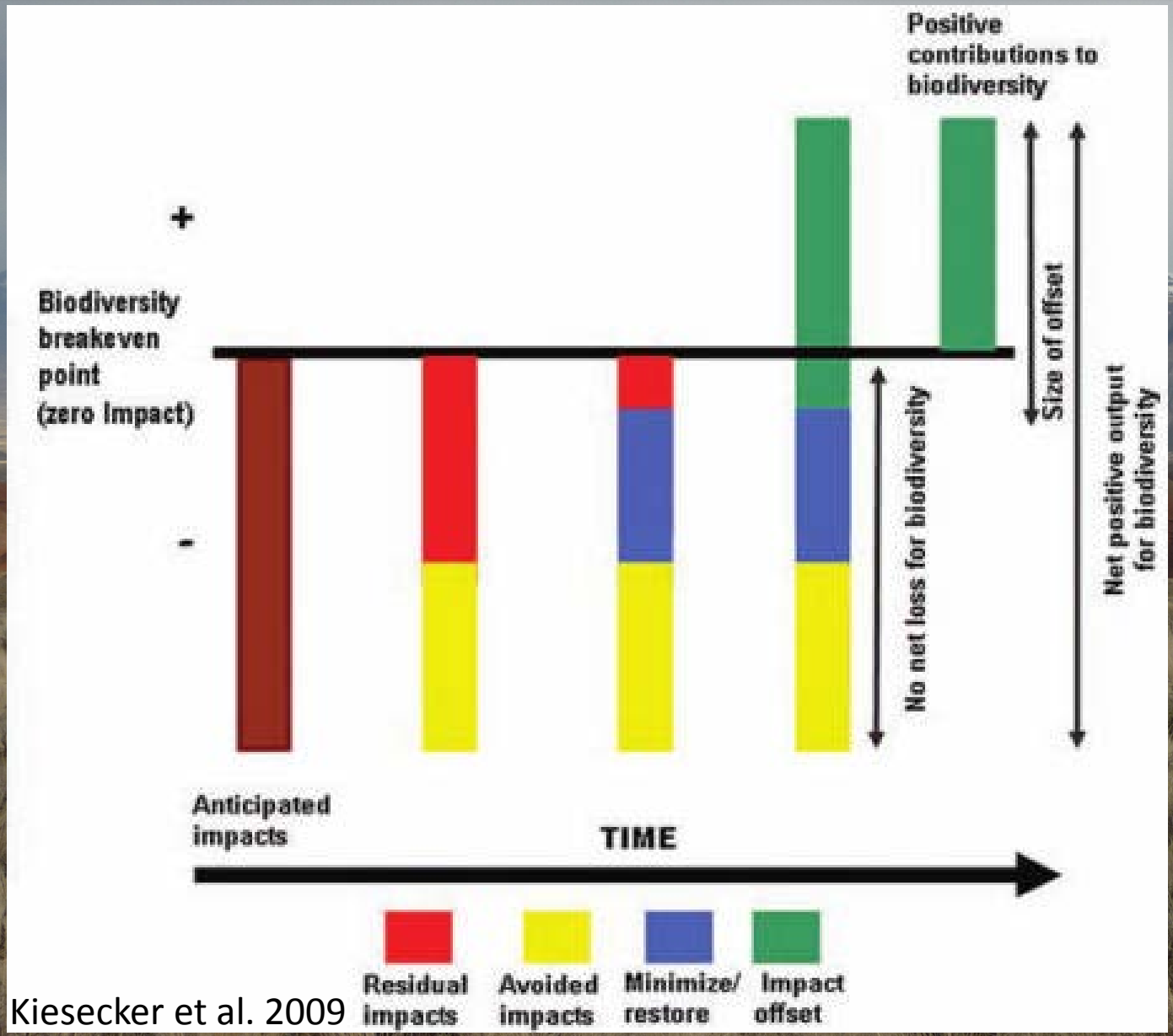
Oil and Gas Development



Oil and Gas Development

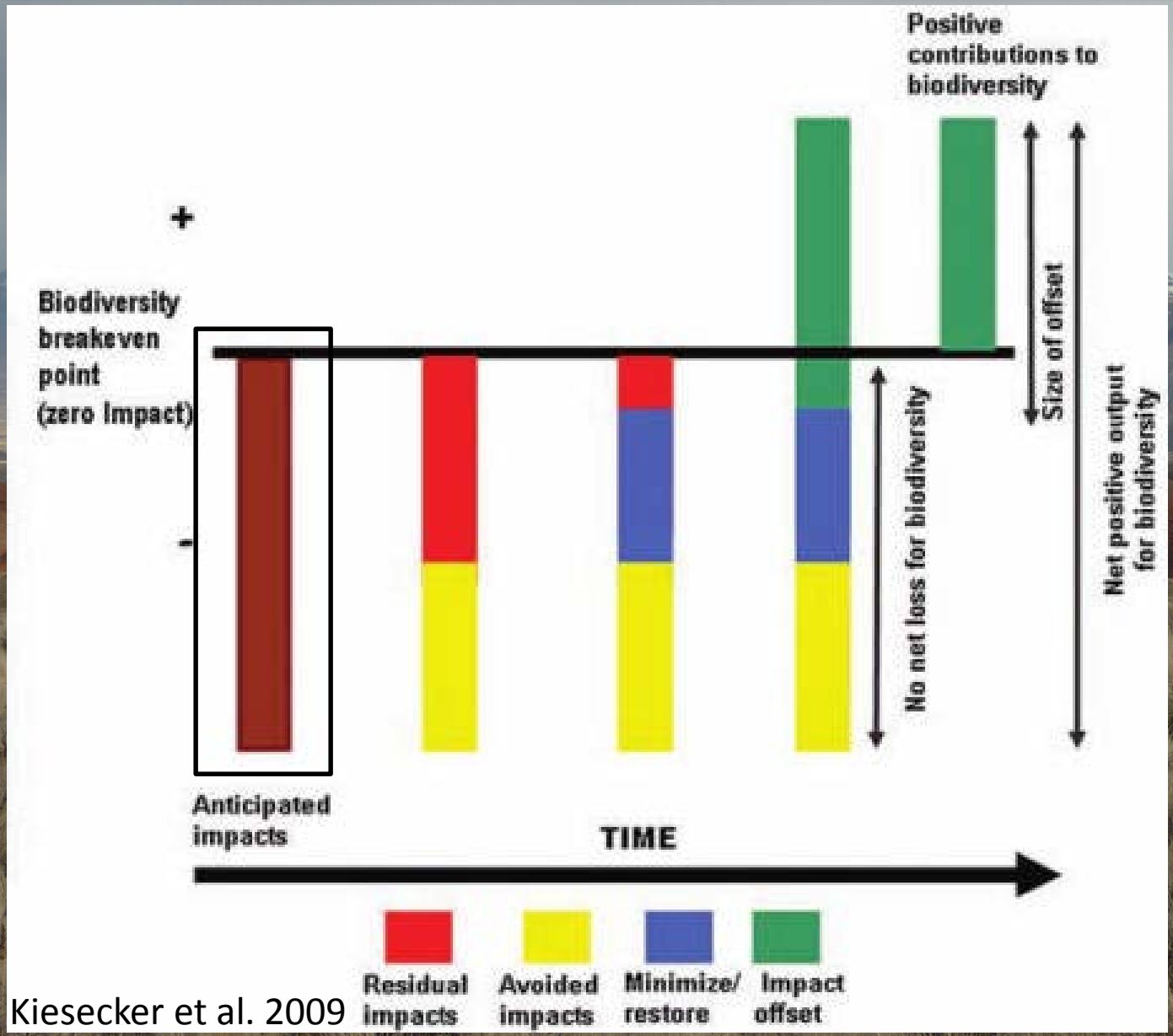


Main objective



Kiesecker et al. 2009

Main objective



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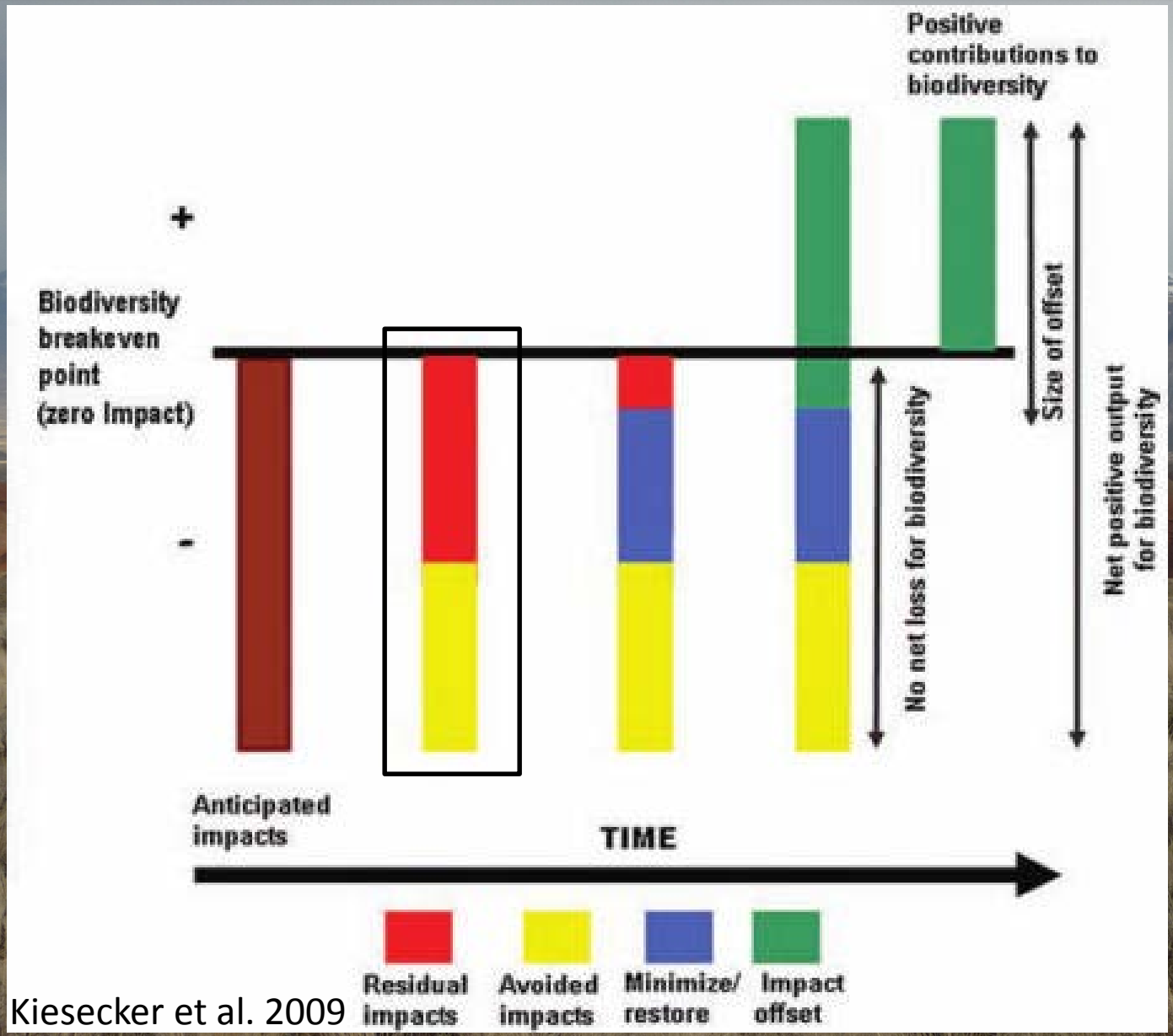
Main objective



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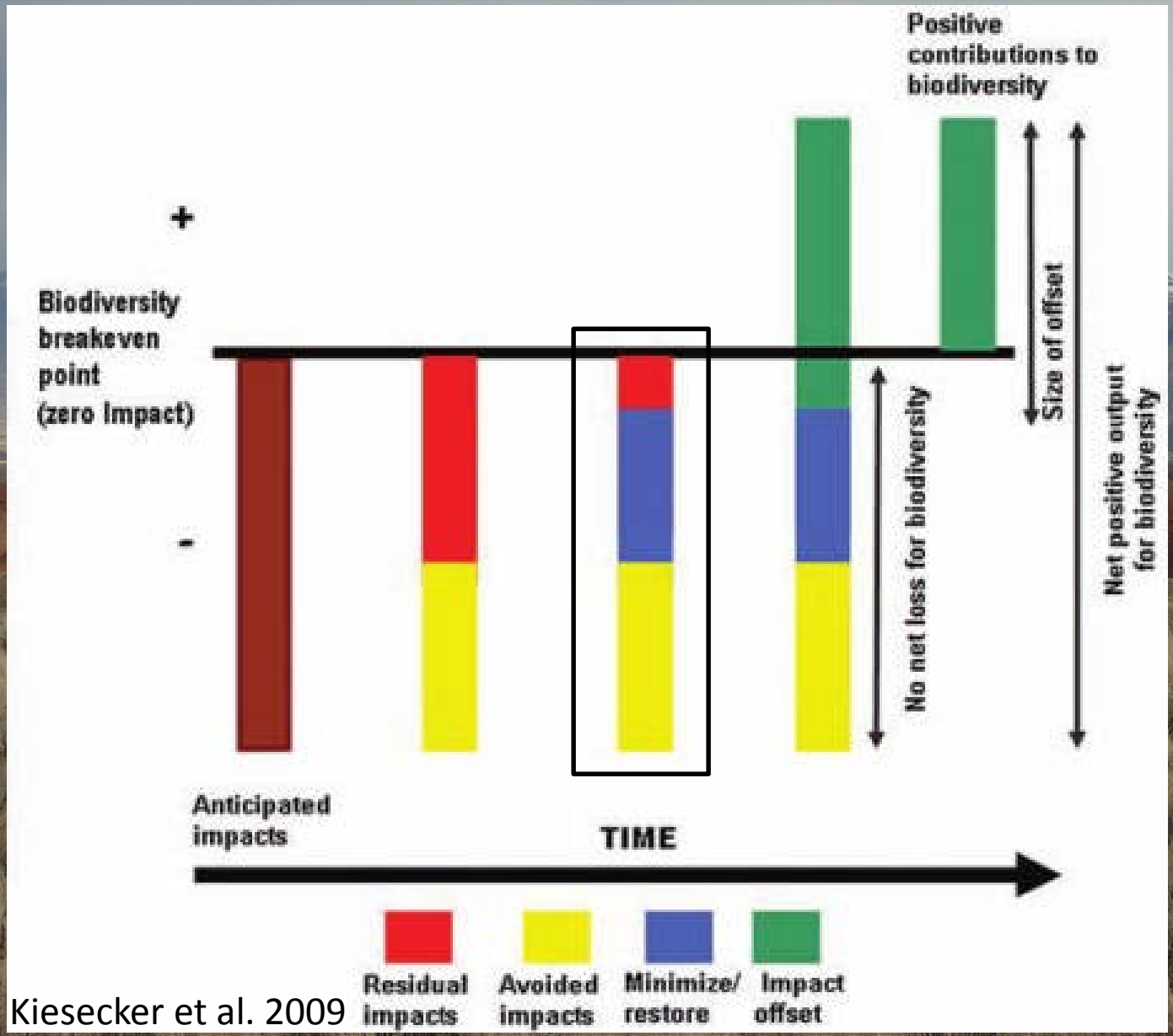

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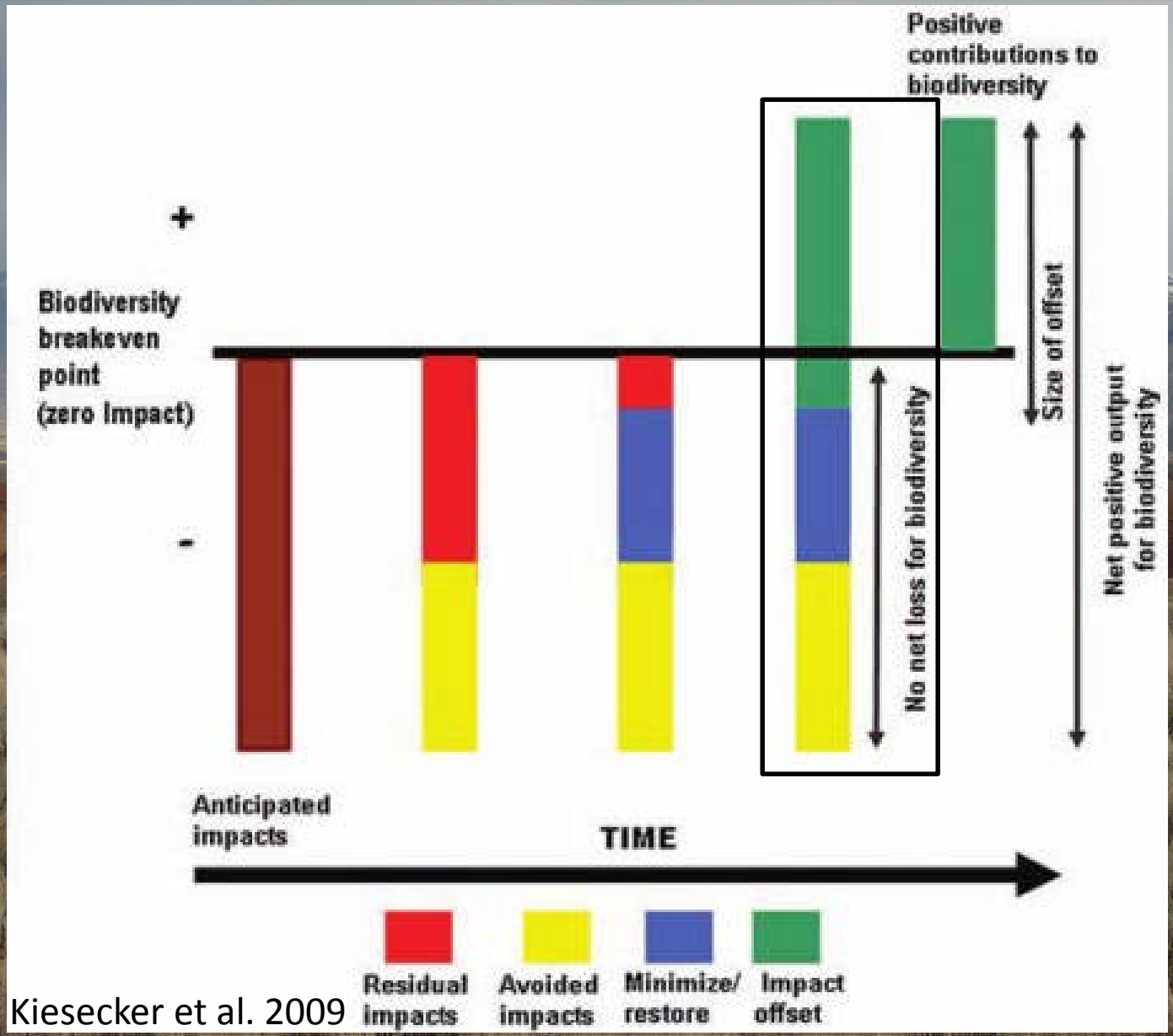
Main objective



Kiesecker et al. 2009

Main objective

To create a tool for managers and developers to prioritize management activities

Objectives

1: To predict probability of occurrence of leks

2: Map connectivity of leks

3: Project future scenarios of land change

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Powder River Basin

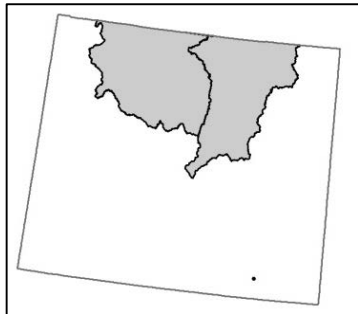
Bighorn Basin

Legend

Leks

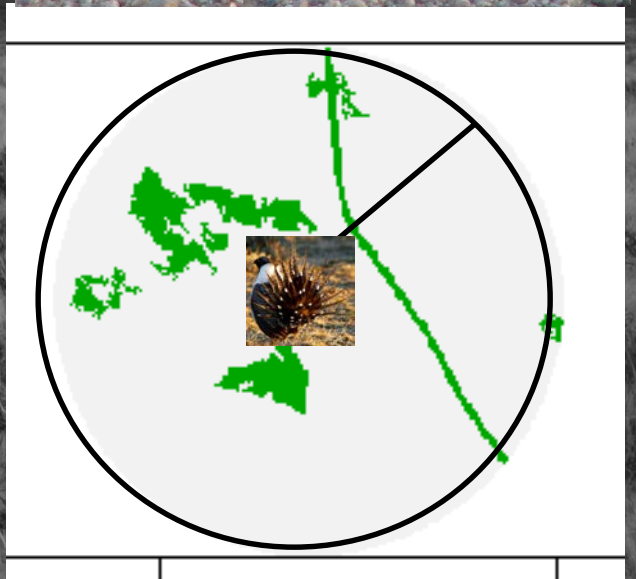
- Absence
- Presence
- Core Areas
- Wells
- Study Area

0 30 60 120 Kilometers



Methods: Spatial Data

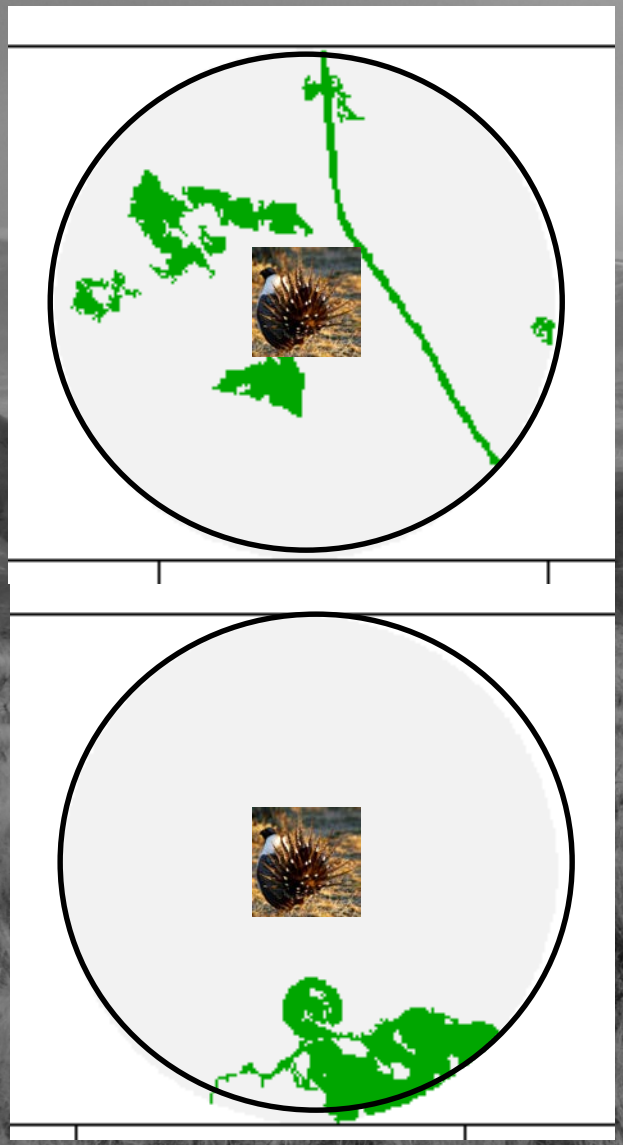
- Lek Presence and Absence
  - 461 leks (WGFD)
  - 80 absences
- Development (Kiesecker et al. 2012)
- Sagebrush (NLCD)
- Growing Season Precip. (Rehfeldt et al. 2006)
- Mean Annual Precip. (Rehfeldt et al. 2006)
- Well locations (WOGCC & MBOG)
- Compound topographic index (Moore 1993)
- Elevation relief ratio (topography) (Evans 1972)

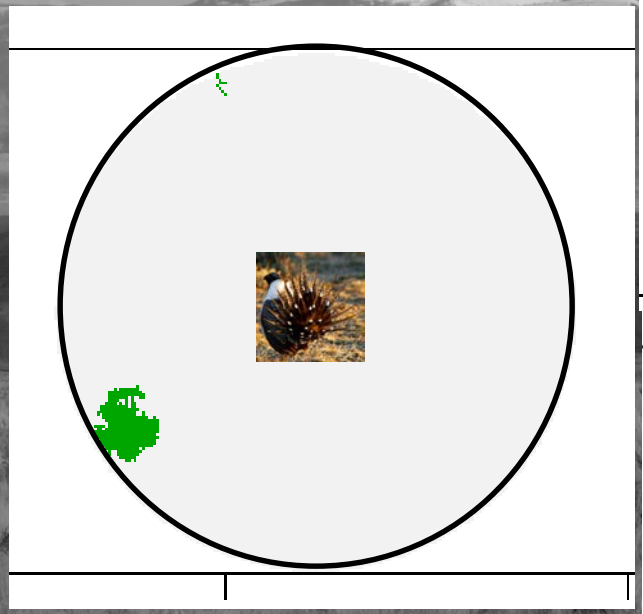


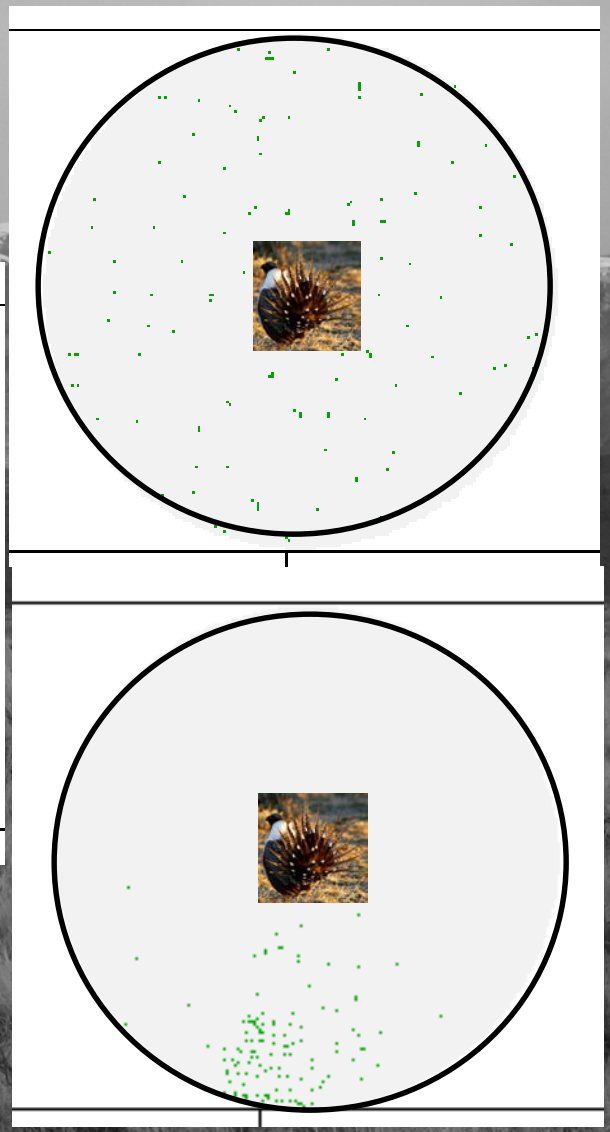
Methods: Landscape Metrics

Percent Landscape

Edge Density







Percent of Like Adjacencies

Aggregation Index

Random Forest

(Breiman 2001; Liaw & Wiener 2002)

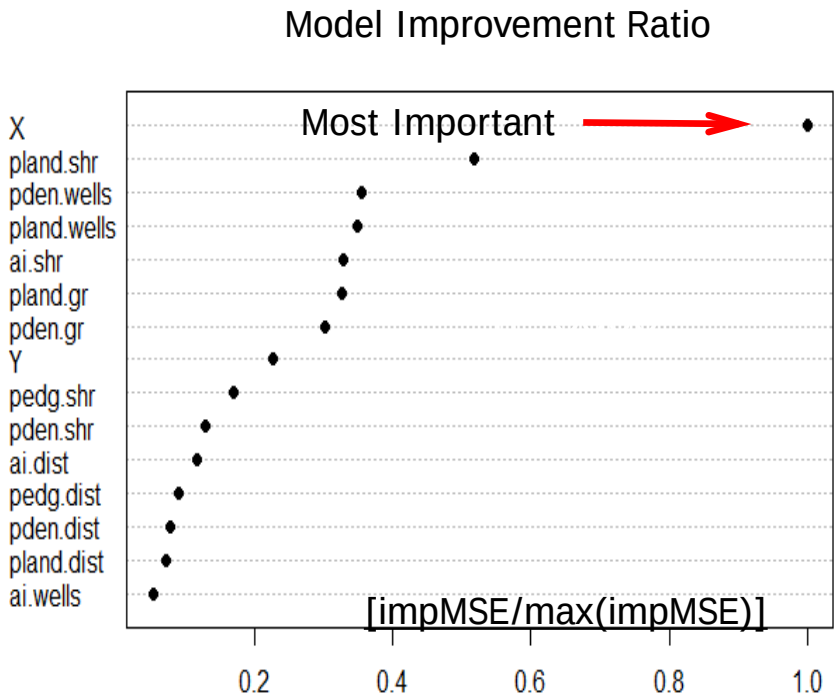
33% Out of Bag (OOB)

Iterate variables

Predict to OOB sample

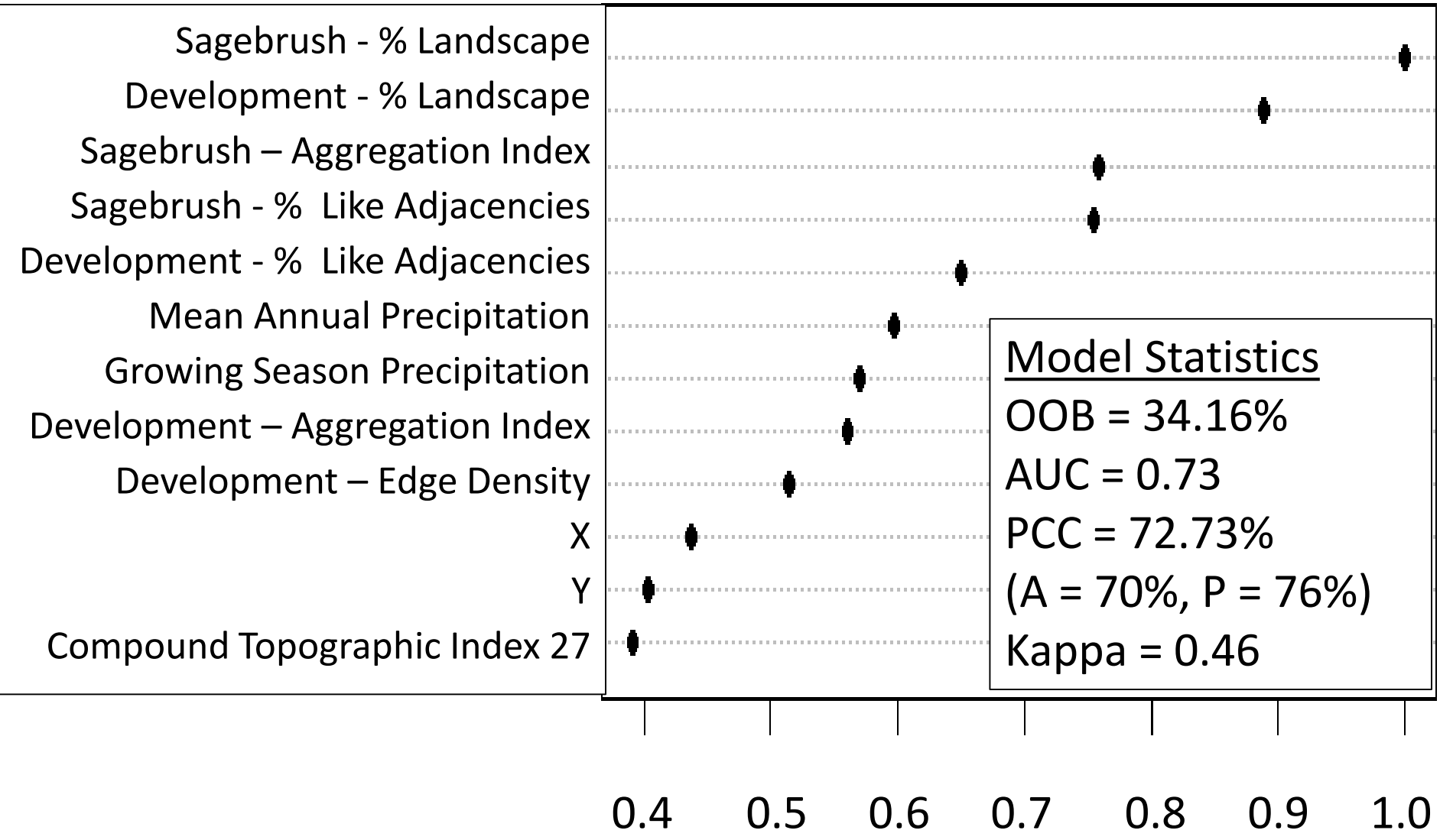
n=7000

OOB classification error
Variable Importance



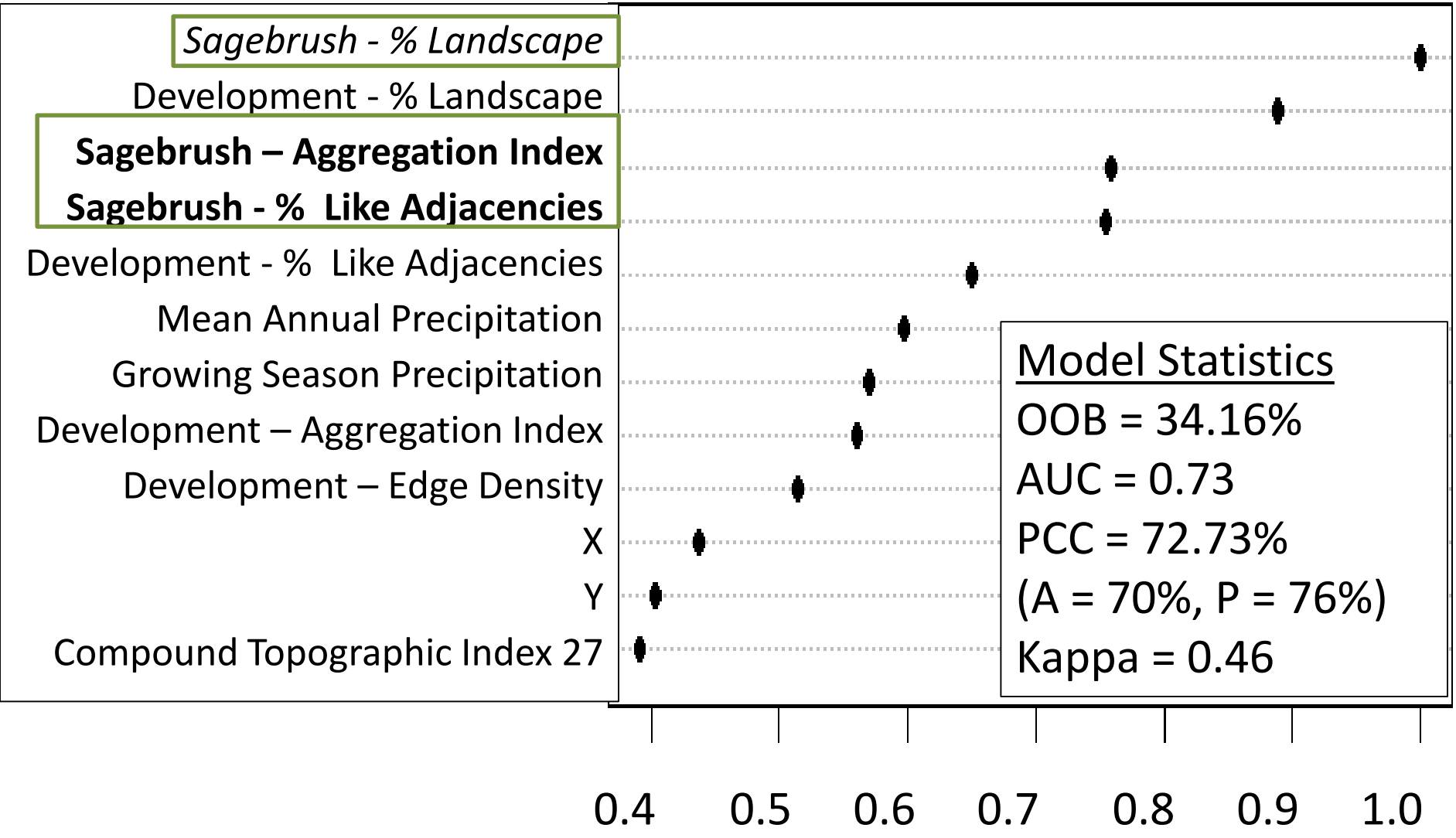
Removed multivariate redundant variables, balanced sample

Model Improvement Ratio



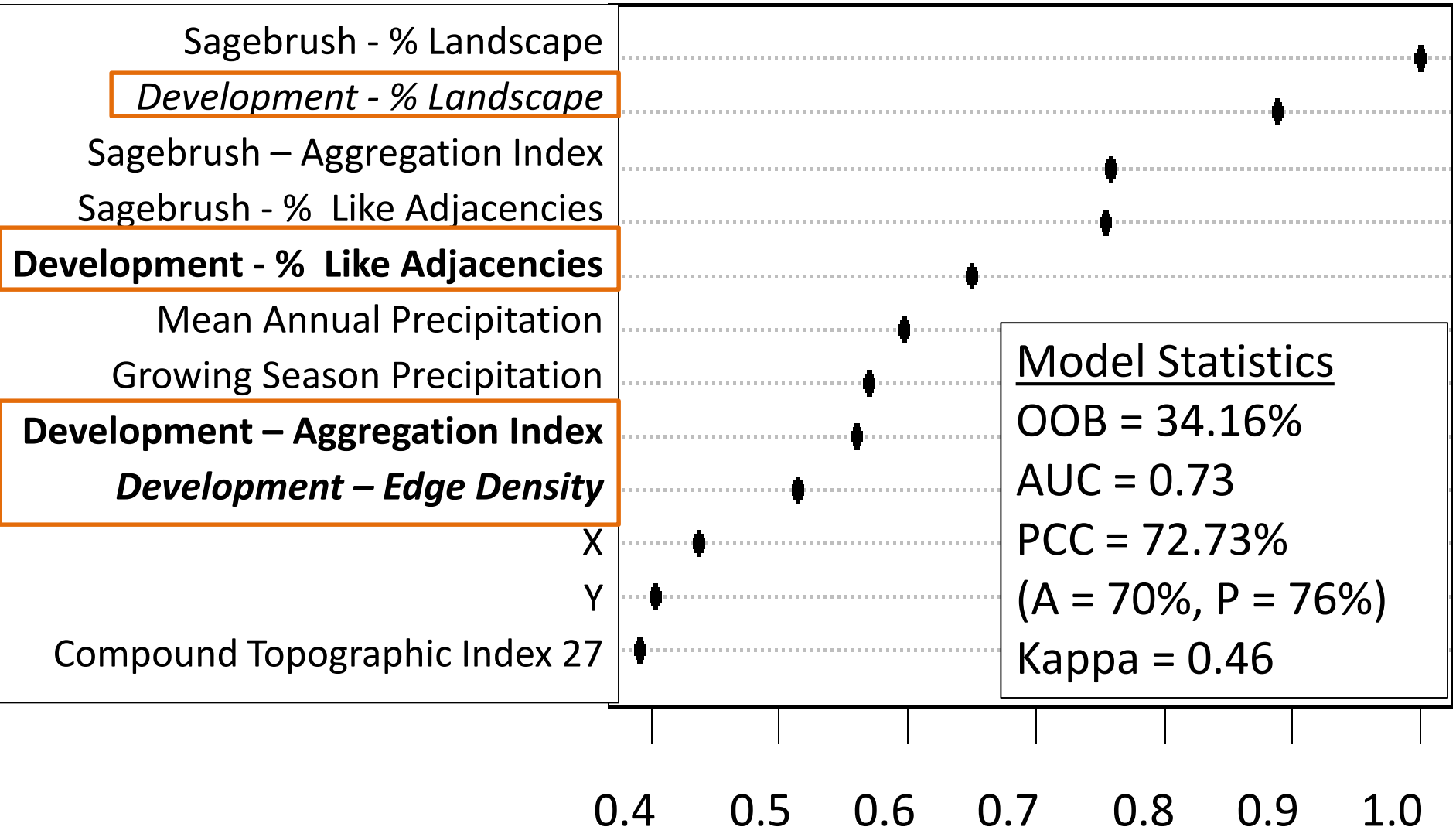
Model Improvement Ratio

habitat variables



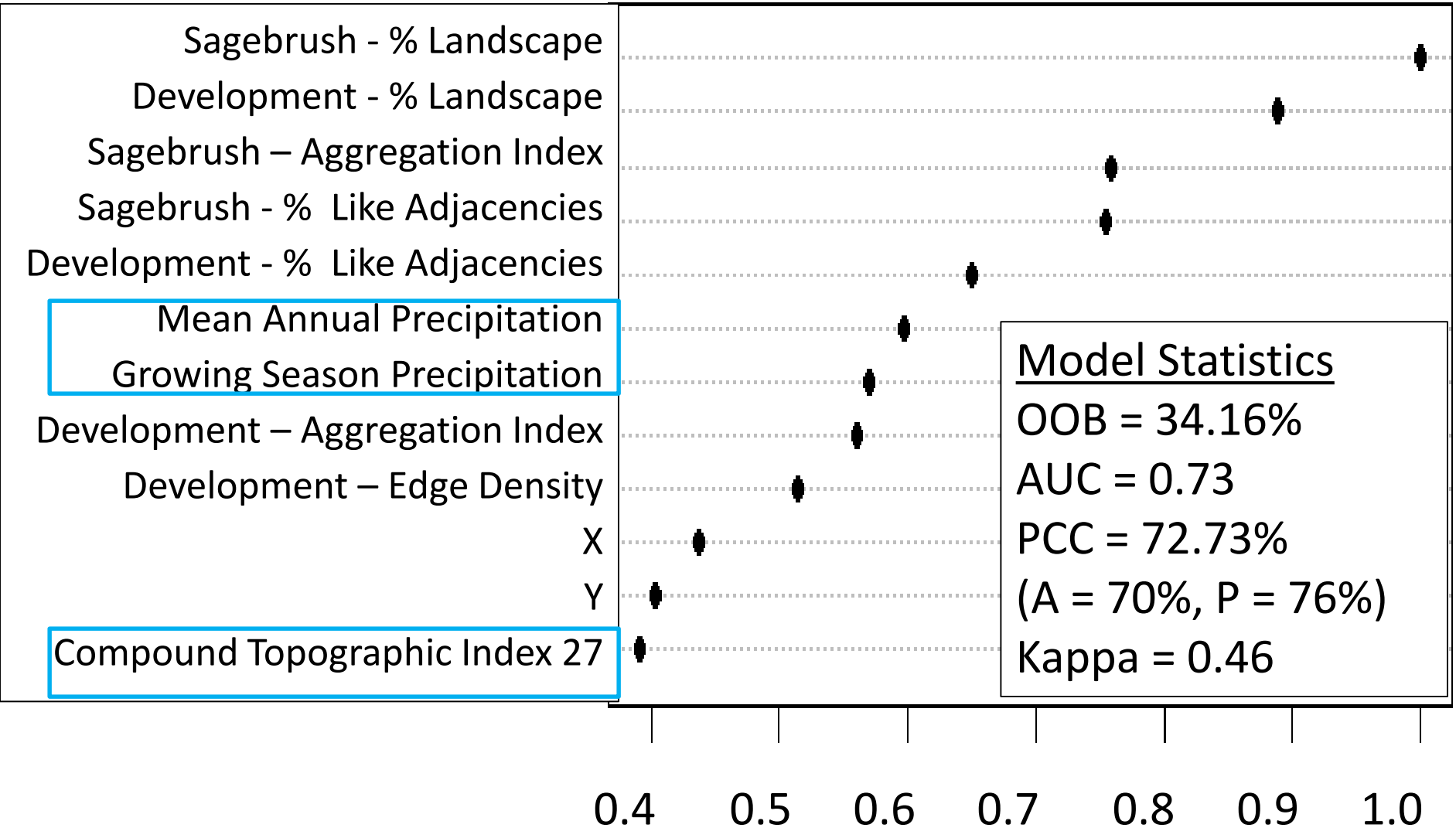
Model Improvement Ratio

Development variables



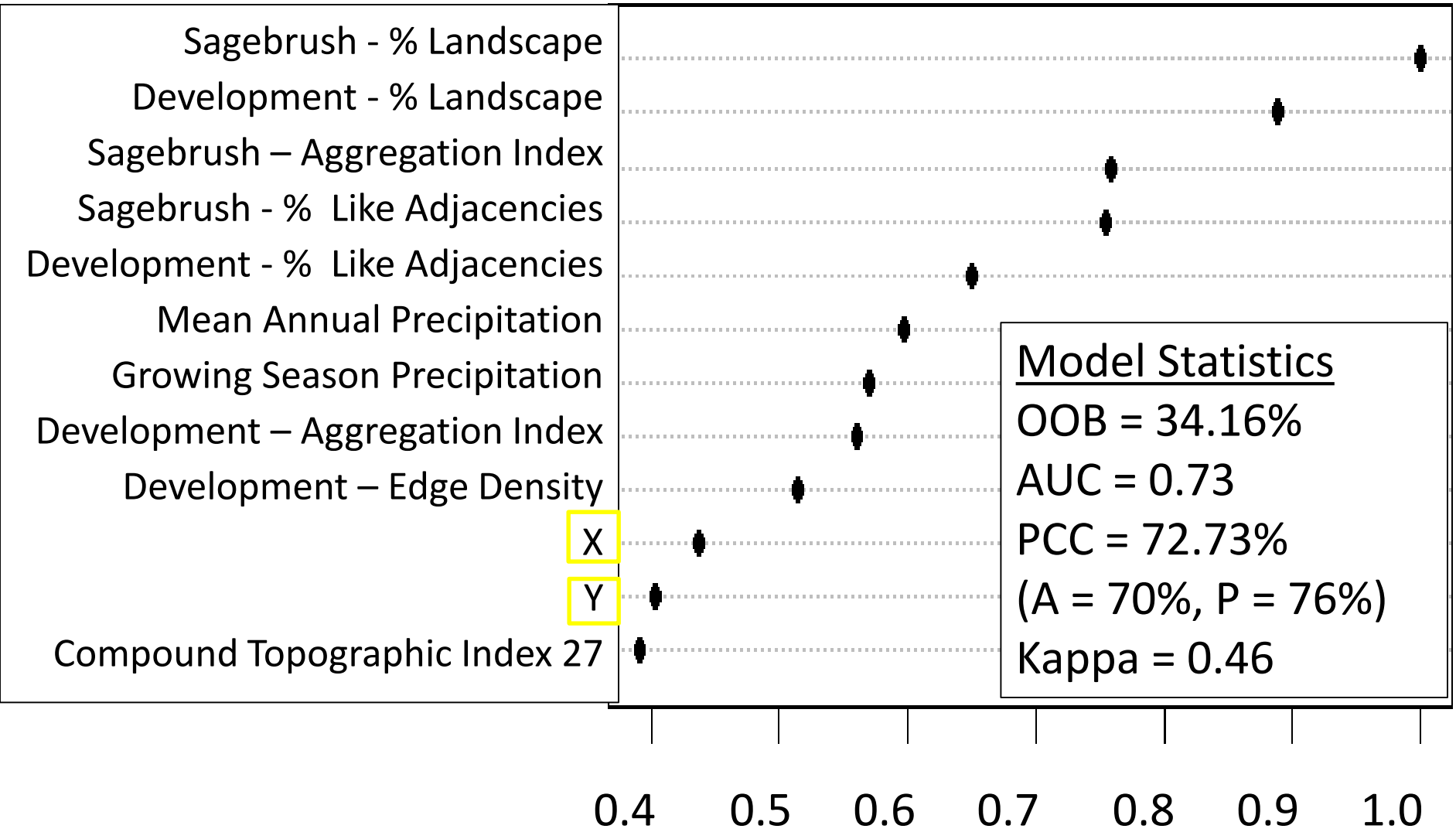
Model Improvement Ratio

moisture variables

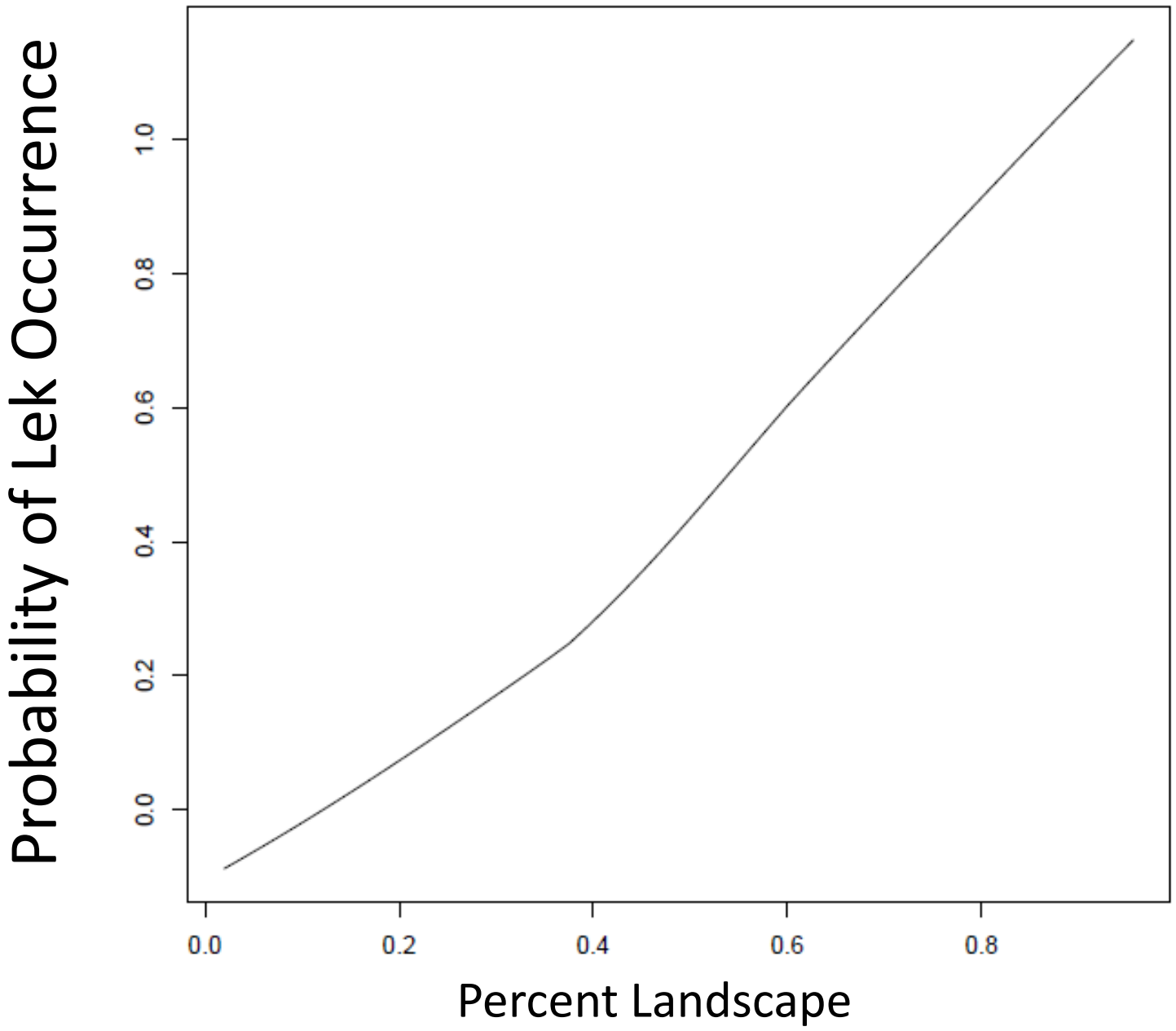


Model Improvement Ratio

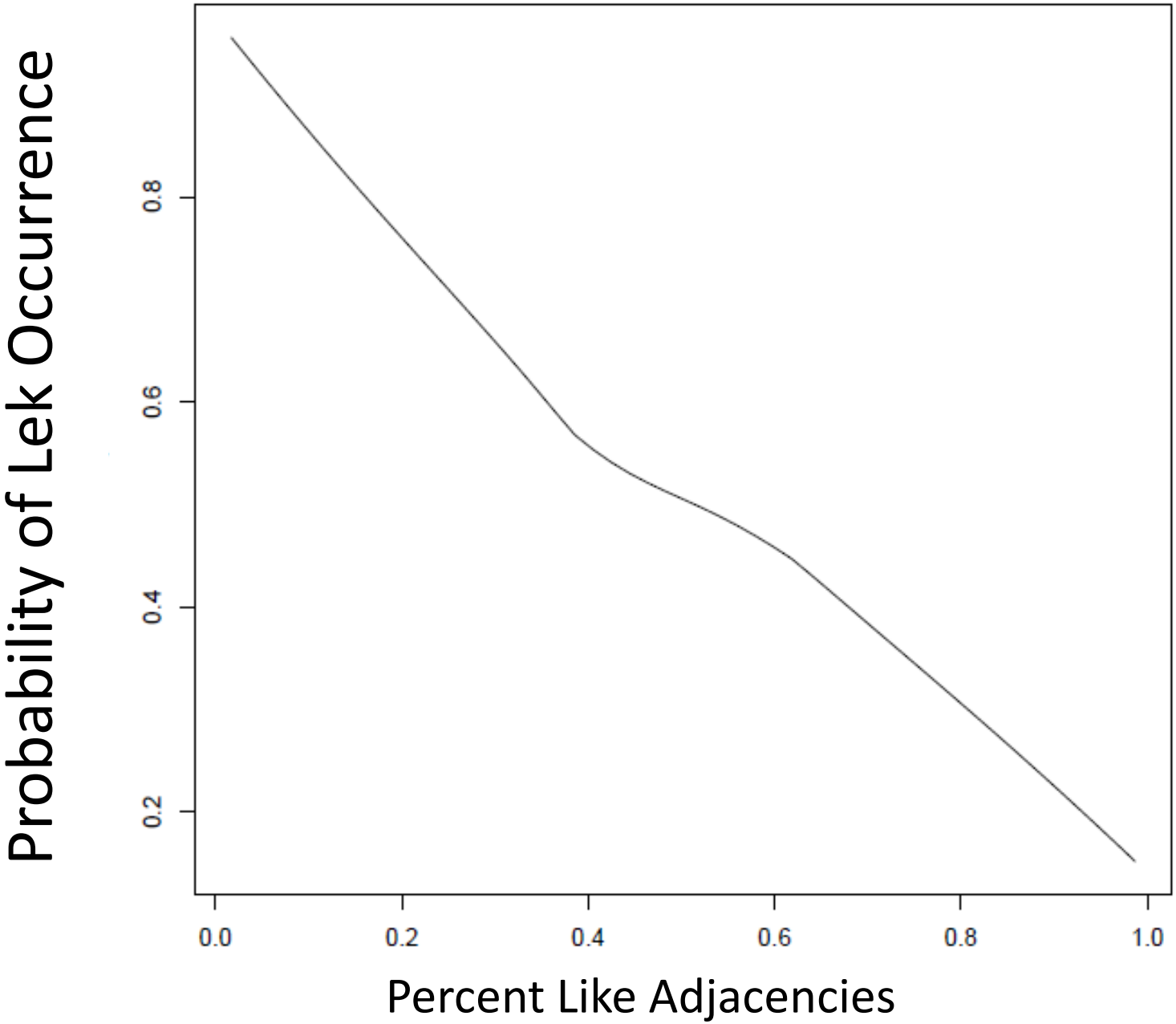
space variables



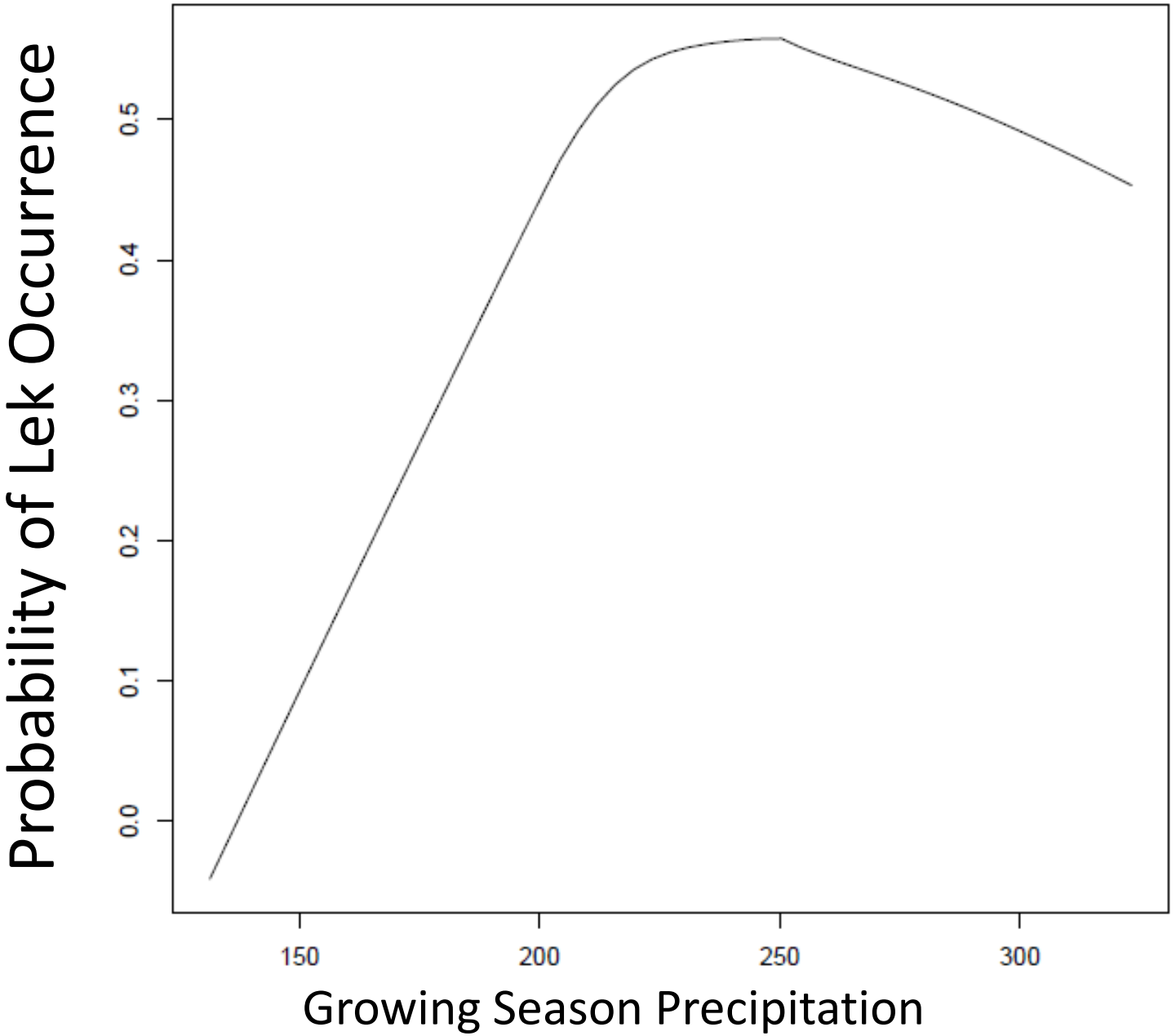
Percent Landscape - Sagebrush

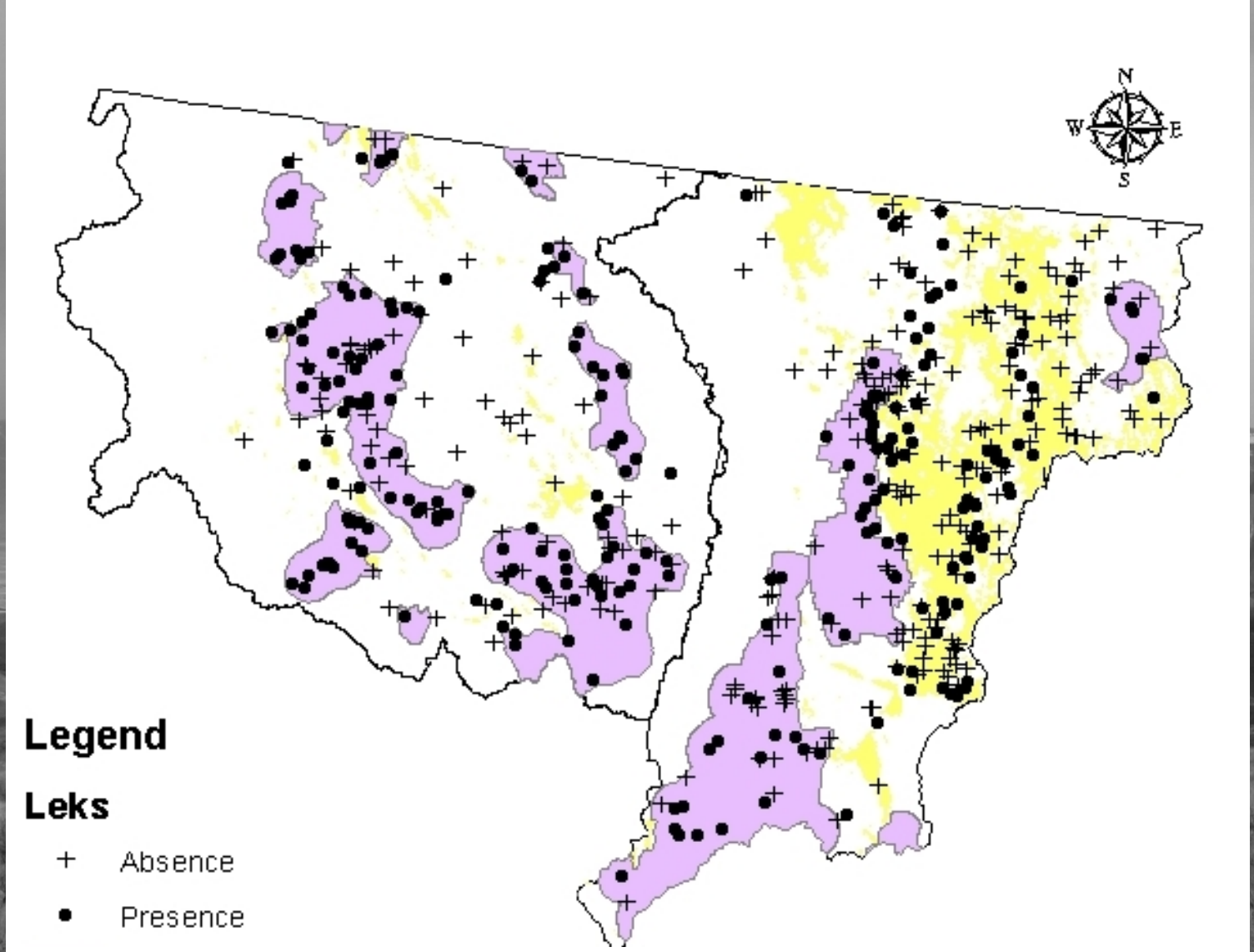


Percent Like Adjacencies - Development



Growing Season Precipitation





Bighorn Basin: 135/191 leks with birds (70.7%)

Powder River Basin: 128/295 leks with birds (43.4%)

Objectives

1: To predict probability of occurrence of leks

2: Map connectivity of leks

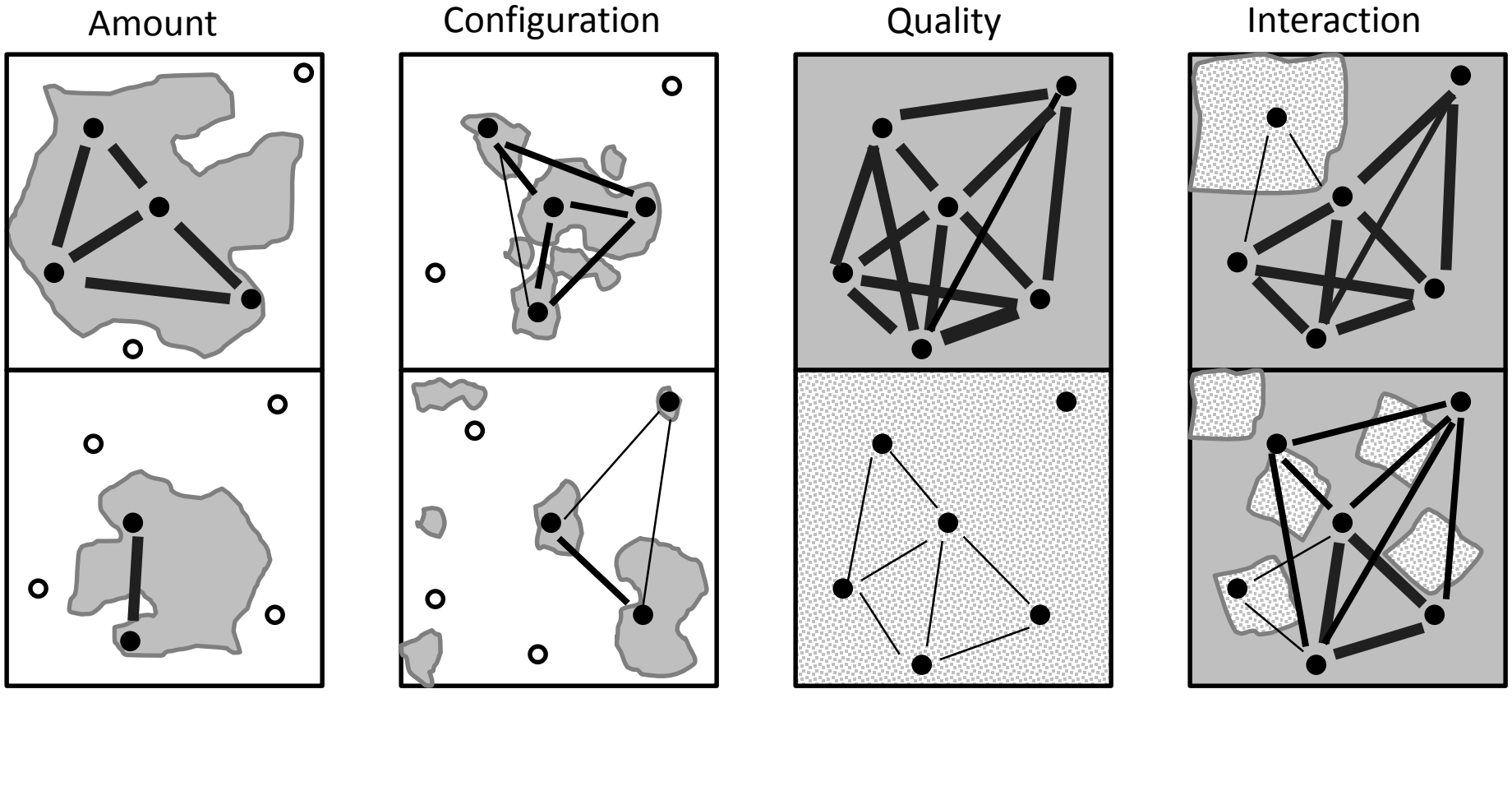
3: Project future scenarios of land change

DNA Extraction

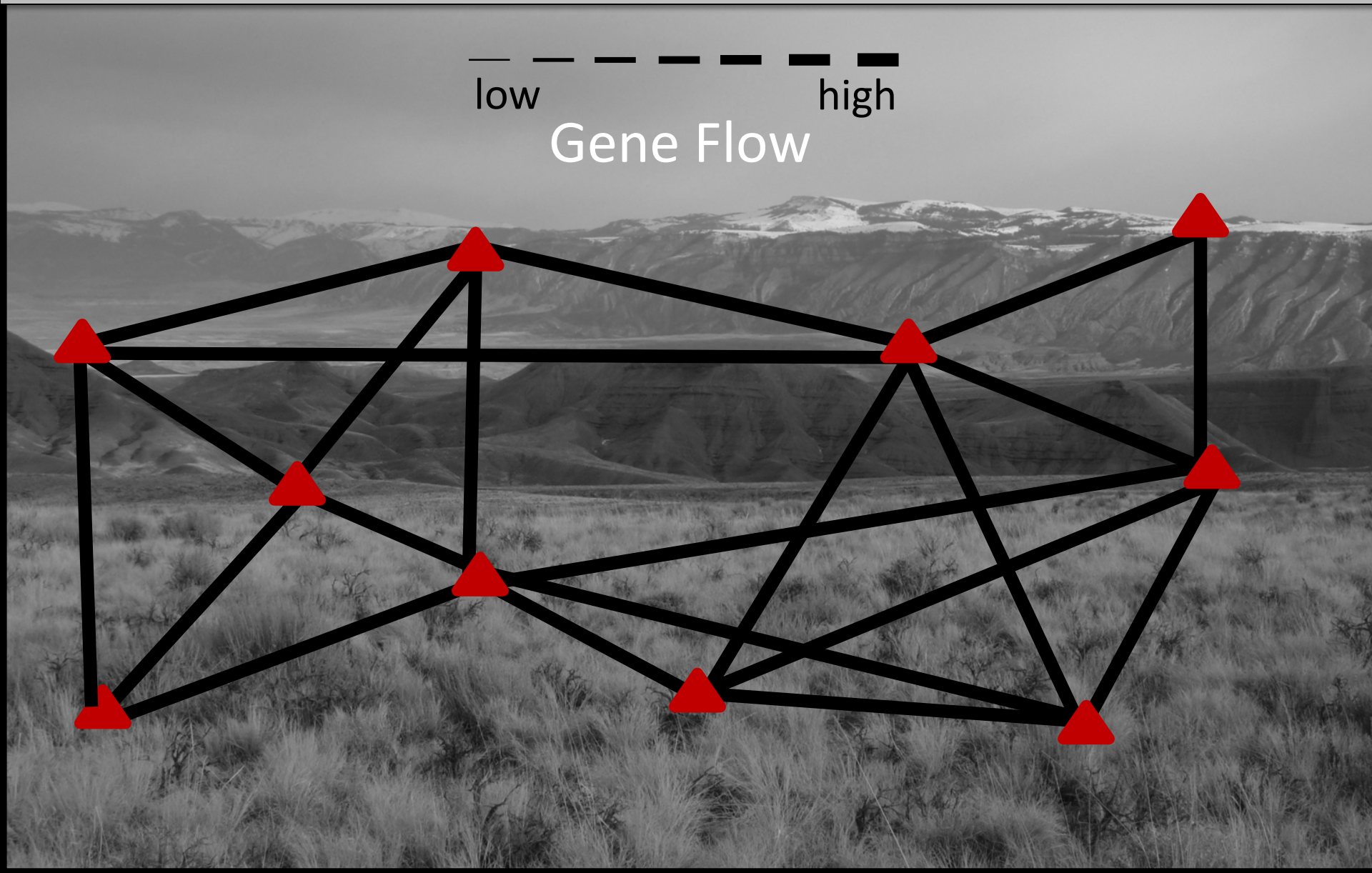
In 2012:
Samples from 82 leks
(*PRB = 33; BHB = 49*)
Extracted DNA > 1200 samples

Goal: 300 leks, 3000 samples

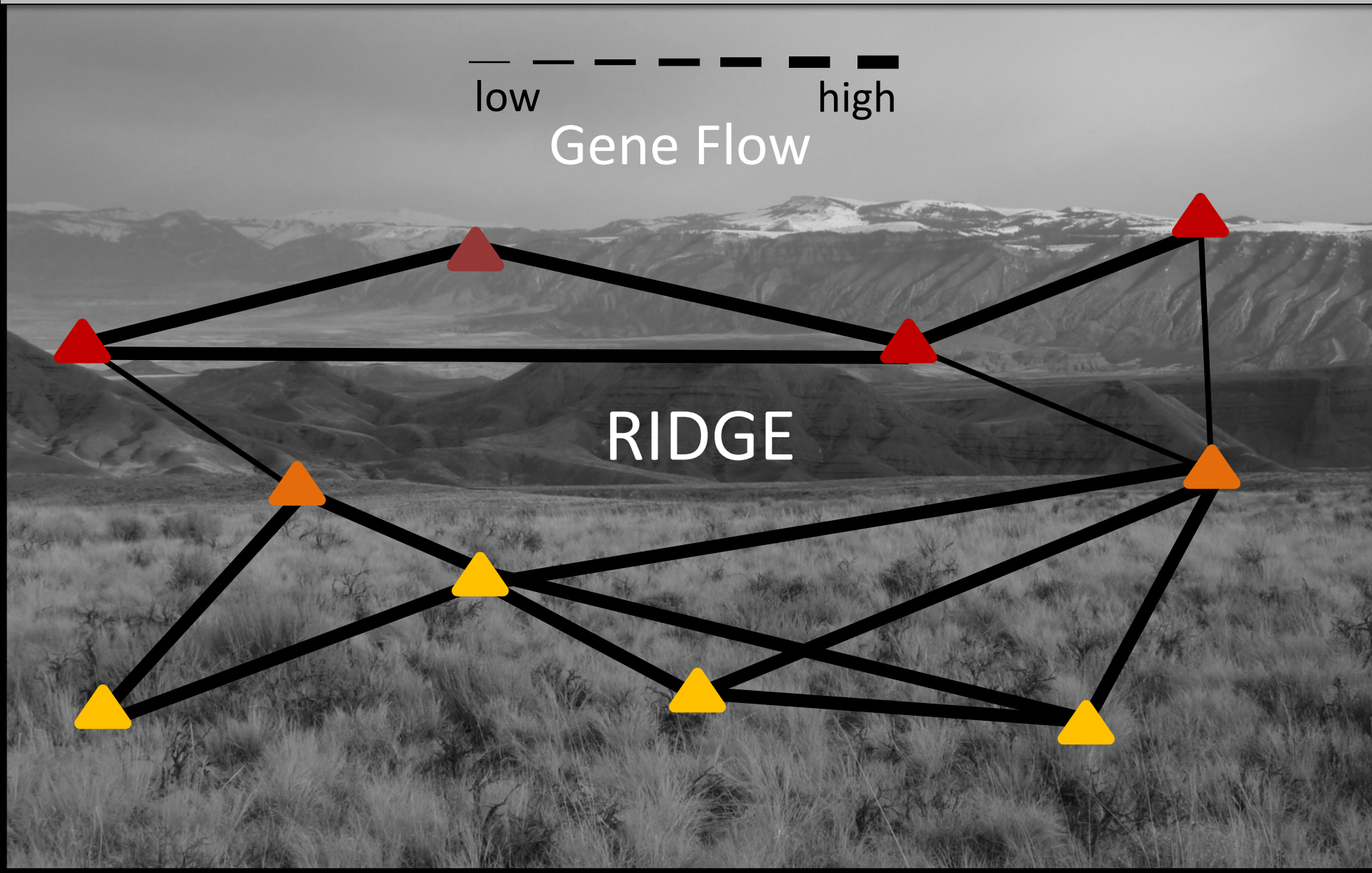
Functional Connectivity Hypotheses



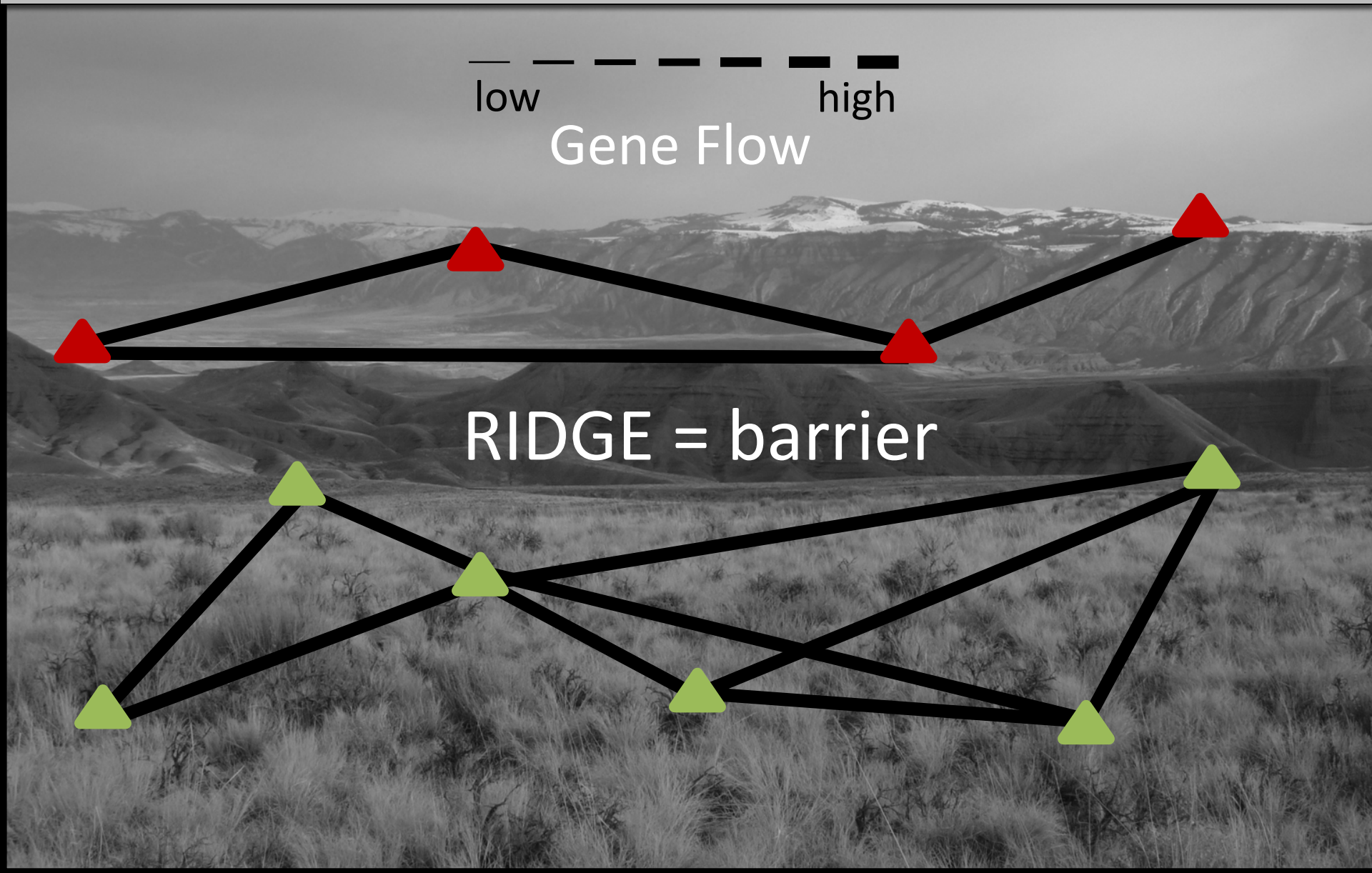
Methods



Methods



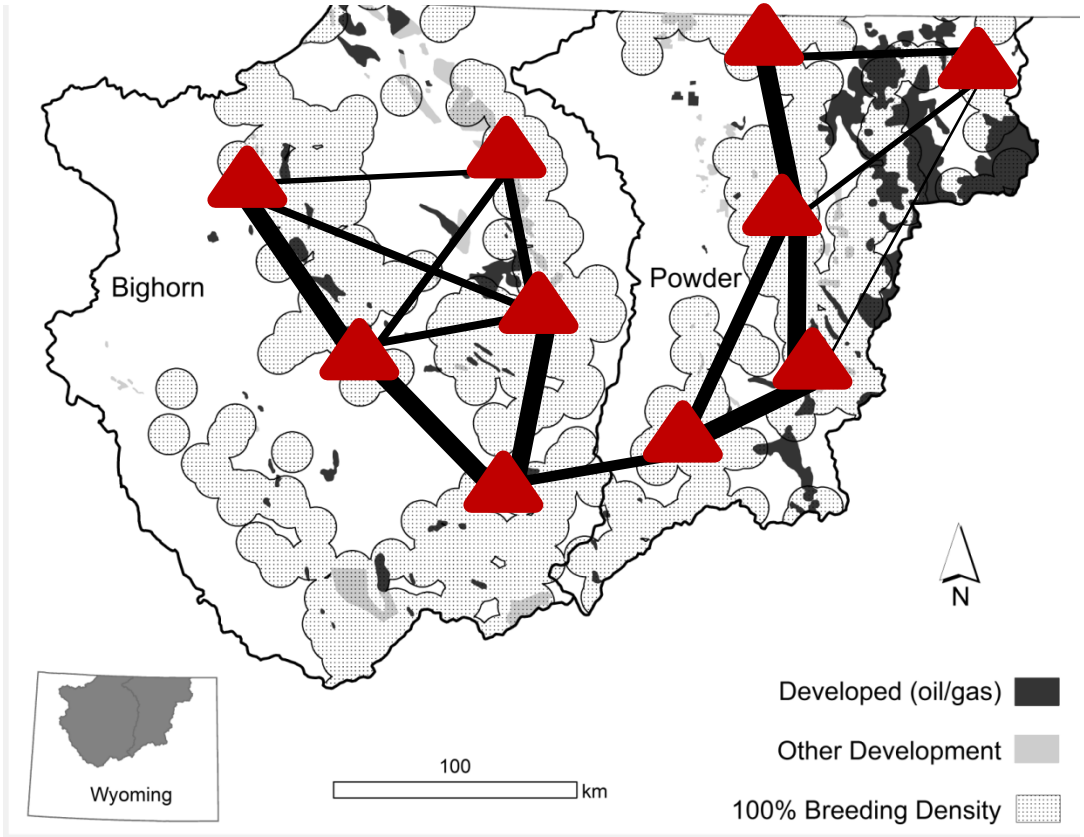
Methods



Methods

Presence = ▲

low — high
Gene Flow



Development
Noise
Ridges
Rivers
Fragmentation
Distance

Objectives

1: To predict probability of occurrence of leks

2: Map connectivity of leks

3: Project future scenarios of land change

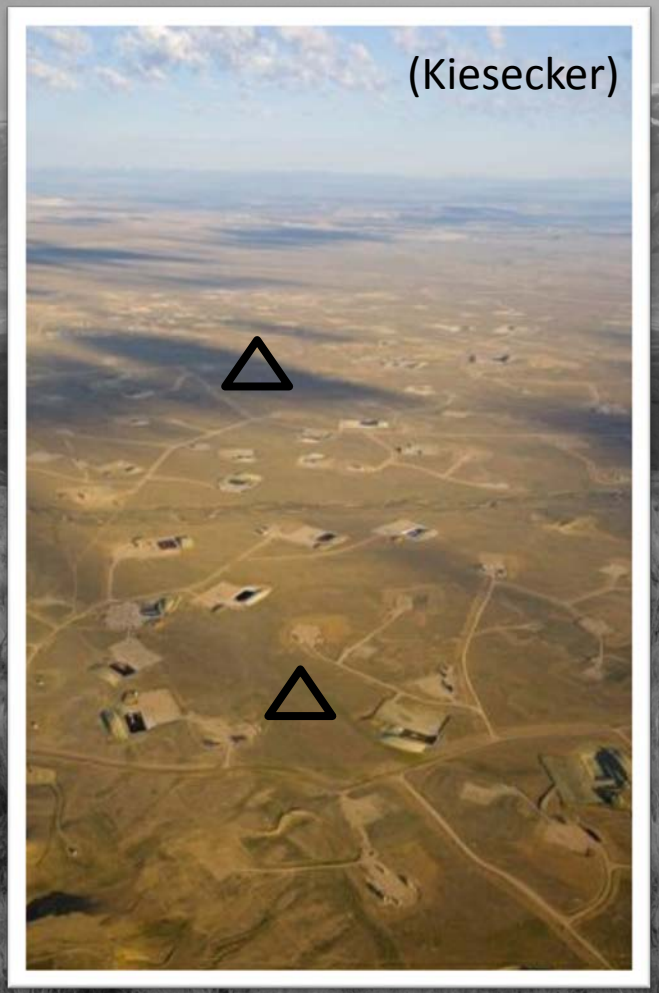
Research Impact

Presence =

Absence =

low — high

Gene Flow



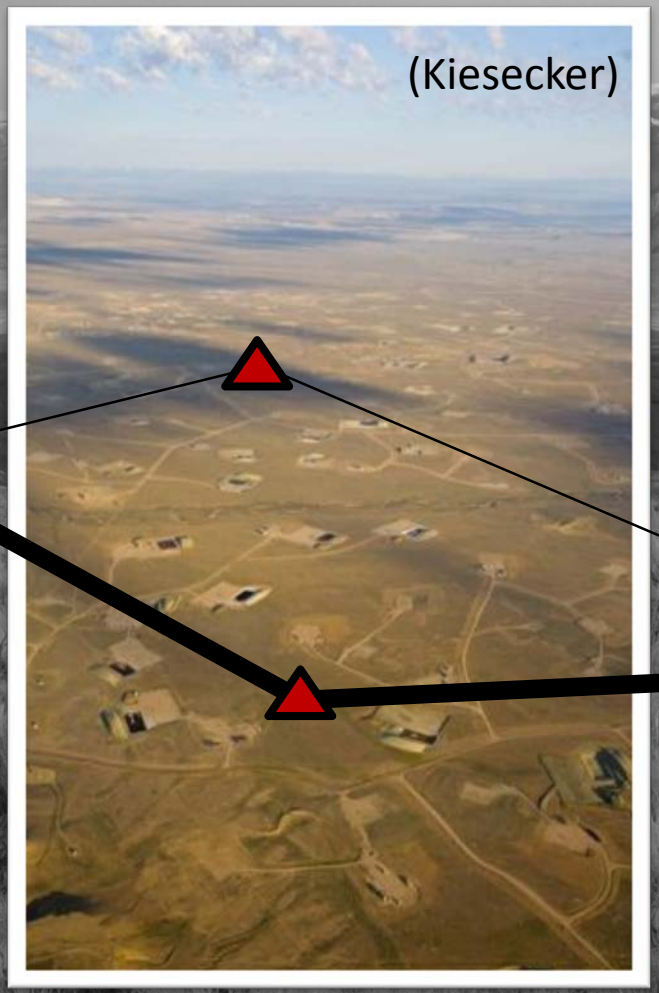
Research Impact

Presence =

Absence =

low — high

Gene Flow



Products

Objective 1: Map probability of lek occurrence

Objective 2: Define characteristics that impact gene flow

Objective 3: Predict lek occurrence and connectivity under different restoration and development scenarios

PROJECT OBJECTIVE: Map areas of importance for protection, restoration, and development

Questions?

Funding: Northeast Wyoming Sage-grouse Working Group, Margaret and Sam Kelly Ornithology Research Fund, Society for Integrative and Comparative Biology GIAR, Sigma Xi GIAR

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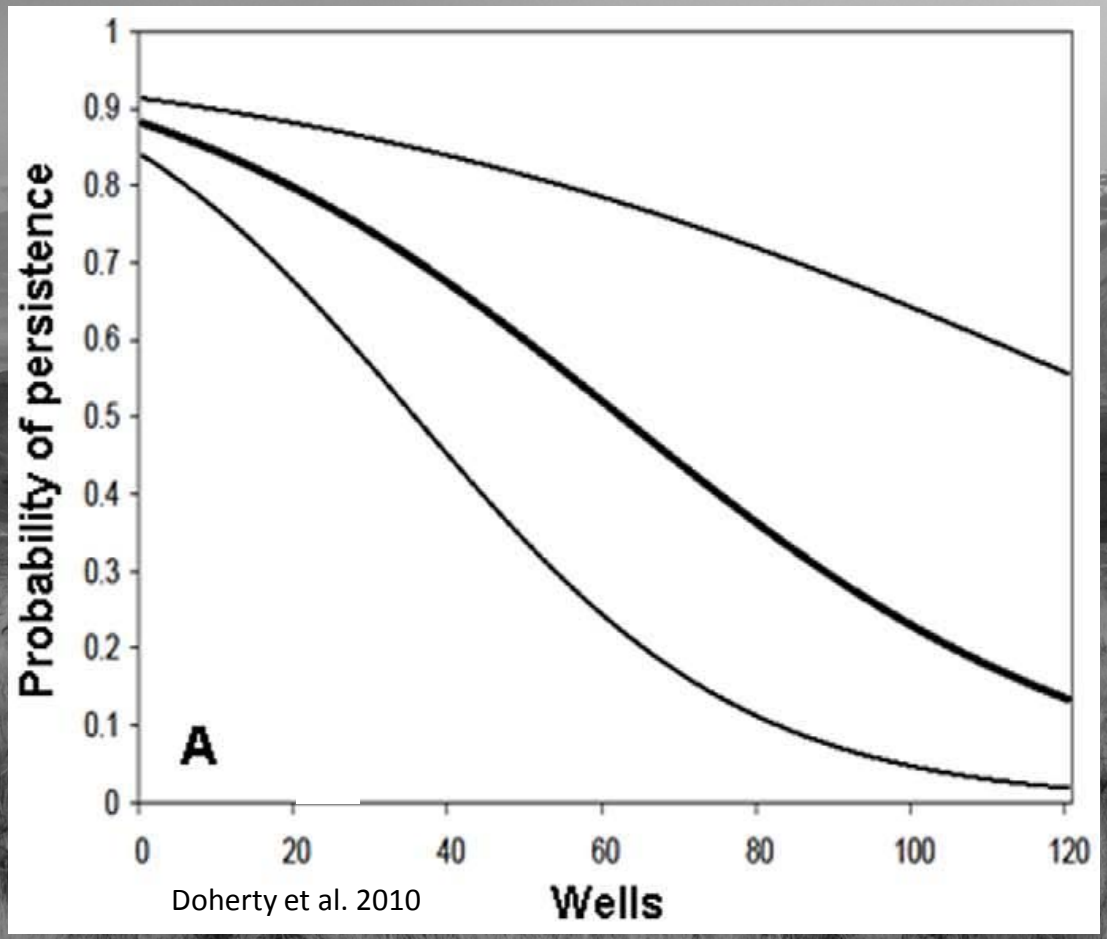
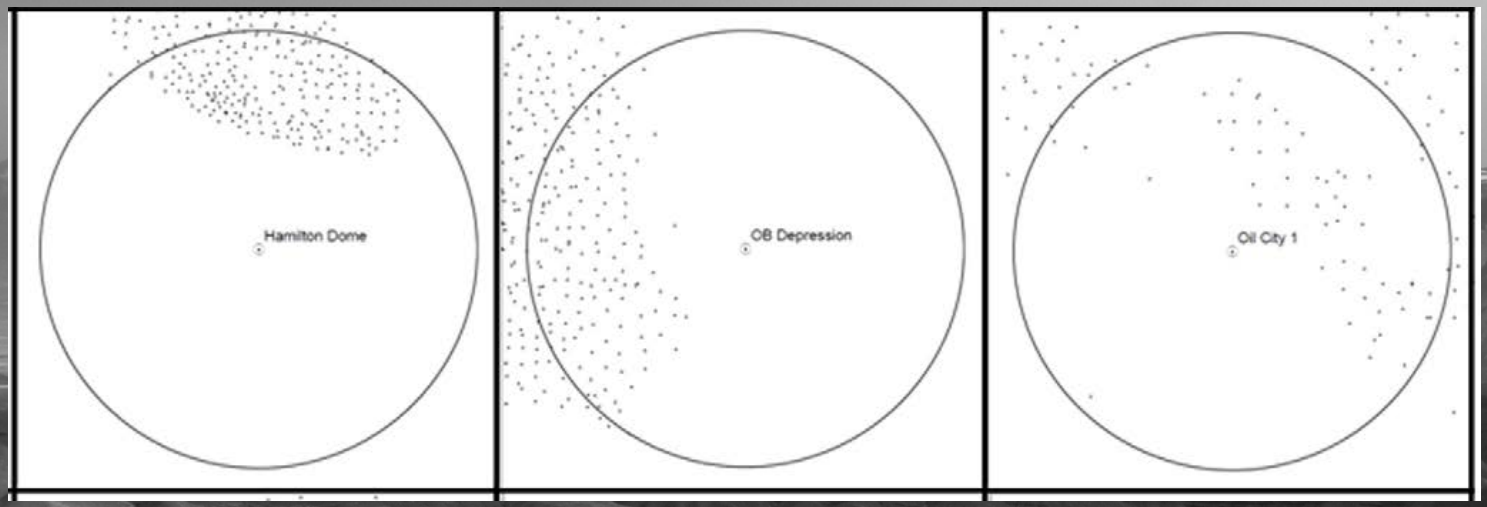
Can Sage-Grouse Persist With Oil and Gas Development?



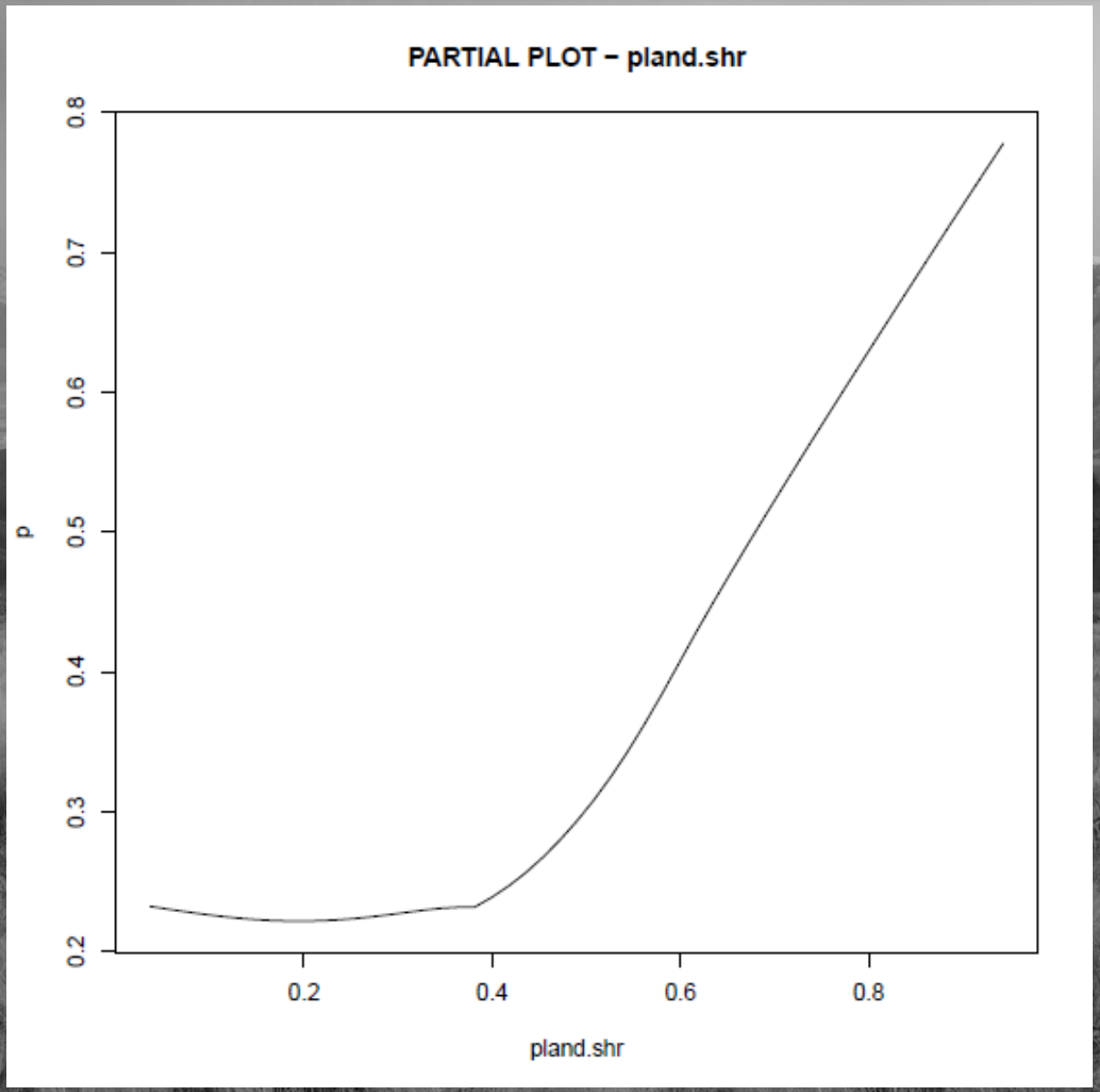
Doherty et al. 2010

Can Sage-Grouse Persist With Oil and Gas Development?

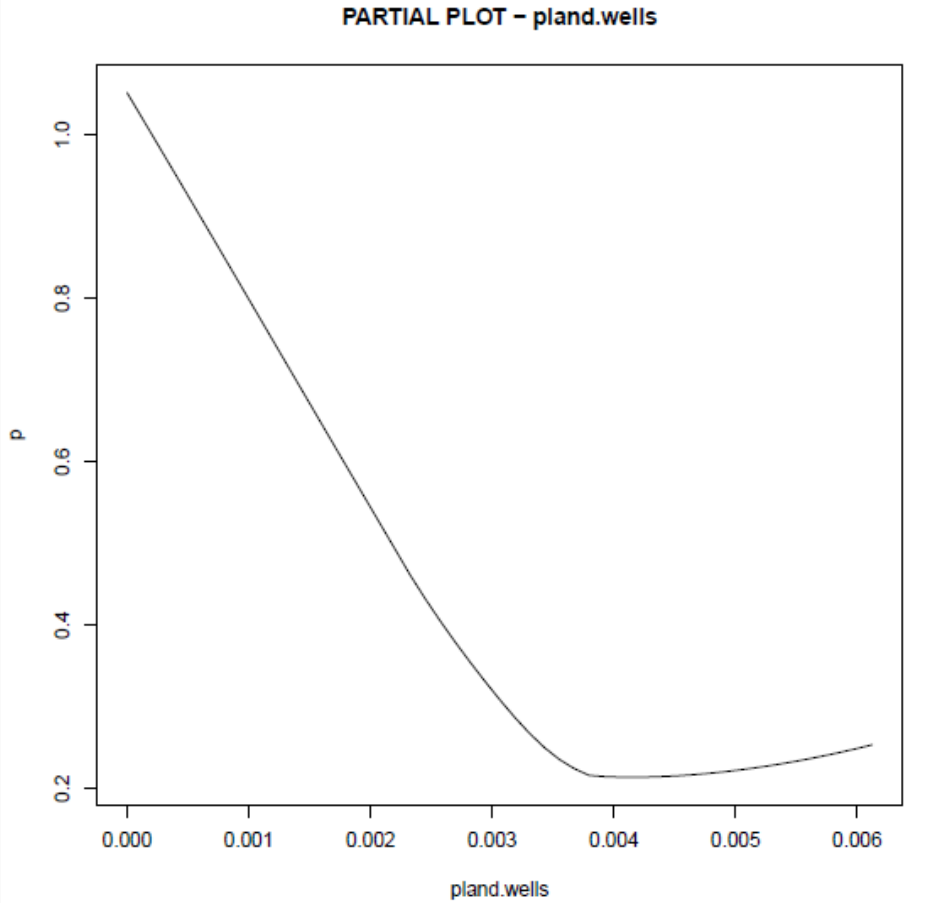
Doherty et al. 2010

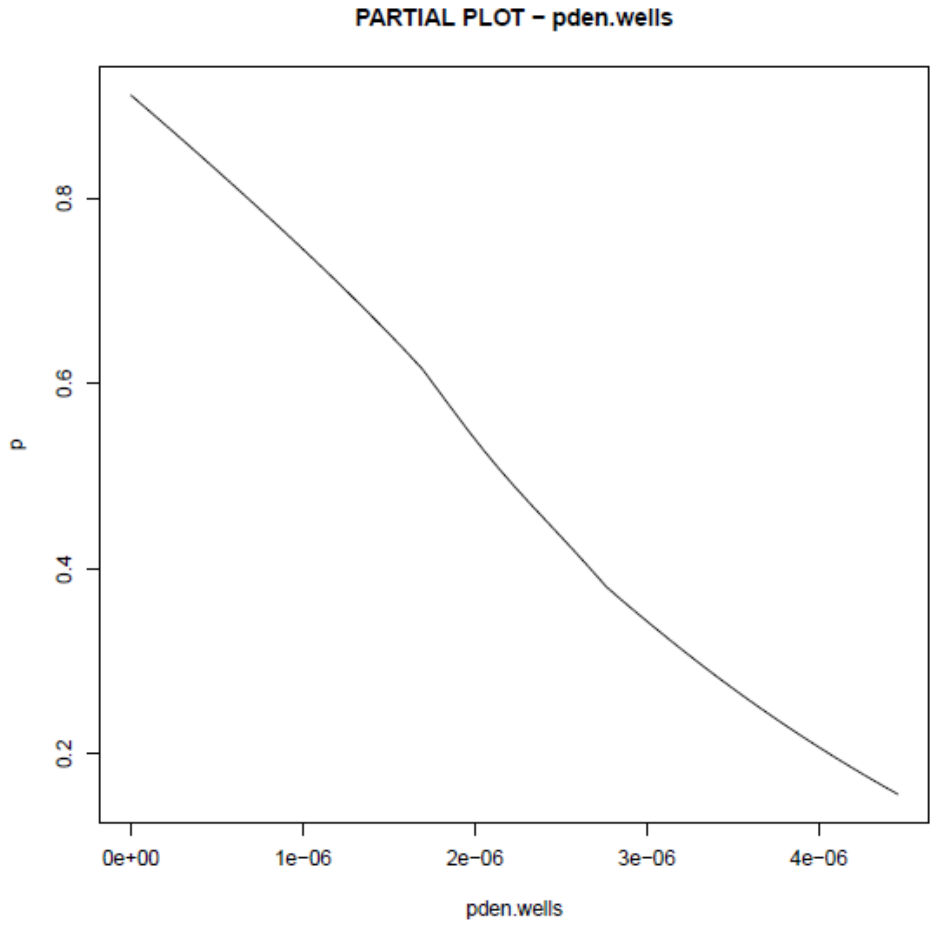


Results


PARTIAL PLOT – pland.shr
p
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.2
0.4
0.6
0.8
pland.shr

Results


PARTIAL PLOT – pland.wells
p
1.0
0.8
0.6
0.4
0.2
0.000
0.001
0.002
0.003
0.004
0.005
0.006
pland.wells


PARTIAL PLOT – pden.wells
p
0.8
0.6
0.4
0.2
0e+00
1e−06
2e−06
3e−06
4e−06
pden.wells

Microsatellites

- Microsatellites

- How many alleles at a locus?

Heterozygosity:

Individual - proportion of loci with two different alleles

Population - Proportion of genotypes in the entire population that are heterozygous.

Genetic Diversity Measures

Individual

Aa

BB

cc

Dd

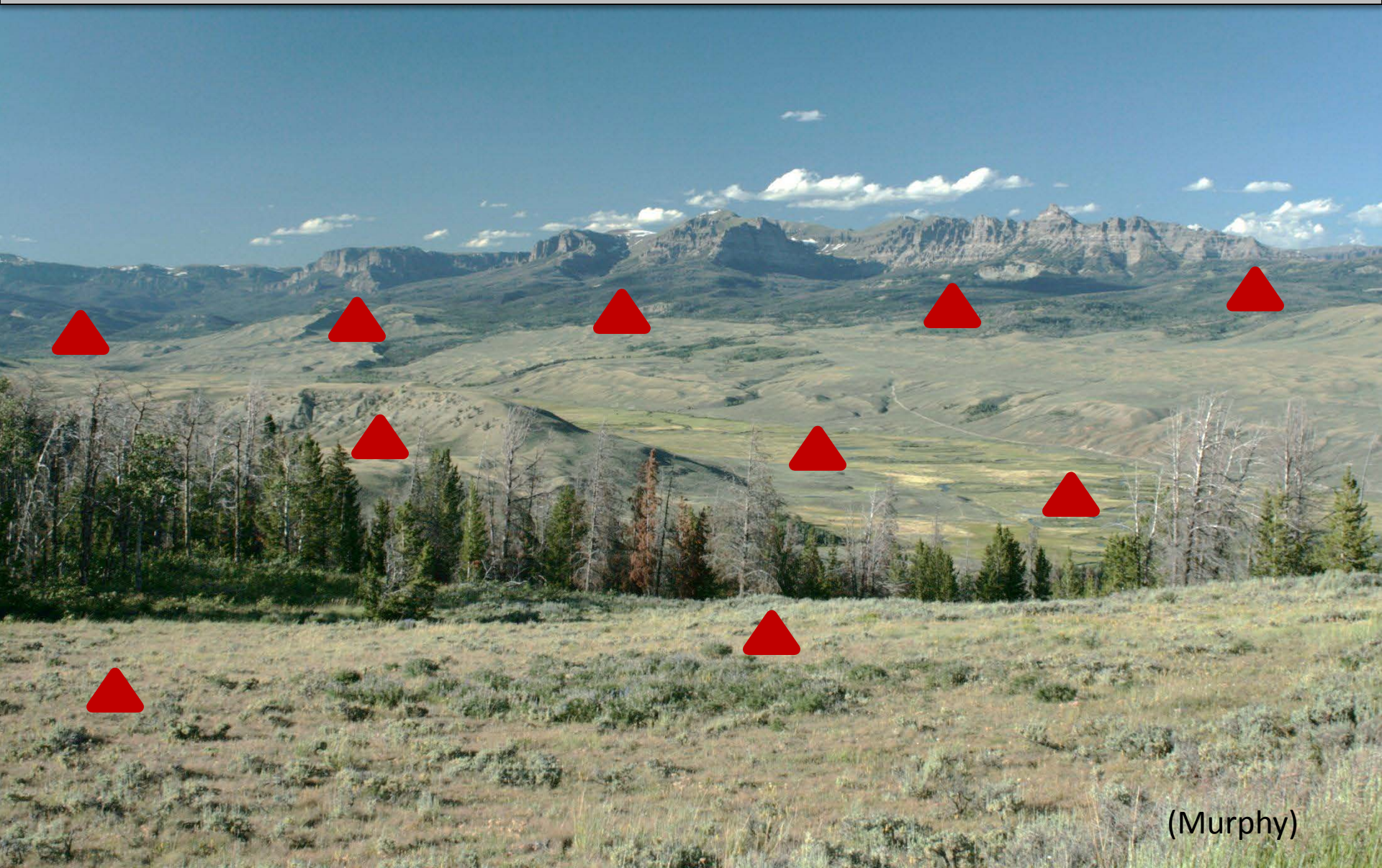
Heterozygosity: 0.50

Population

Aa
AA
aa
Aa
AA
aa
Aa
Aa
Aa
Aa
AA
aa
AA

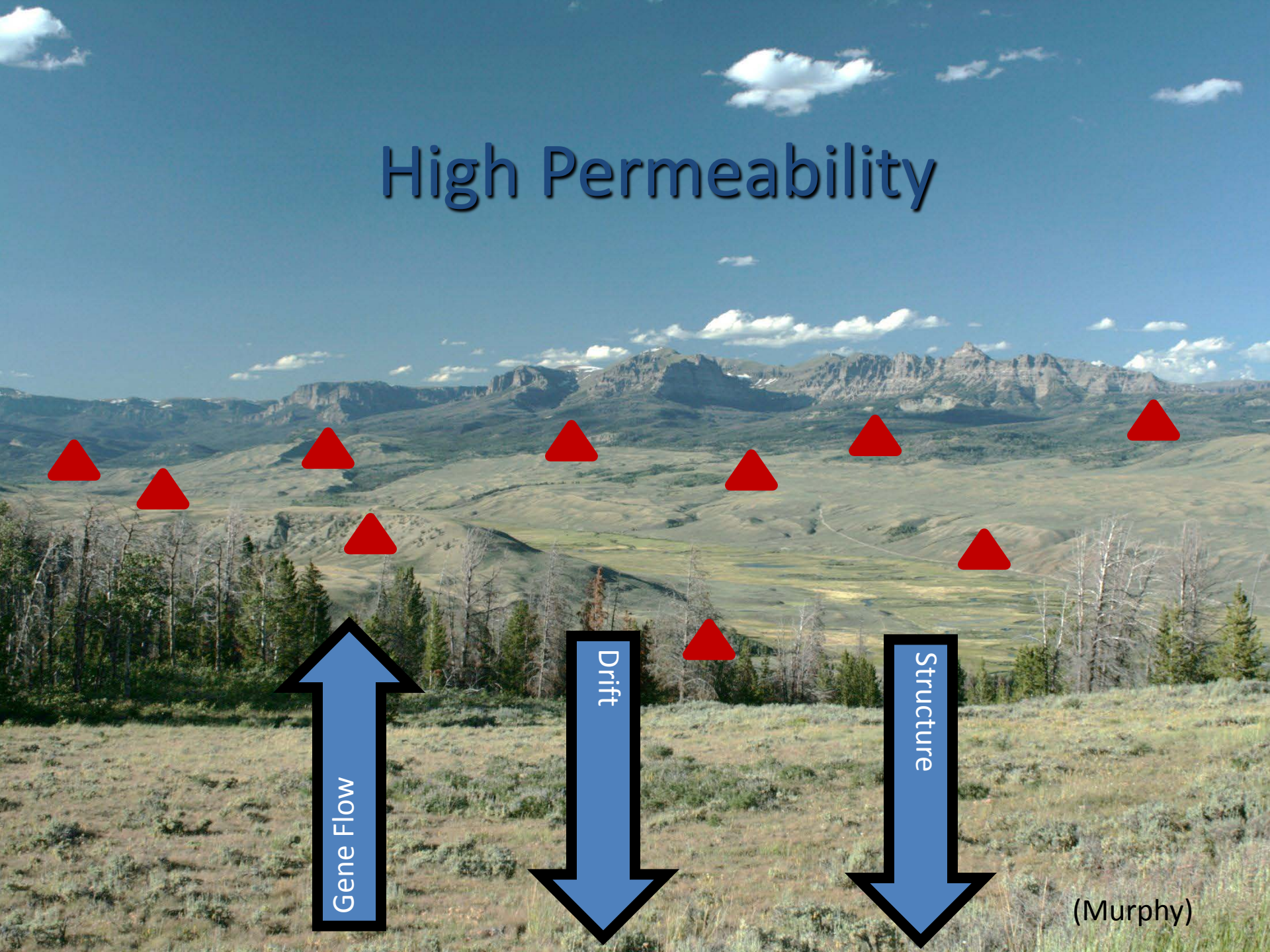
Heterozygosity: 0.462

Connectivity



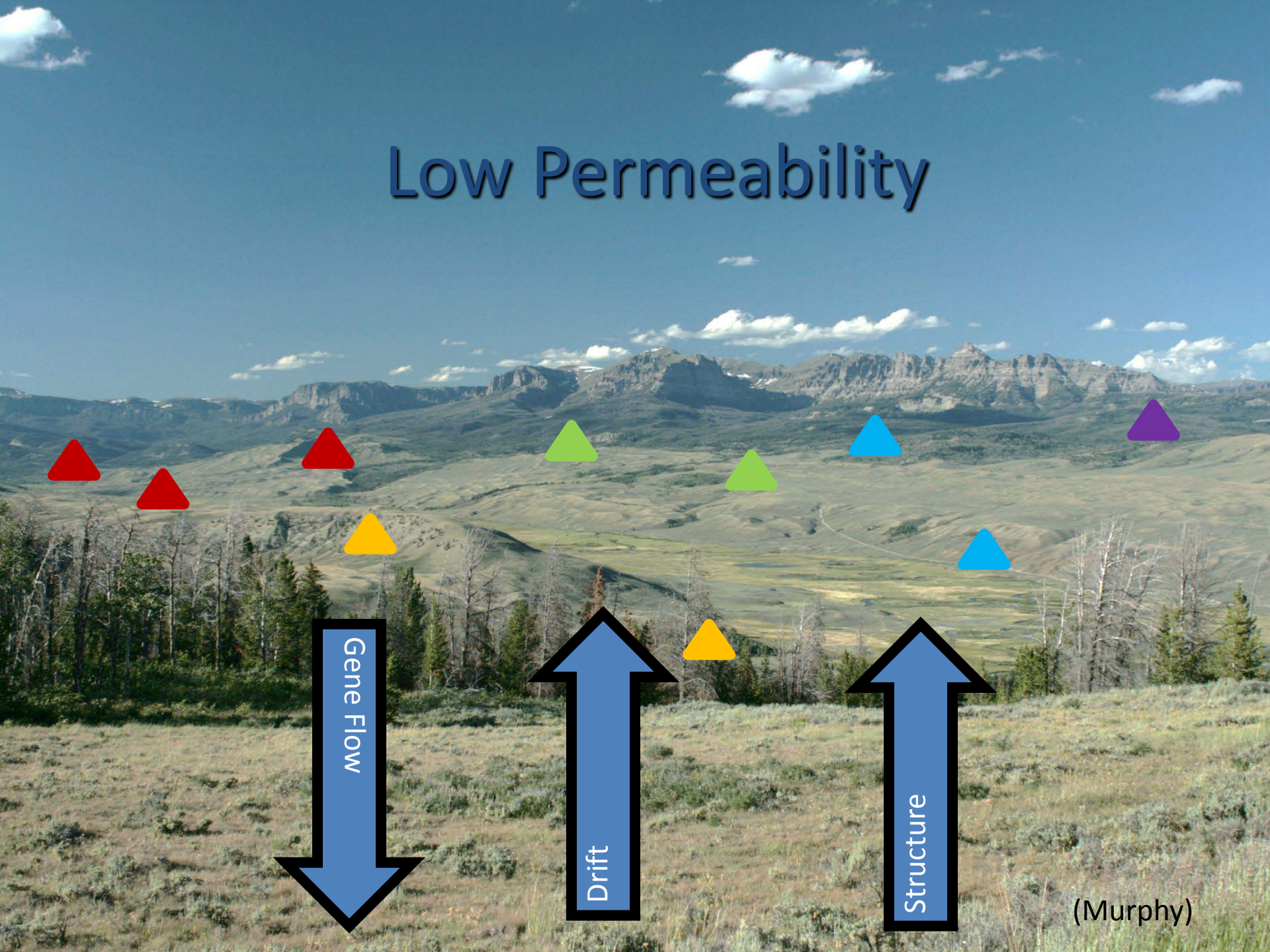
(Murphy)

High Permeability



(Murphy)

Low Permeability



(Murphy)

Mitigation Hierarchy

Avoid

Minimize

Restore

Offset