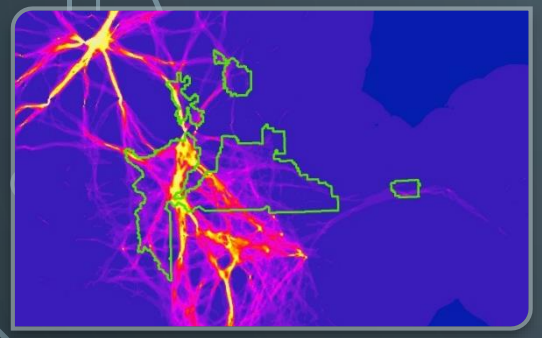
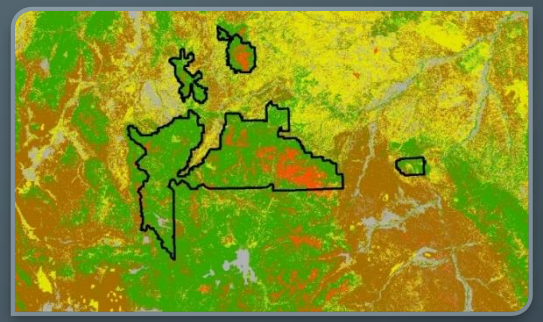




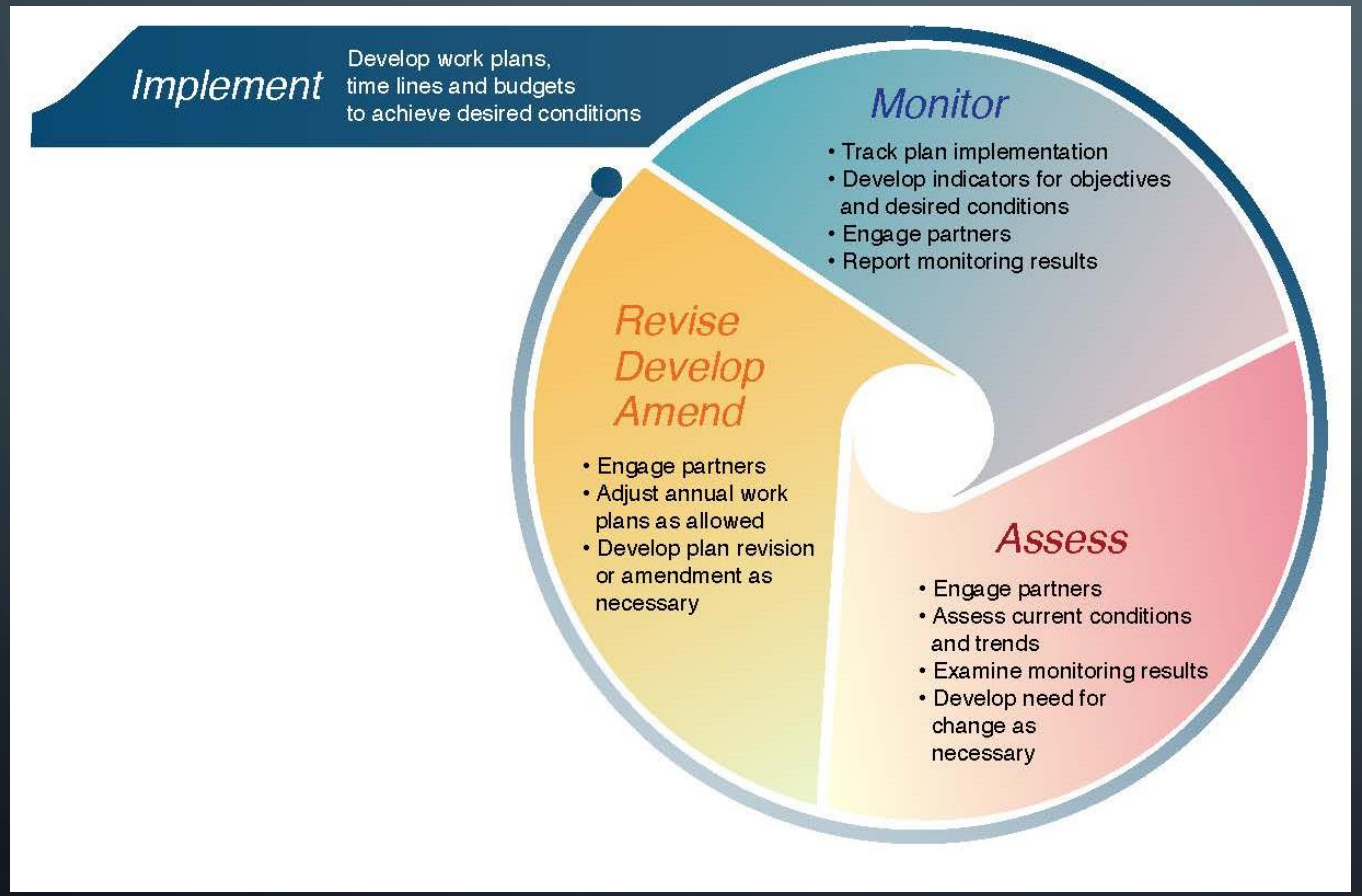

Planning for Connectivity on the Custer Gallatin National Forest

GUNNAR CARNWATH[1], TYLER CREECH[2], BEV DIXON[1]

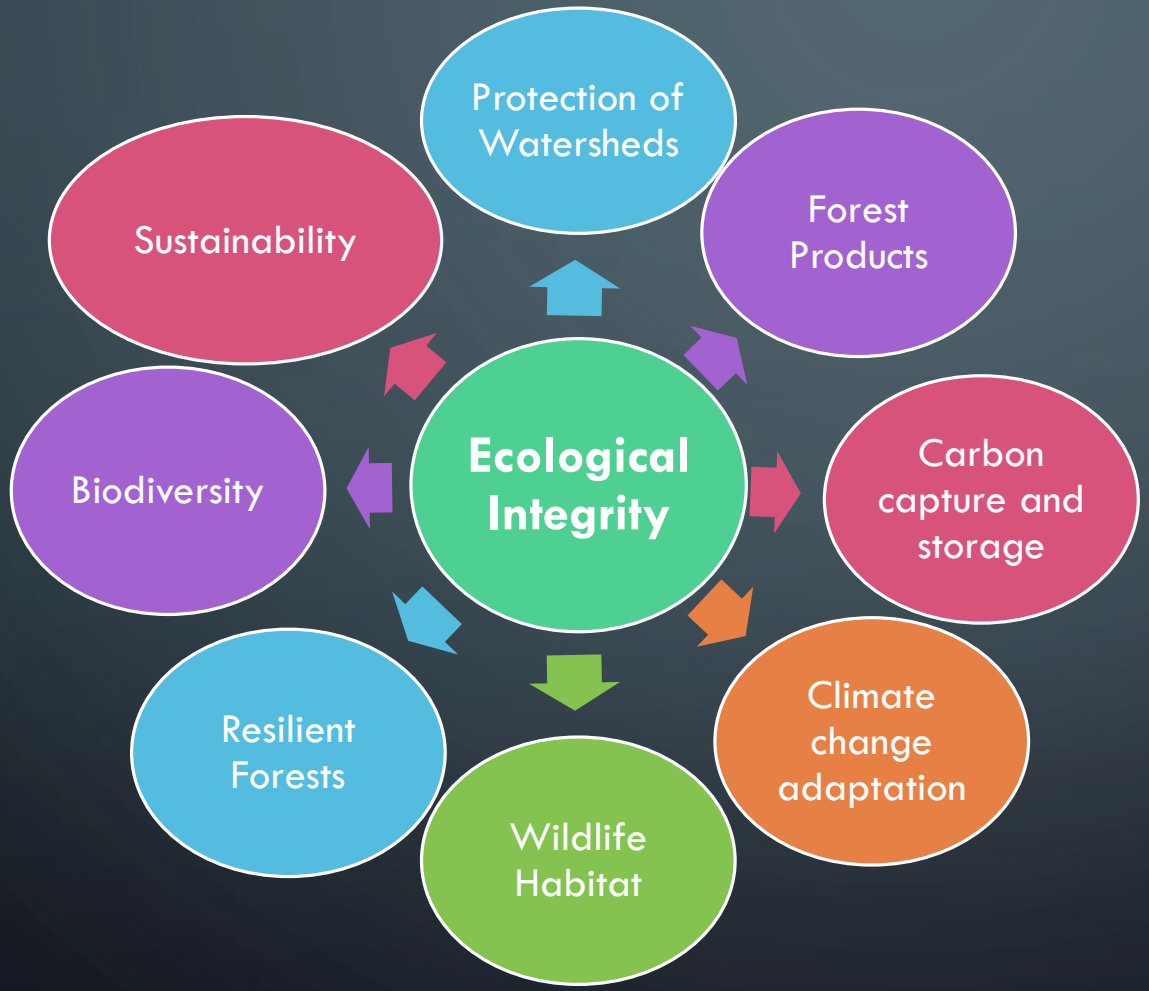
[1] CUSTER GALLATIN NATIONAL FOREST, BOZEMAN, MT

[2] CENTER FOR LARGE LANDSCAPE CONSERVATION, BOZEMAN, MT

THE 2012 PLANNING RULE



THE 2012 PLANNING RULE



THE 2012 PLANNING RULE

Ecological integrity. The quality or condition of an ecosystem when its dominant **ecological characteristics** (for example, composition, structure, function, **connectivity**, and species composition and diversity) occur within the **natural range of variation** and can **withstand and recover from most perturbations** imposed by natural environmental dynamics or human influence (36 CFR 219.19).

THE 2012 PLANNING RULE

Connectivity. Ecological conditions that exist at several spatial and temporal scales that provide landscape linkages that permit the exchange of flow, sediments, and nutrients; the daily and seasonal movements of animals within home ranges; the dispersal and genetic interchange between populations; and the long distance range shifts of species, such as in response to climate change (36 CFR 219.19).

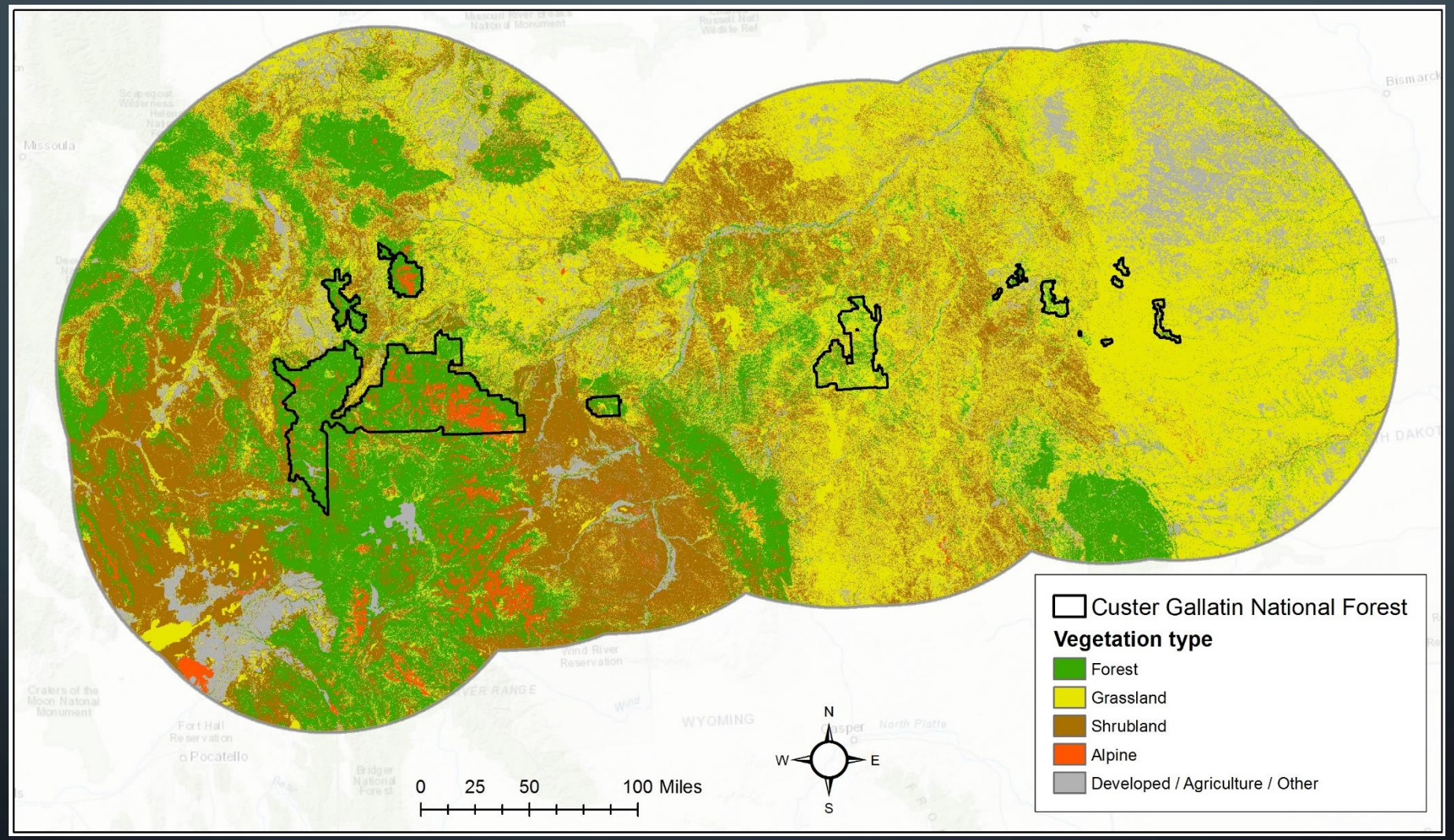
PLANNING FOR CONNECTIVITY

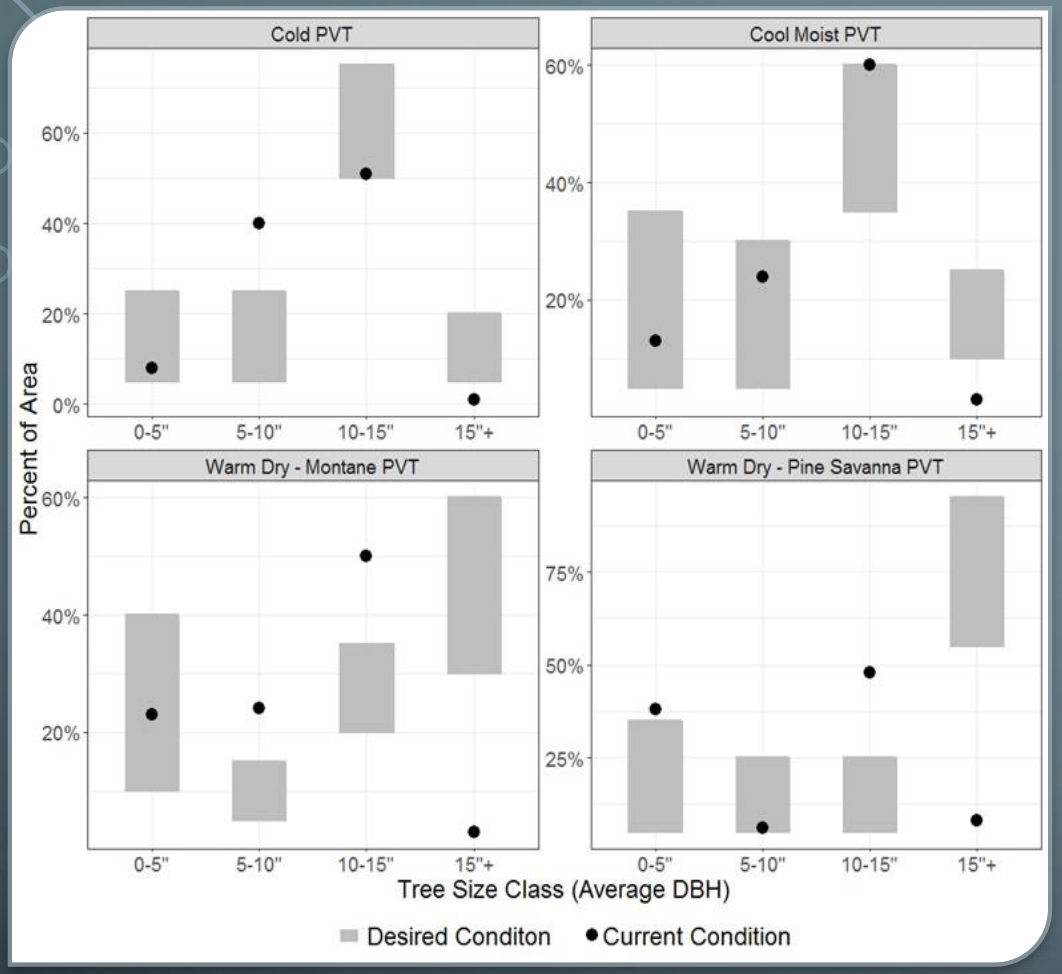
Structural Connectivity

Functional Connectivity

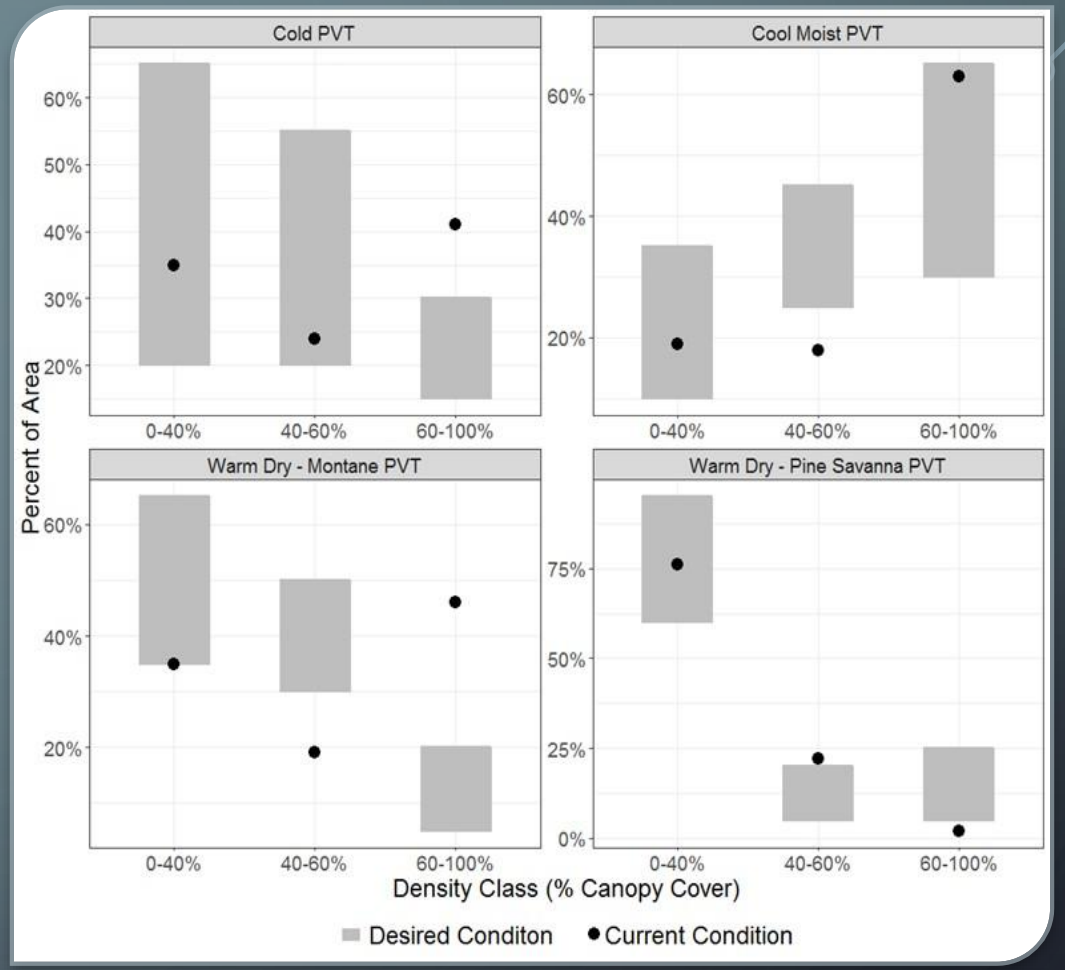
- Patch Analysis
  - Composition
  - Size distribution
  - Configuration

- Least cost analysis
- Circuit theory
- Individual species-based models


Custer Gallatin National Forest
Vegetation type
Forest
Grassland
Shrubland
Alpine
Developed / Agriculture / Other
0 25 50 100 Miles
N
W
E
S
Missoula
Bismarck
Pocatello
WYOMING



Tree Size



Tree Density

STRUCTURAL CONNECTIVITY: PATCH COMPOSITION

Cool-Moist Potential Vegetation Types:

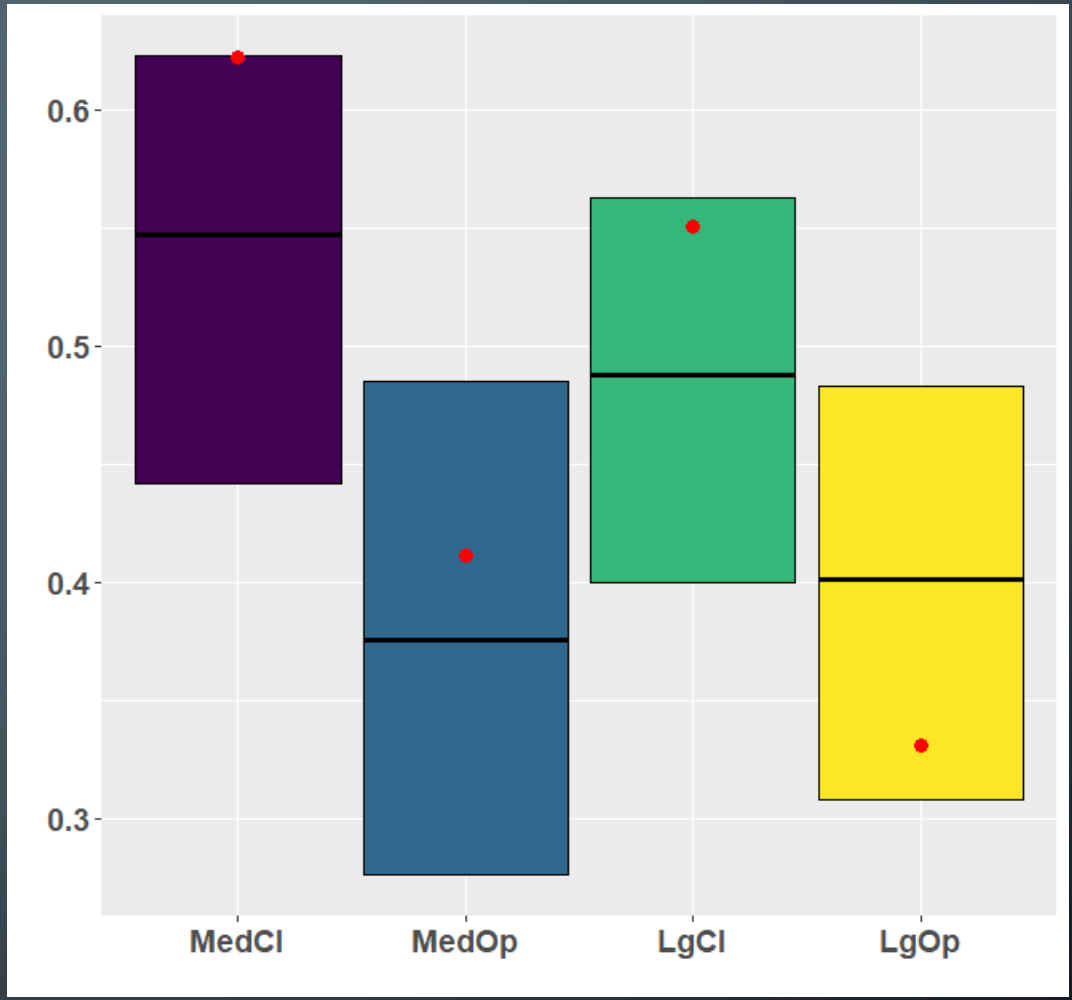
	Early Seral		Mid Seral		Late-Seral	
Patch Size (Acres)	Current Condition	NRV	Current Condition	NRV	Current Condition	NRV
under 40	6%	5 - 11 %	13%	11 - 14 %	2%	12 - 15 %
40-100	2%	1 - 4 %	8%	4 - 6 %	1%	4 - 5 %
100-500	3%	1 - 6 %	14%	6 - 10 %	1%	6 - 9 %
500-1,000	1%	0 - 2 %	6%	2 - 5 %	0%	2 - 4 %
over 1,000	5%	0 - 8 %	39%	4 - 15 %	0%	8 - 19 %

STRUCTURAL CONNECTIVITY: PATCH SIZE

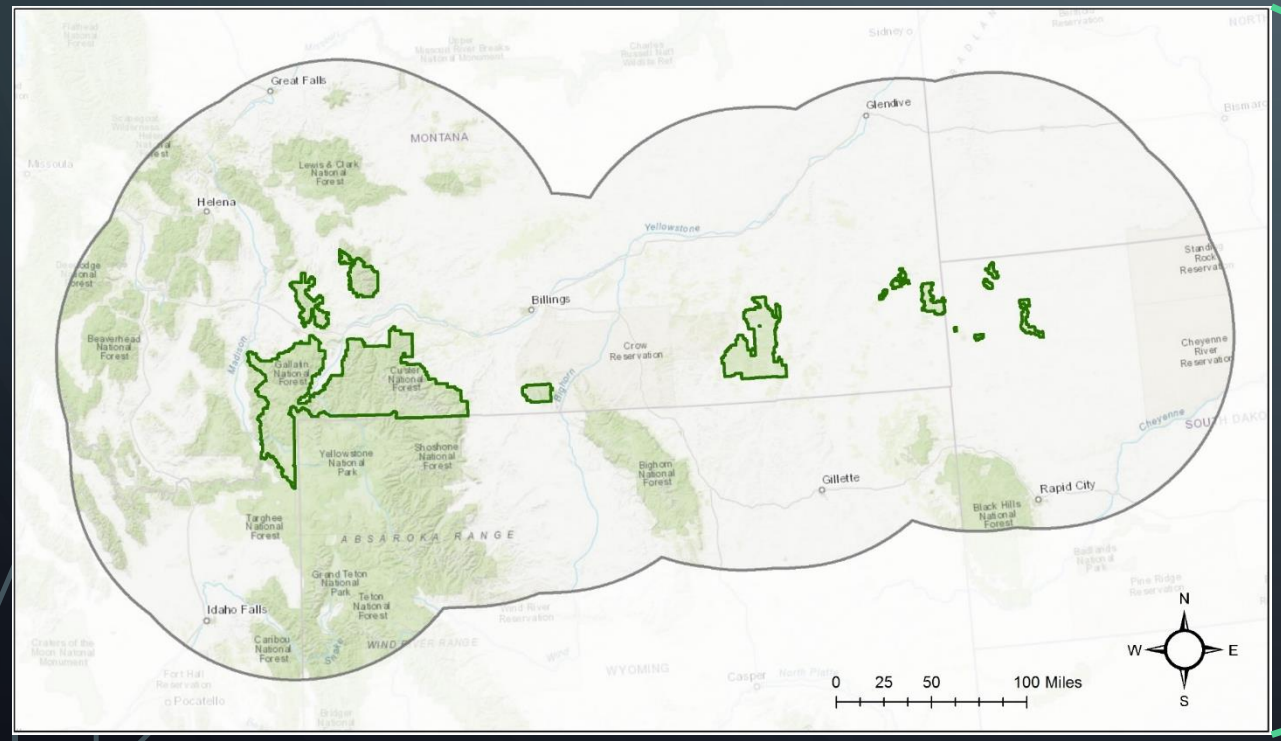
STRUCTURAL CONNECTIVITY: PATCH CONFIGURATION

Gallatin, Madison, Henrys Geographic Area:

“Clumpiness”



FUNCTIONAL CONNECTIVITY

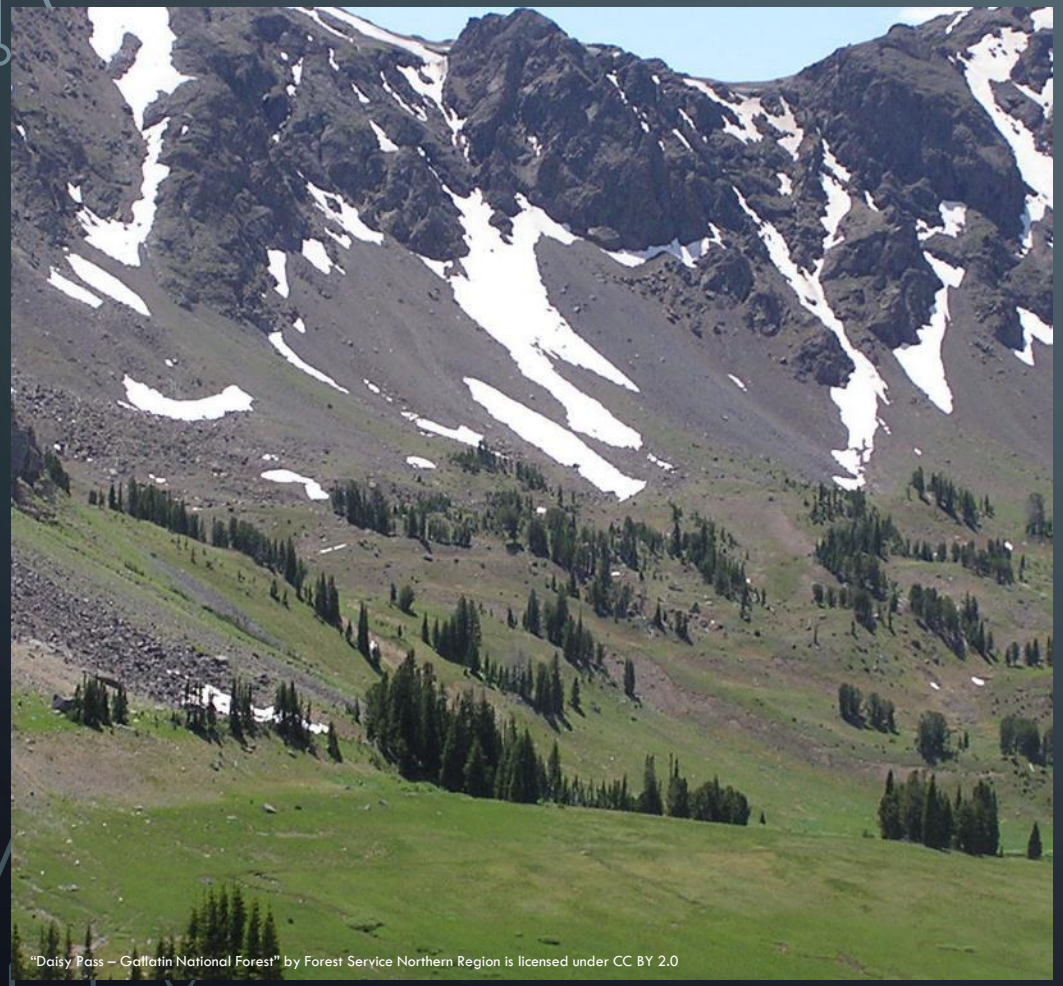


CONNECTIVITY FOR WHOM?

- Individual species?
- Umbrella species?
- **Generic species**: a virtual species with a set of ecological requirements that reflect the needs of a group of real species
  - Organism size (large or small)
  - Preferred vegetation type (forest, grassland, shrubland, or alpine)
  - Habitat specificity (specialist or generalist)

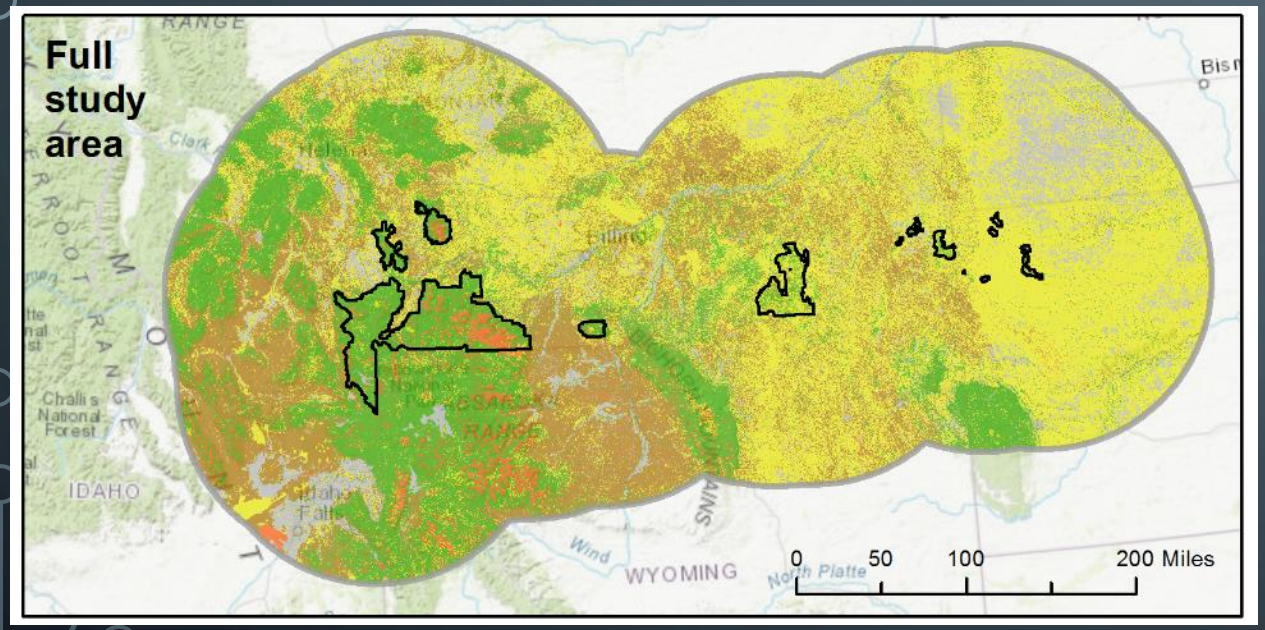
Large Alpine Specialist
Large Forest Specialist
Large Grassland Specialist
Large Shrubland Specialist
Large Generalist
Small Alpine Specialist
Small Forest Specialist
Small Grassland Specialist
Small Shrubland Specialist
Small Generalist

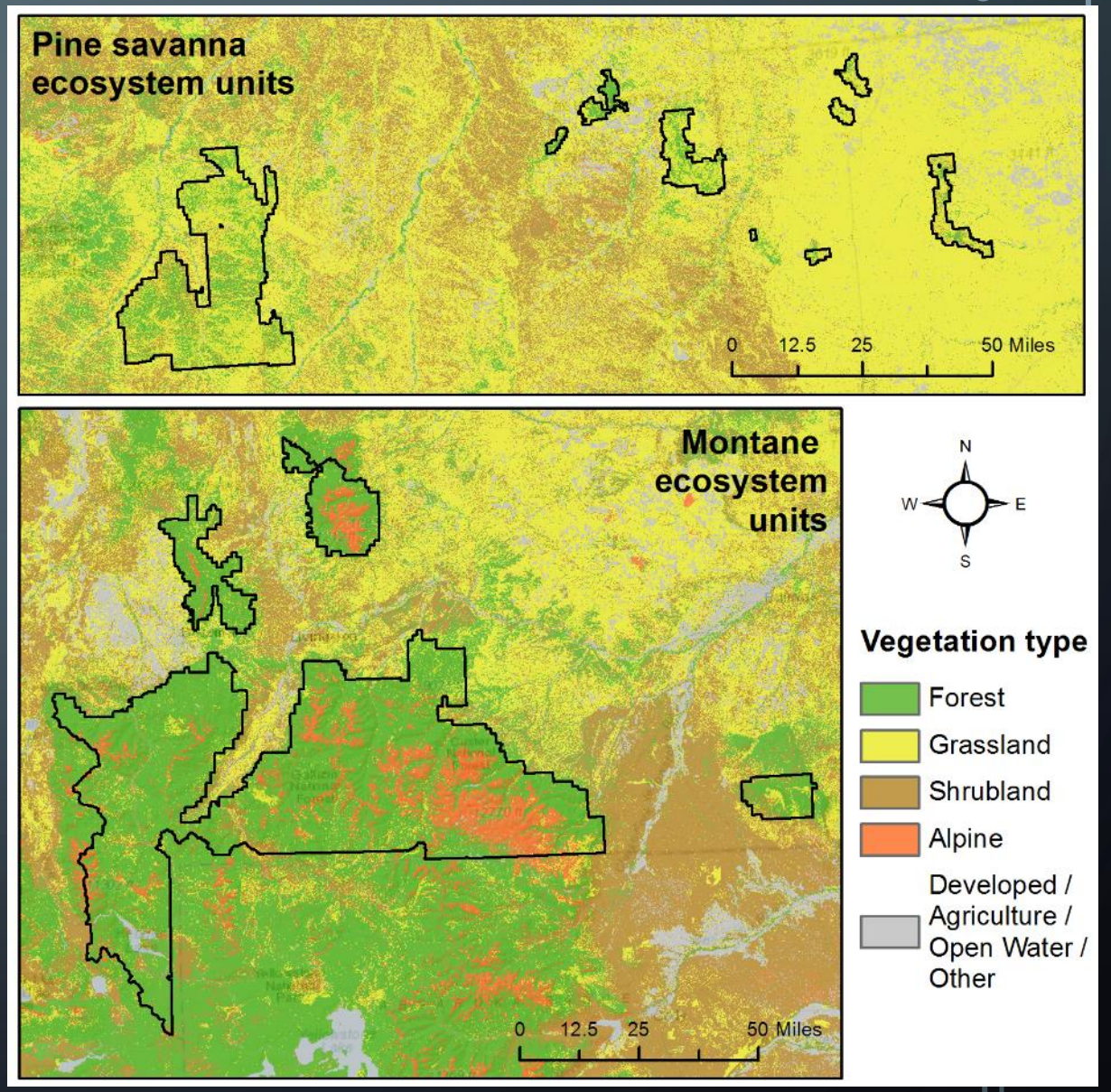
CONNECTING WHAT?



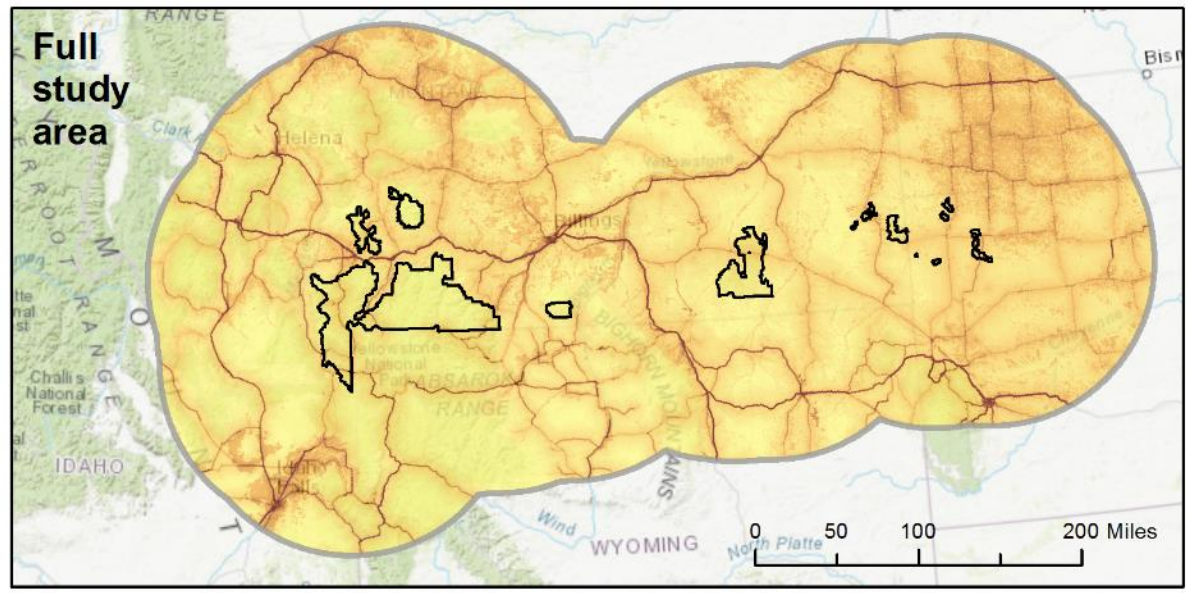
- Traditionally: connect geographic areas based on protected status or administrative boundaries
- Our approach: connect the highest quality habitat patches for generic species – "core areas"
  - Preferred dominant vegetation type
  - Minimal human modification of environment
  - Perceptual range of species

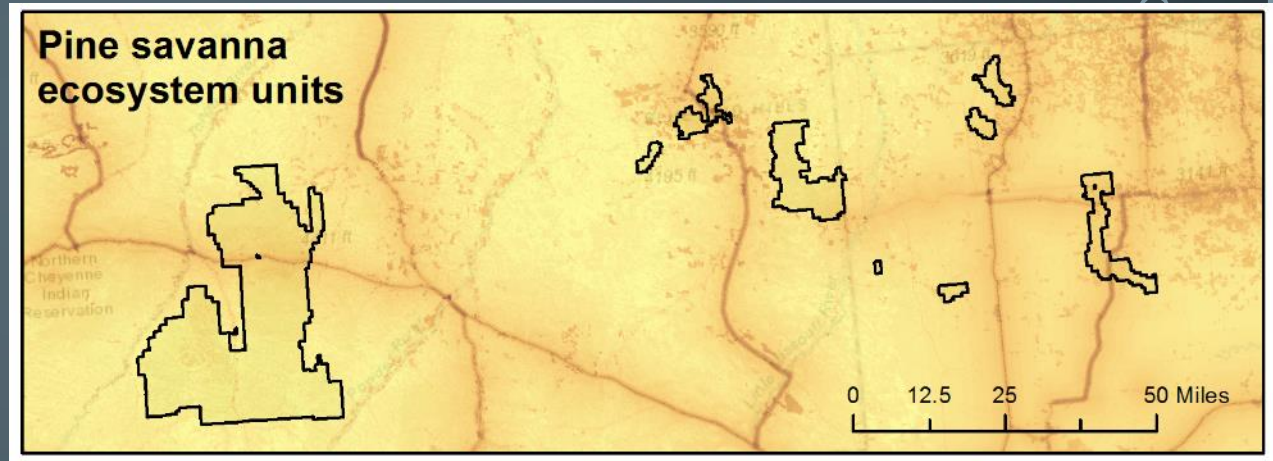
VEGETATION TYPE

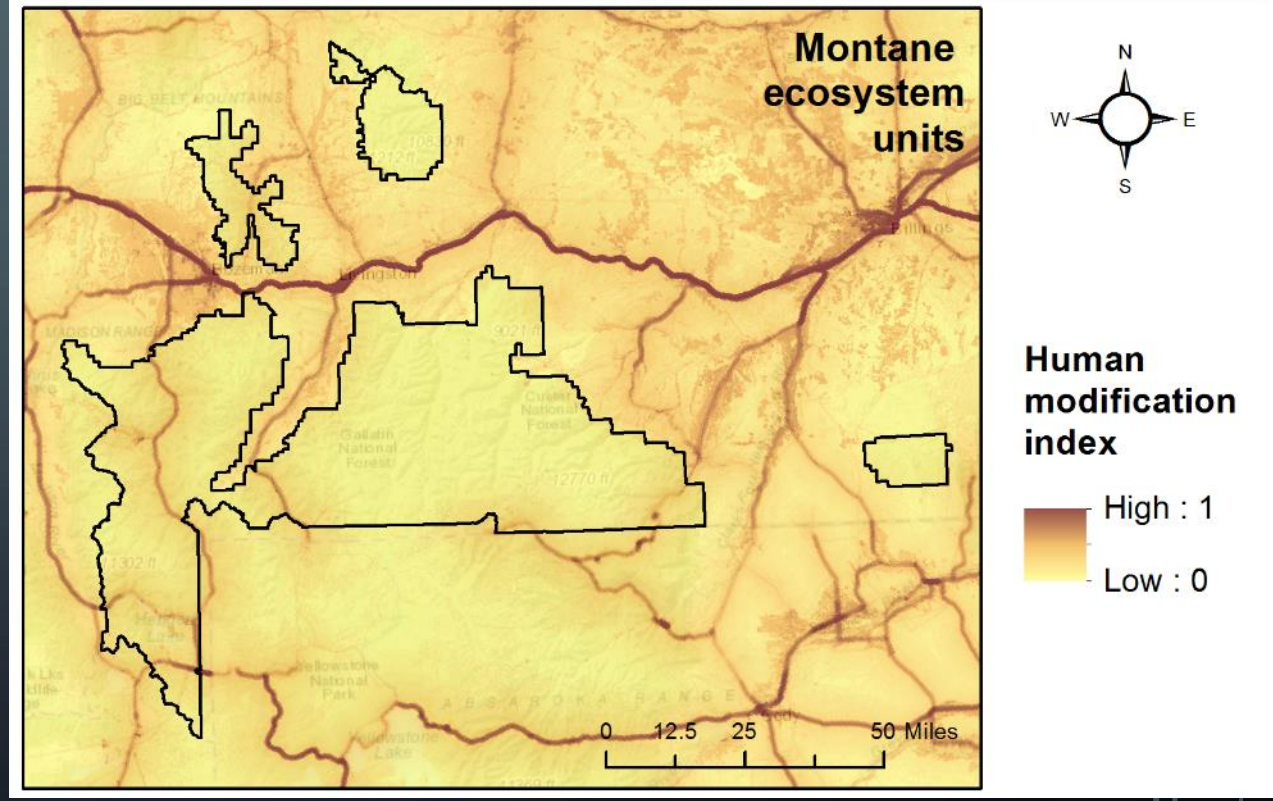




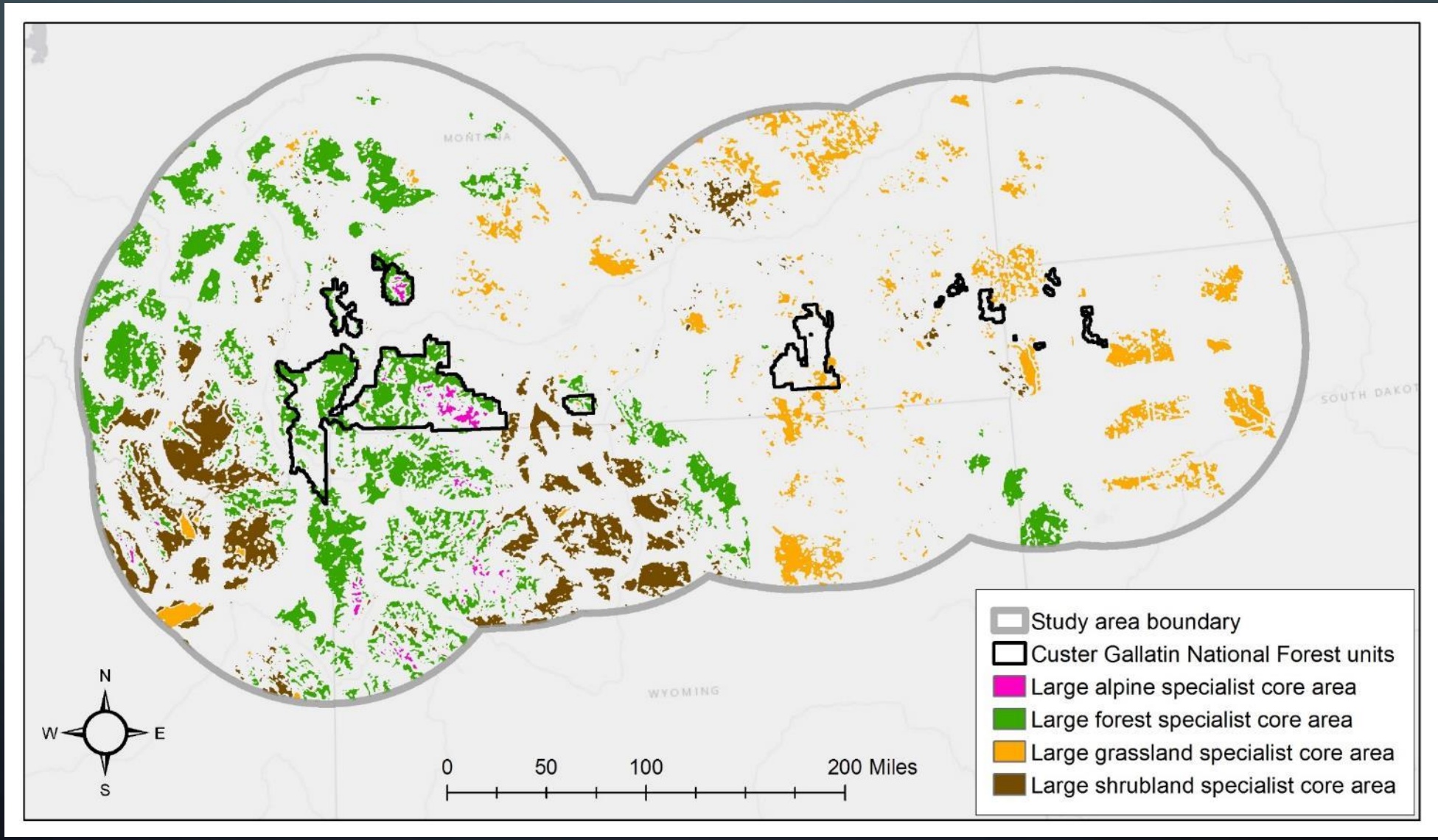
HUMAN MODIFICATION



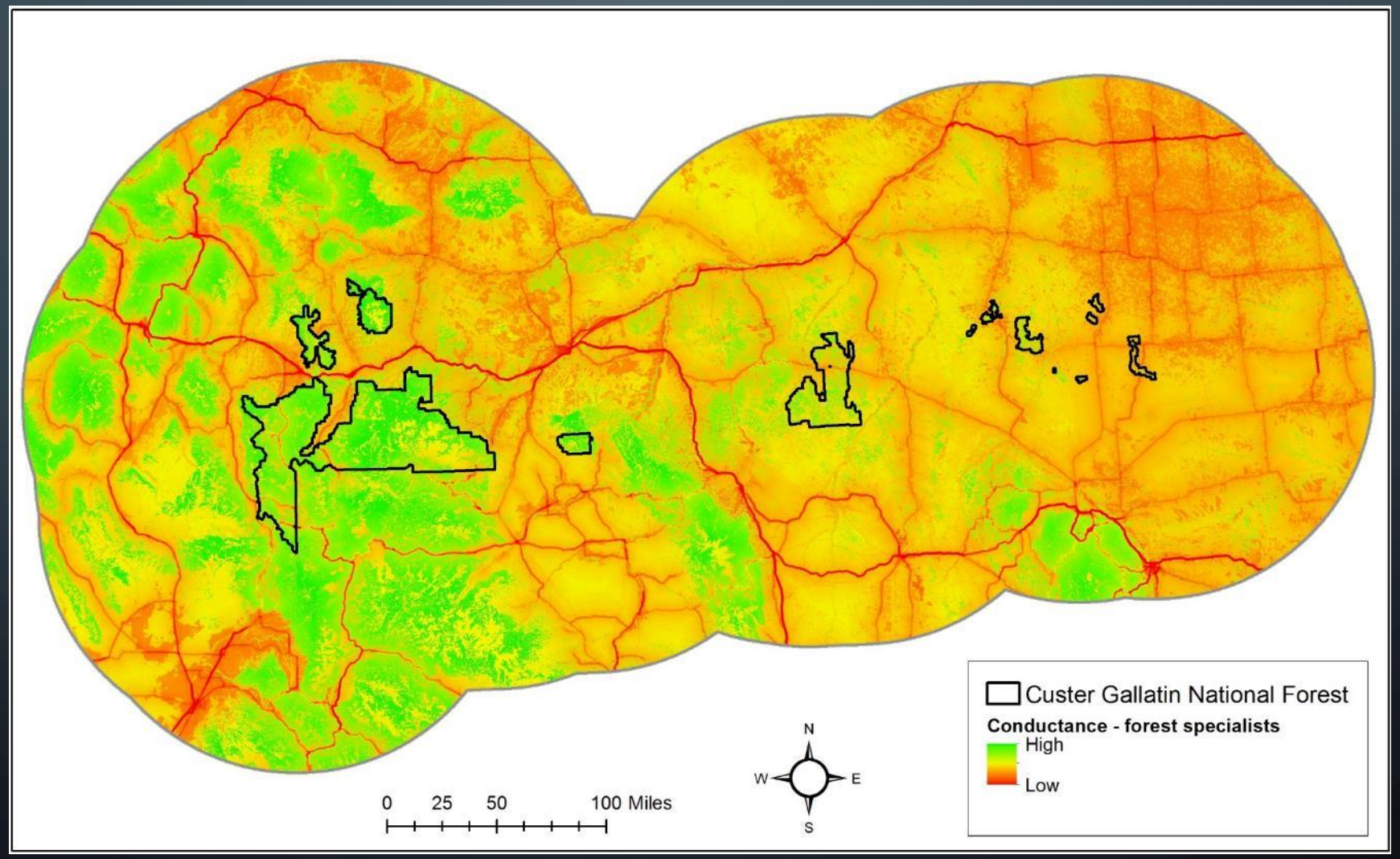




CORE HABITAT – LARGE SPECIALISTS

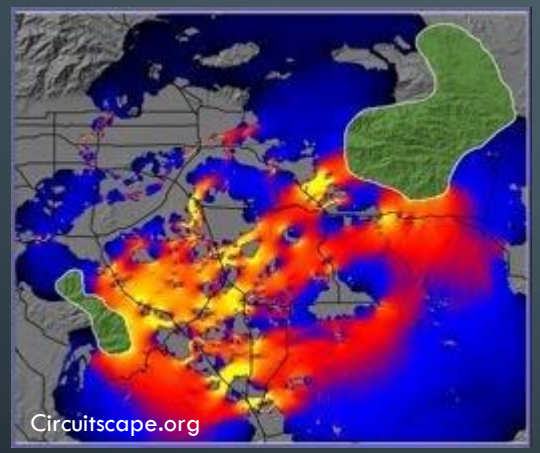


LANDSCAPE CONDUCTANCE SURFACES

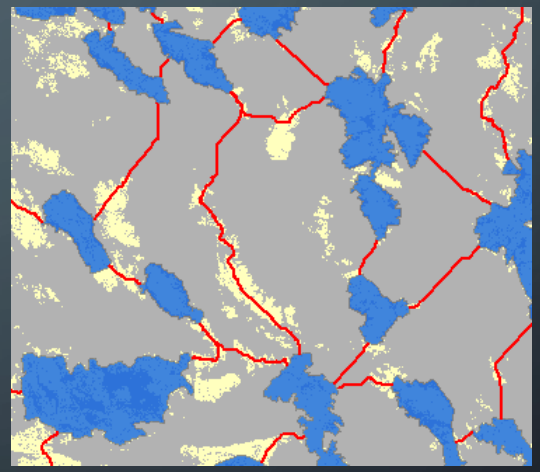


MOVEMENT BEHAVIOR

How do animals navigate between origin and destination points in a landscape?



?



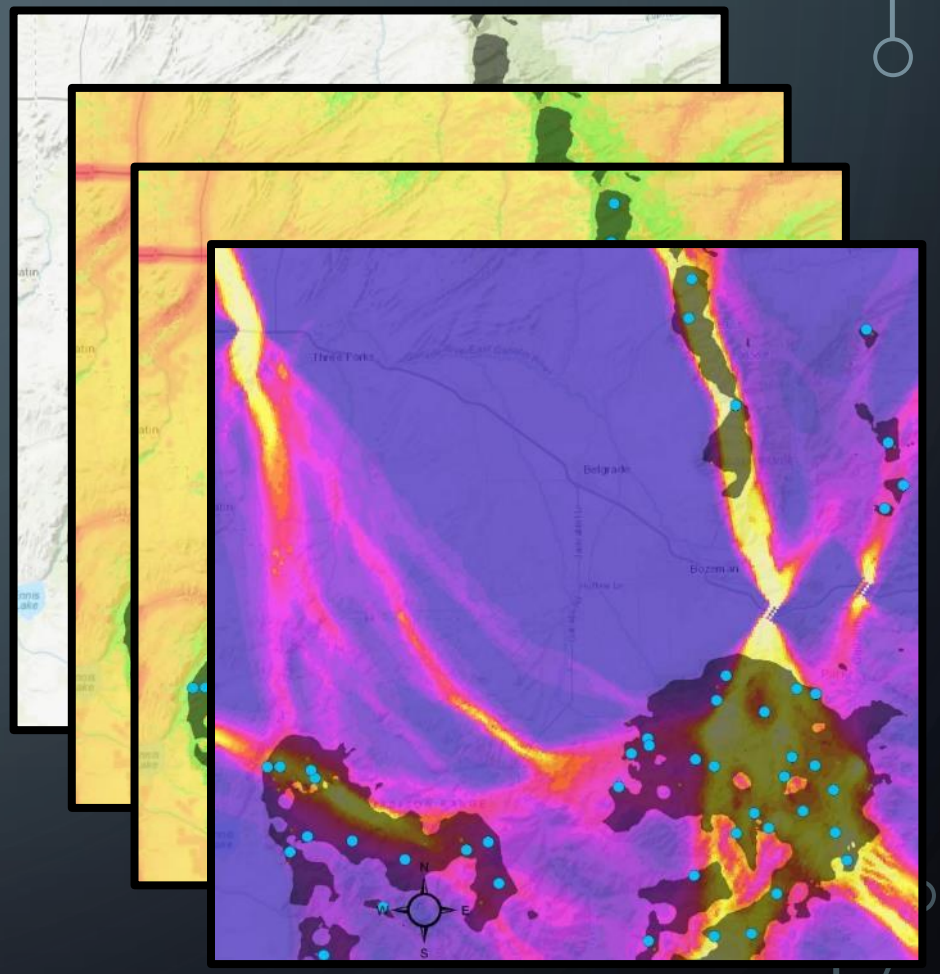
Knowledge of landscape

None:
RANDOM
MOVEMENT

Complete:
OPTIMAL
MOVEMENT

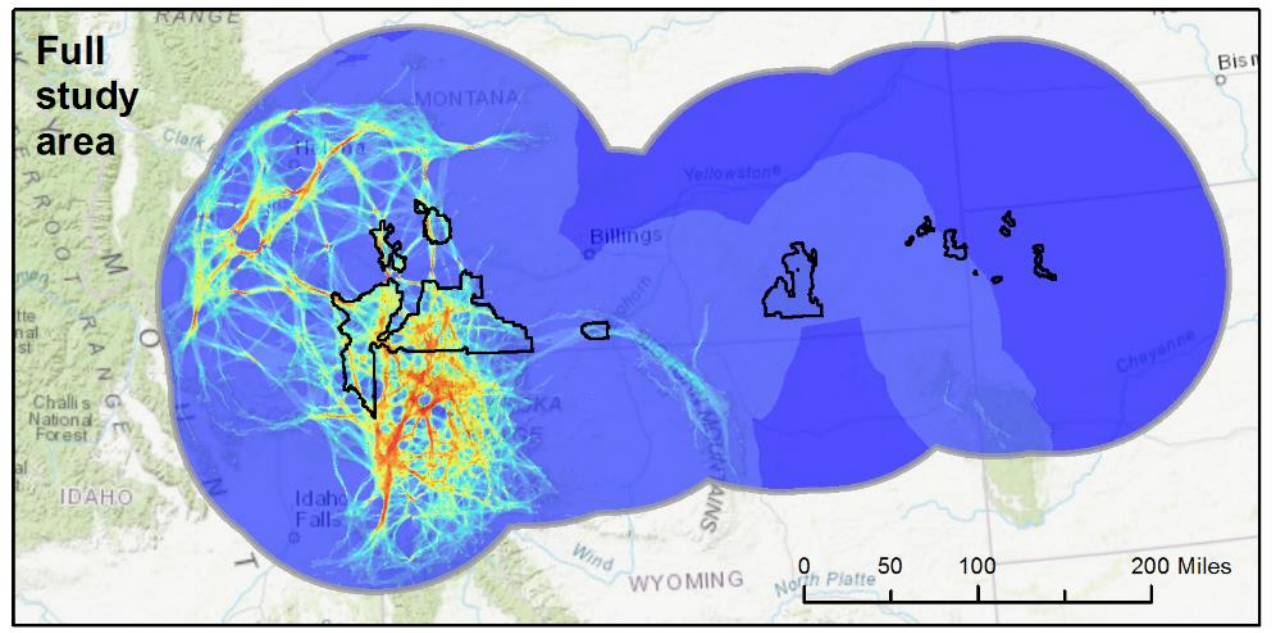
CONNECTIVITY MODELING STEPS

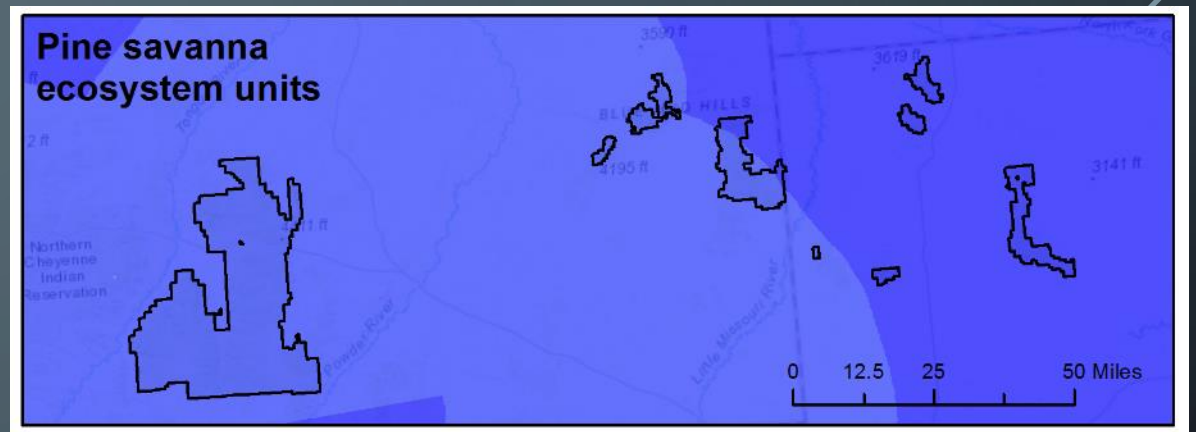
1. Map core habitat areas
2. Generate landscape conductance surface
3. Randomly place nodes (start/end points) within cores
4. Run connectivity model connecting pairs of nodes

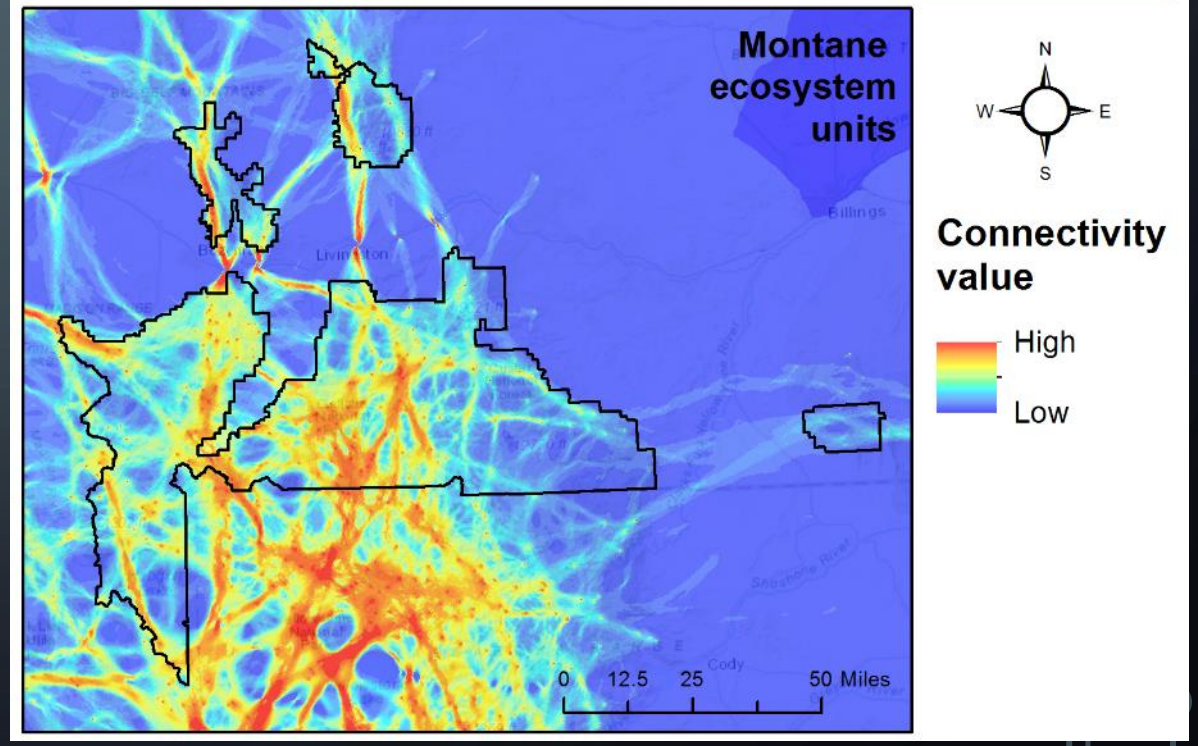


- Output: a gridded surface showing the expected connectivity value for each pixel in the landscape
  - Pixel value = number of passages through that pixel (summed across all node pairs)

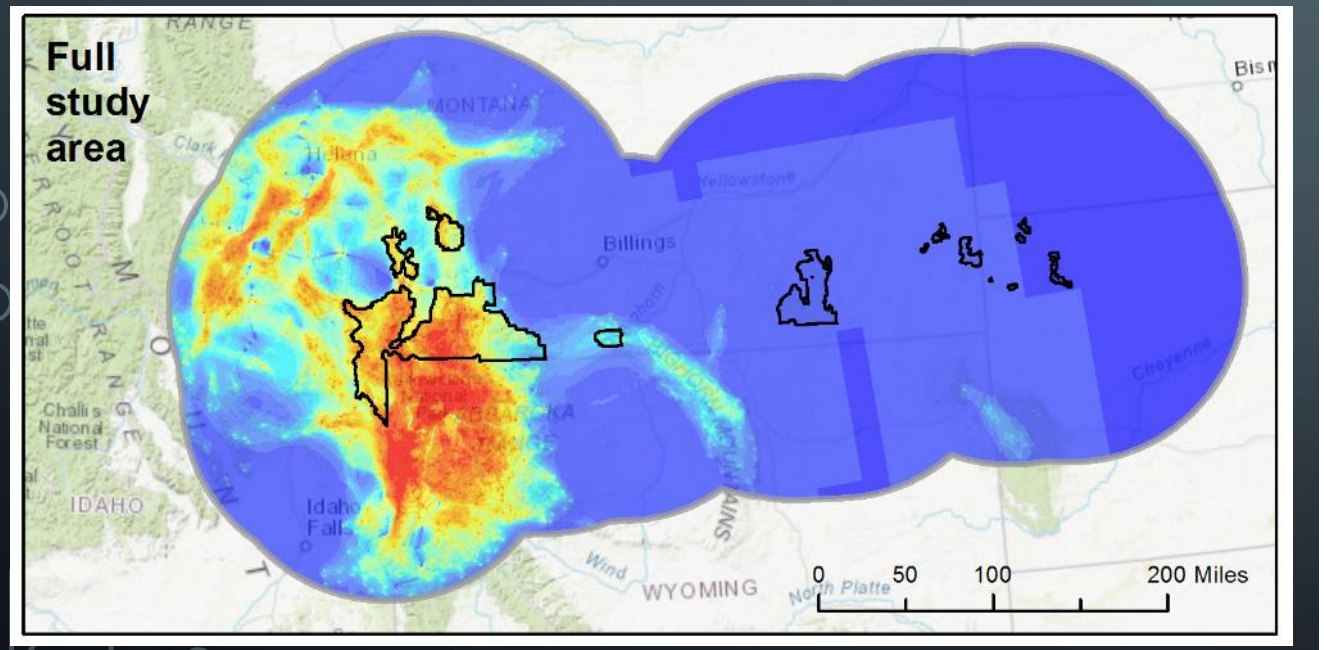
EXAMPLE MODEL OUTPUT: LARGE FOREST SPECIALIST, OPTIMAL MOVEMENT

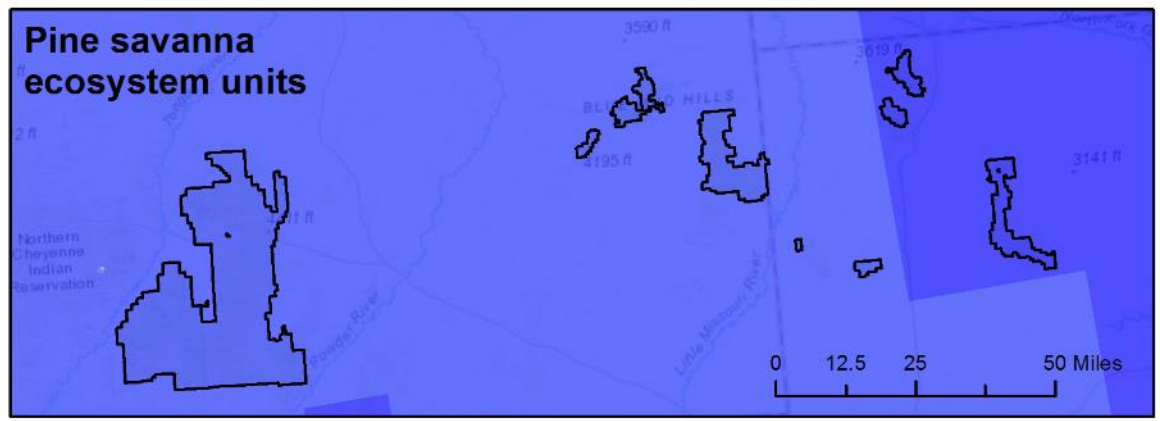


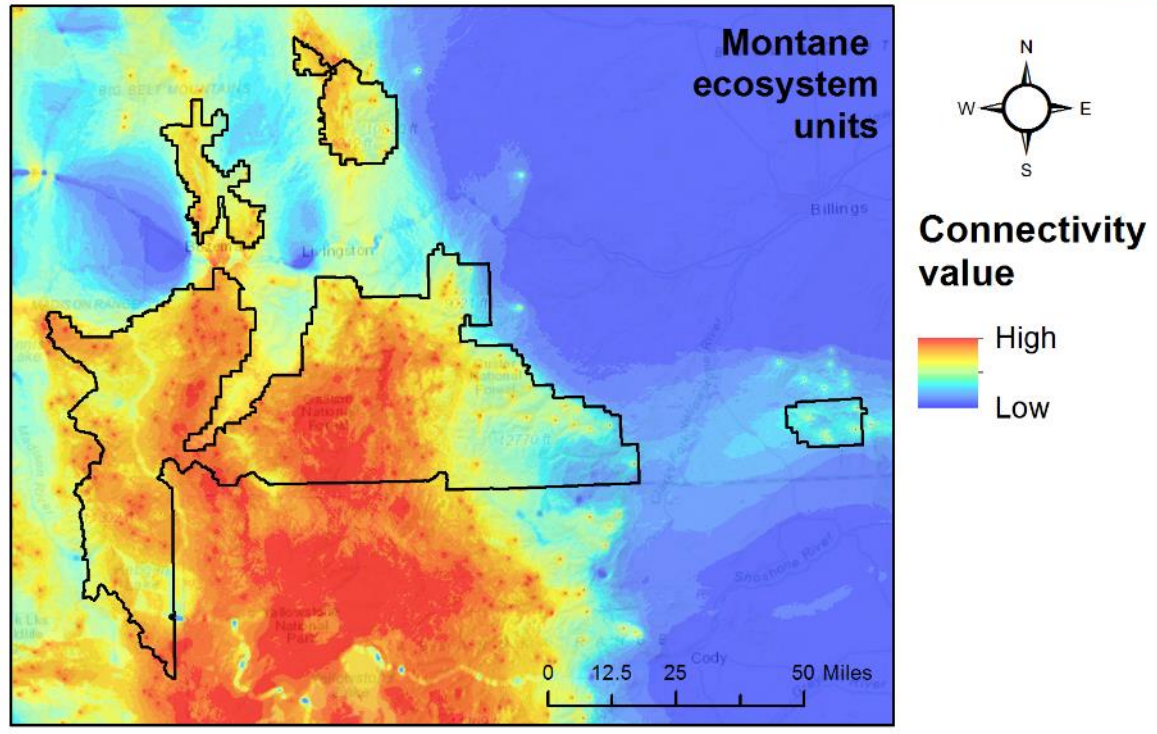


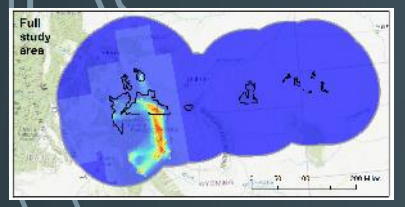
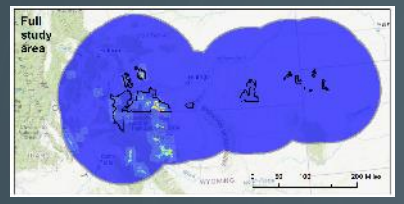
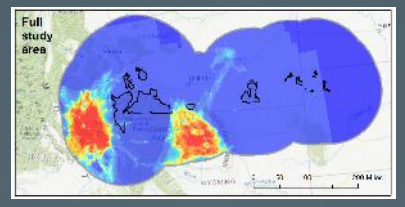
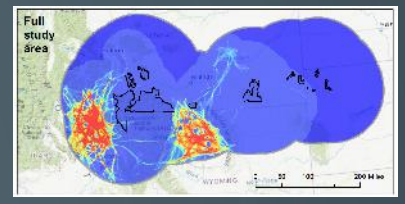
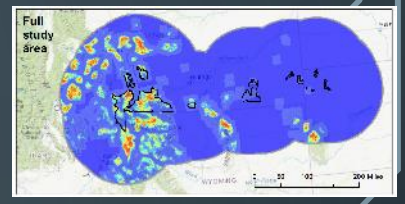
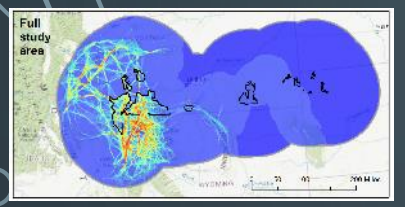
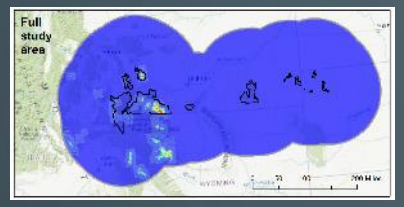
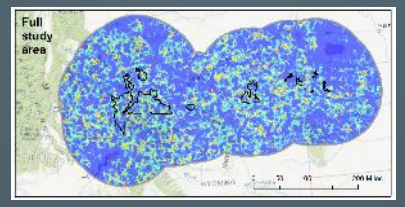
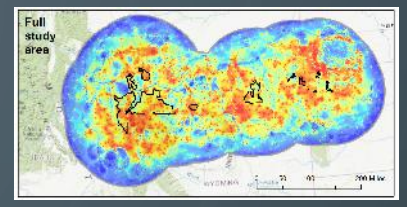
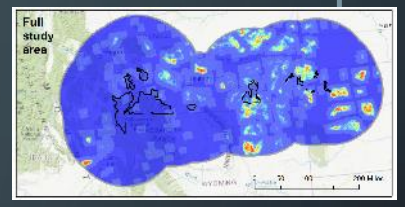


EXAMPLE MODEL OUTPUT: LARGE FOREST SPECIALIST, RANDOM MOVEMENT



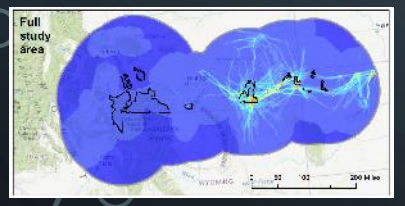
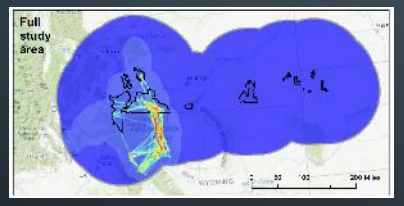
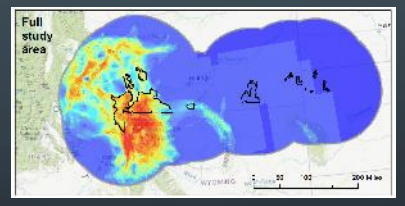
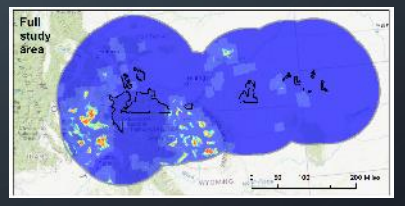
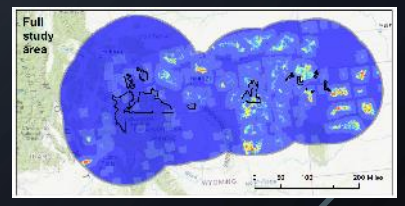
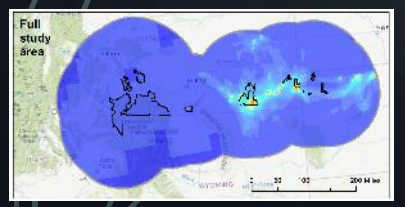
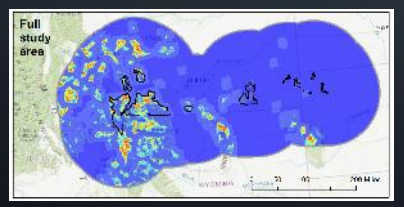
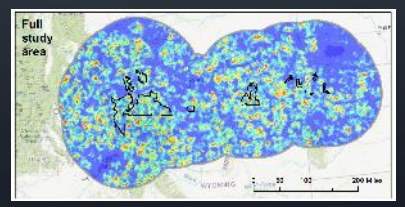
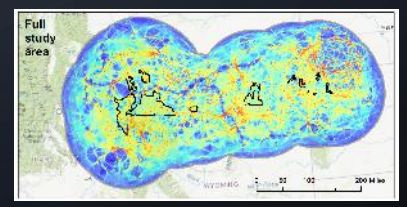
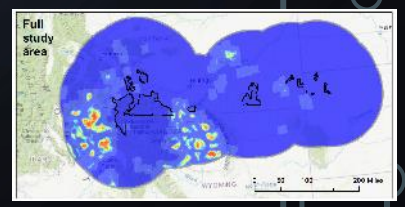




5 vegetation preferences × 2 body sizes × 2 movement behaviors

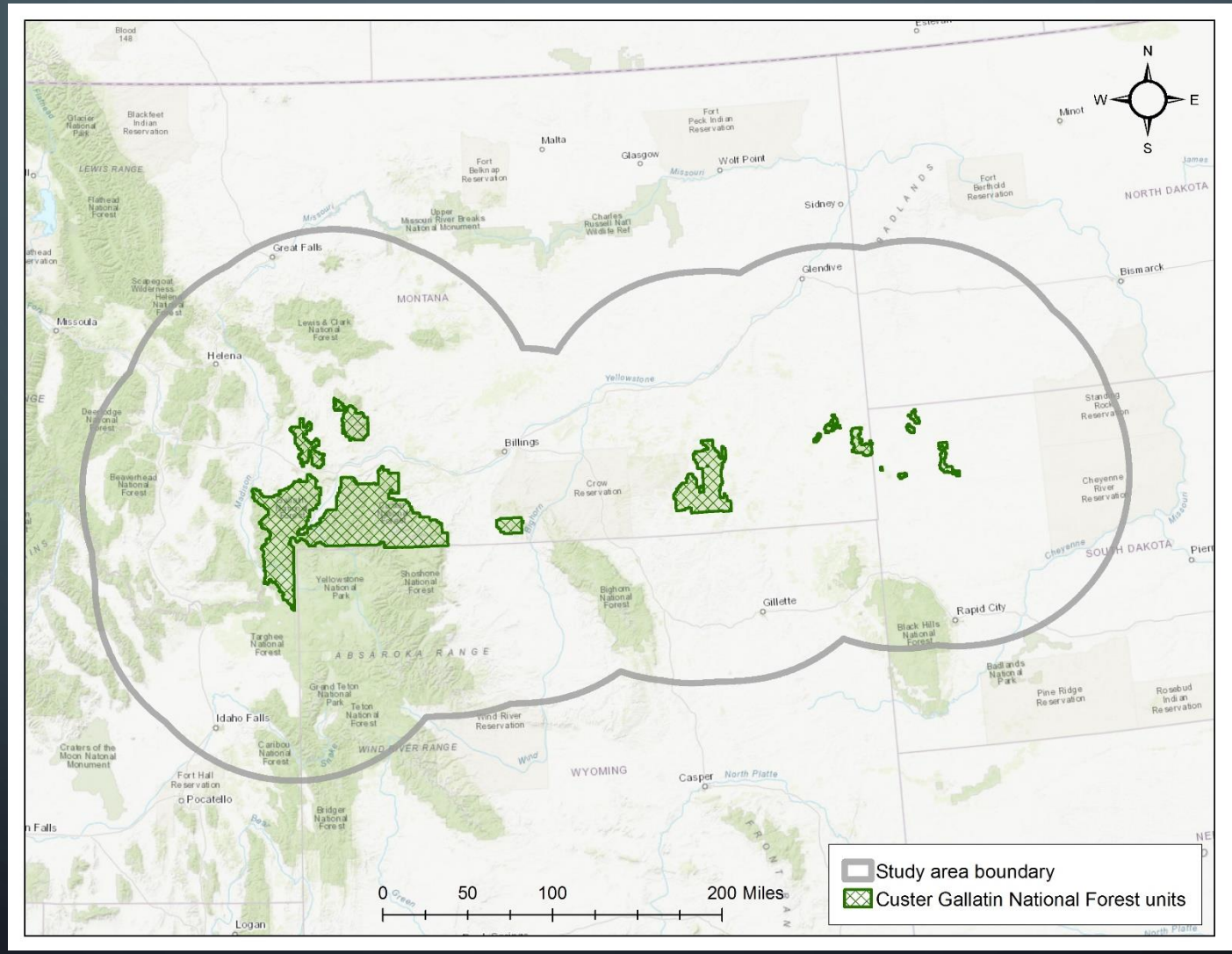
= 20 connectivity model outputs

WILDLIFE HABITAT CONNECTIVITY

Analysis
&
Plan Components

Custer Gallatin Landscape: Challenges and Opportunities



2012 PLANNING RULE

Definition: *Connectivity* – Ecological conditions that exist at several spatial and temporal scales that provide landscape linkages that permit the daily and seasonal movements of animals within home ranges, the dispersal and genetic interchange between populations, and the long distance range shifts of species, such as in response to climate change.

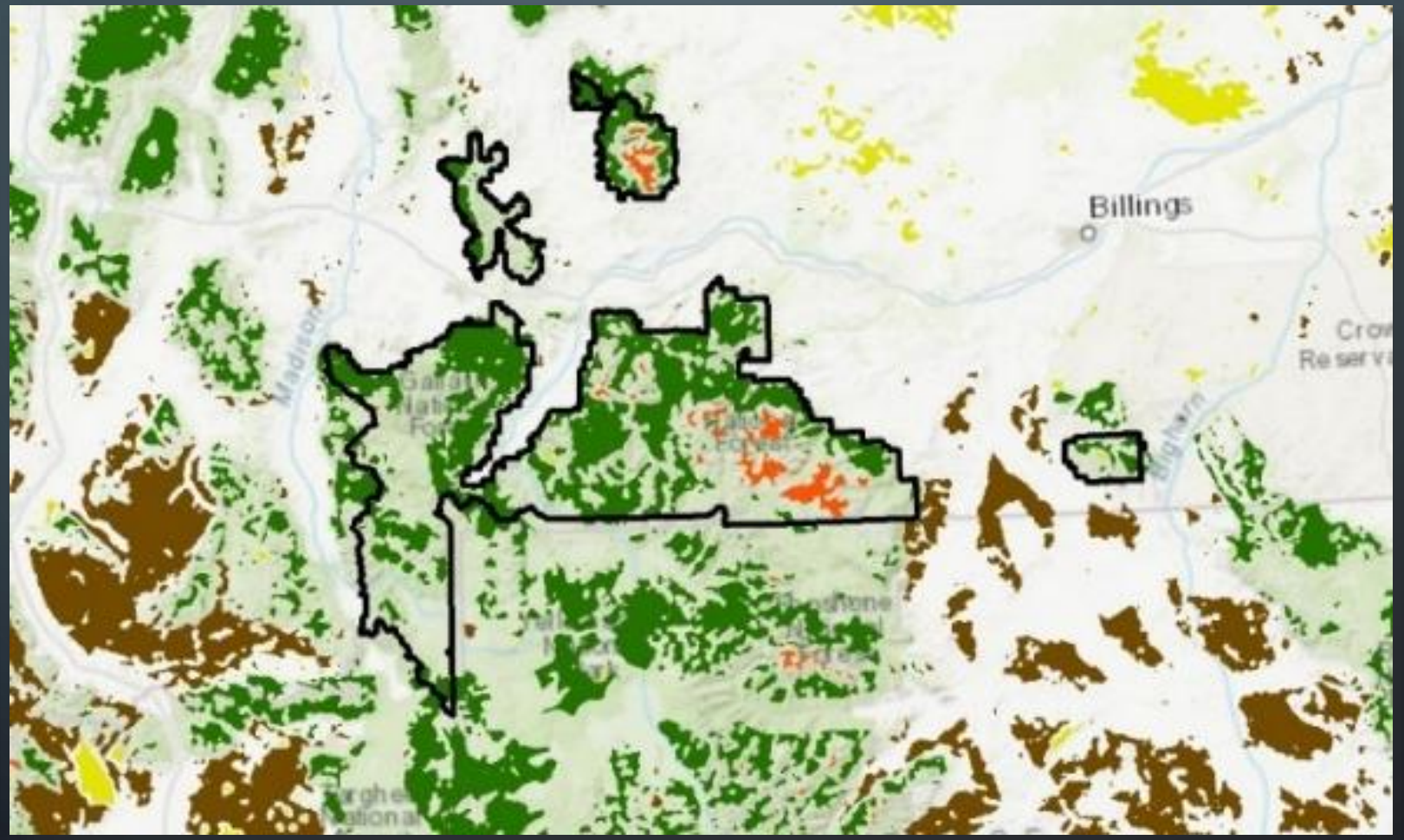
Daily

Seasonal

Dispersal

Focus: larger-bodied terrestrial species

CONNECTIVITY MODEL: "Core" Habitat – Large Specialists



Core areas - meeting basic needs:

Feeding

Breeding

Shelter

REVISED PLAN ALTERNATIVES

Coarse Filter – Ecosystem Function

- Natural Range of Variation: vegetation structure, composition, patch size, etc.
- Watershed protections: riparian management zones
- Wildlife habitat connectivity: species-neutral

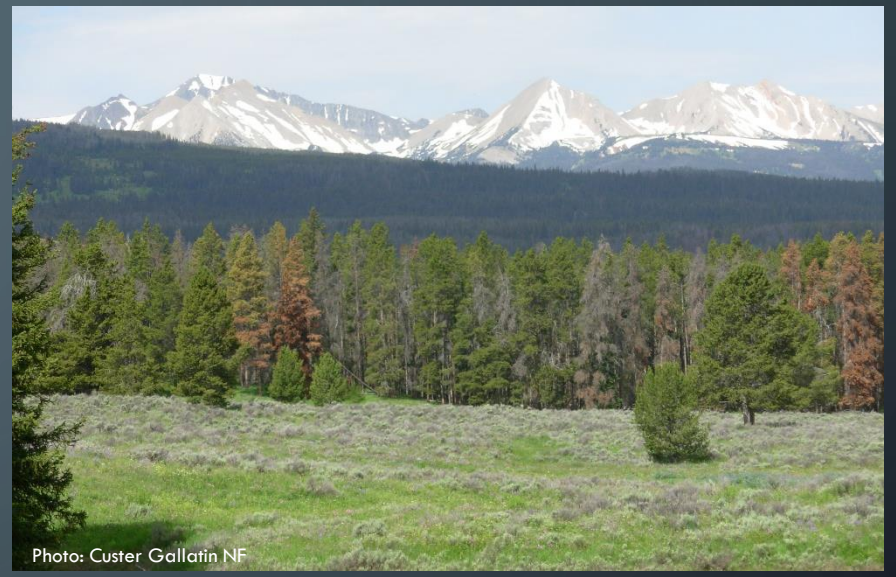


Photo: Custer Gallatin NF

Fine Filter: Species-specific protection measures


Photo: Jesse Achtenberg


Photo: USFWS


Photo: National Wildlife Federation


Photo: Ryan Hagerty/USFWS


Photo: USFWS


Photo: USFWS


Photo: Custer Gallatin NF

Coarse Filter Plan Components – Revised Alternatives (B-E):

Desired Conditions:

- **Watershed:** Spatial connectivity within and between watersheds; riparian vegetation provides life cycle requirements and habitat connectivity/movement corridors for a wide range of species.
- **Vegetation:** Supports natural diversity and distribution of forested habitats within the natural range of variation (e.g. species composition, structure, and patch size).
- **Fire/Fuels:** Fires occur with a range of intensity, severity and frequency that allow ecosystems to function. Vegetation conditions support natural fire regimes except in Wildland-Urban Interface.
- **Wildlife:** Wildlife diversity contributes to ecological processes; e.g. predator-prey relationships, nutrient cycling, hydrologic function, vegetation composition and structure.
    - Landscape patterns provide habitat connectivity, particularly for wide-ranging species. Habitat connectivity facilitates daily and seasonal movement of wildlife, as well as long-range dispersal to support genetic diversity.
    - Habitat conditions provide security and refuge for wildlife to escape from stresses and threats, while still meeting basic needs.
    - Conditions within the CGNF near Forest boundaries provide diversity for resilience and natural movement patterns for a wide range of species across administrative boundaries.

Goals for Revised Alternatives (B-E)

- Cooperate and collaborate with other agencies and Tribal governments to develop conservation strategies and recovery plans for at-risk species.
- Coordinate management actions with other federal, state and local agencies, Tribes, and adjacent land owners.
- Through cooperation with willing landowners and other entities, non-federal lands within the Forest boundary are acquired, or managed under conservation easements where needed to maintain or restore habitat connectivity
- Engage in partnerships to conduct ecological research, improve or coordinate inventories and monitoring, and expand data/knowledge collection where needed.
- Work with partners to develop and disseminate information designed to increase public awareness of the high value of wildlife diversity and habitat connectivity.

Guidelines for Revised Alternatives (B-E): Do not create movement barriers to wide-ranging species except where necessary to provide for human or wildlife safety. Infrastructure; e.g. fences, stock tanks located and designed to minimize impacts on wildlife.


Photo: Bearsmart. com


Photo Credit: Joe Riis


Photo: Hopeland Research & Extension Center

CGNF Plan definition of "barrier": A physical obstruction that precludes the movement of animals.

Wildlife are resourceful and adaptive; not all modifications are “barriers”


Photo: Douglas McCartney


Photo: Chuck Bartlebaugh

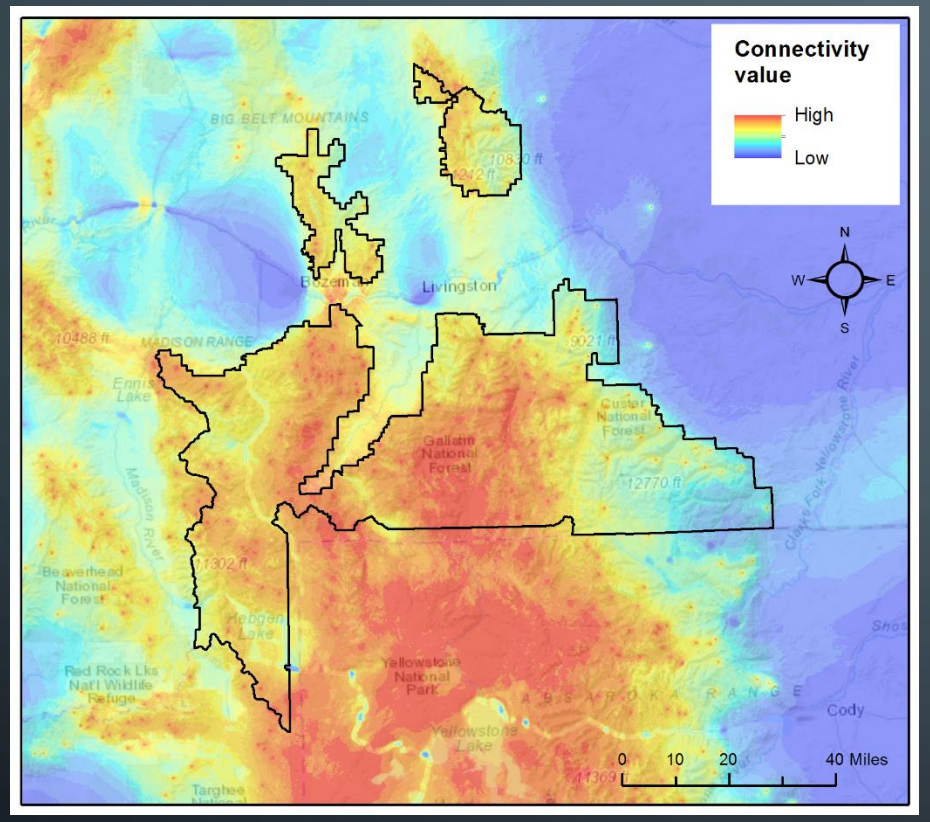

Photo from: Cats of Canada
International Society of Endangered Cats

Some structures actually facilitate wildlife movement

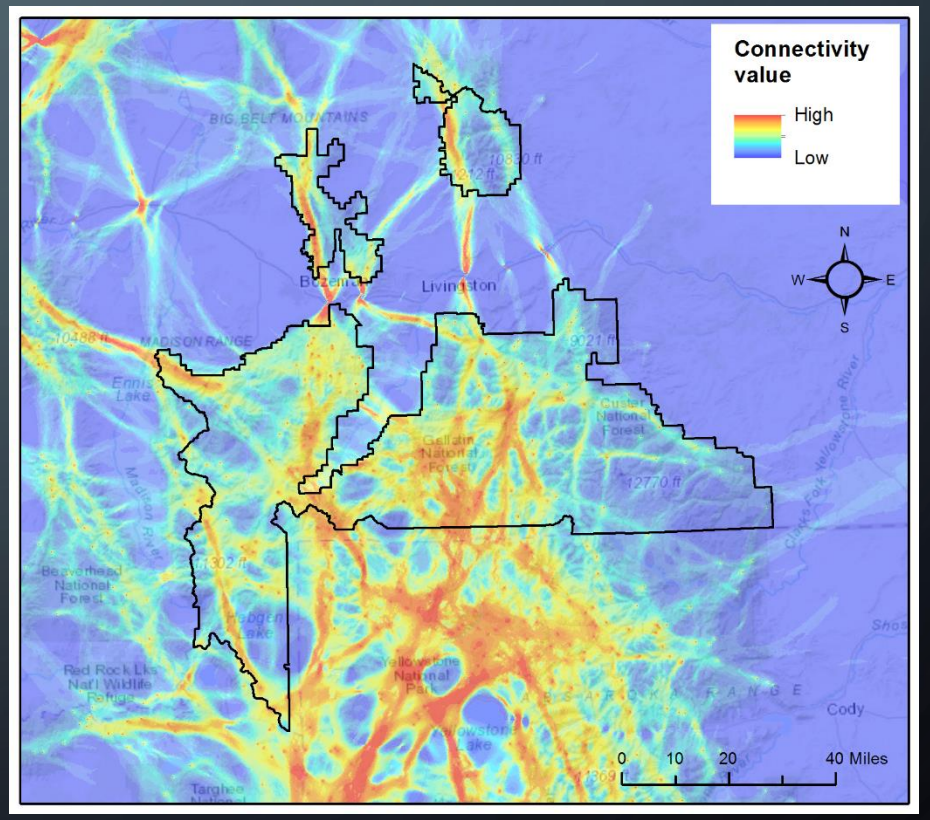

Photo: Parks Canada


Photo: Derek Jerrell

Connectivity Model Results: Useful in wildlife analyses



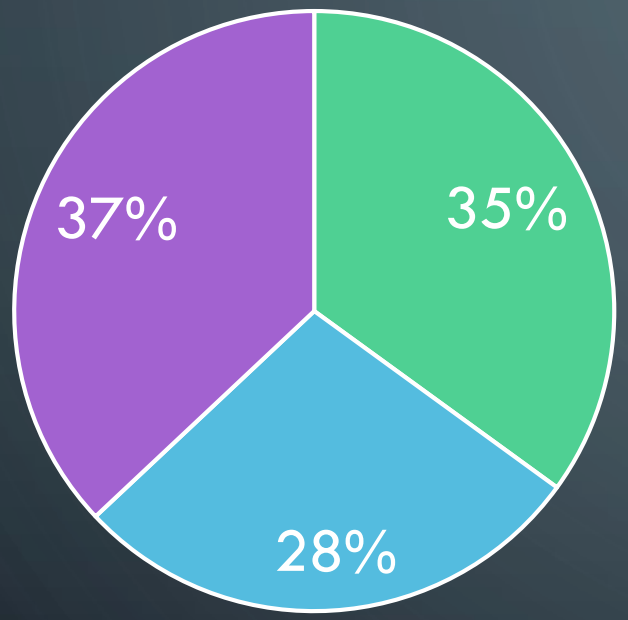
Large Forest Species- Random Movement



Large Forest Specialists – Optimal Movement

Habitat Connectivity Analysis

Entire CGNF Land base



Habitat	Wilderness	IRA	Total
Forest – optimal	49	34	83
Forest – random	73	17	90
Alpine – optimal	89	7	96
Alpine – random	98	1	99
Grass – optimal	0	7	7
Grass – random	0	8	8
Shrub	0	0	0

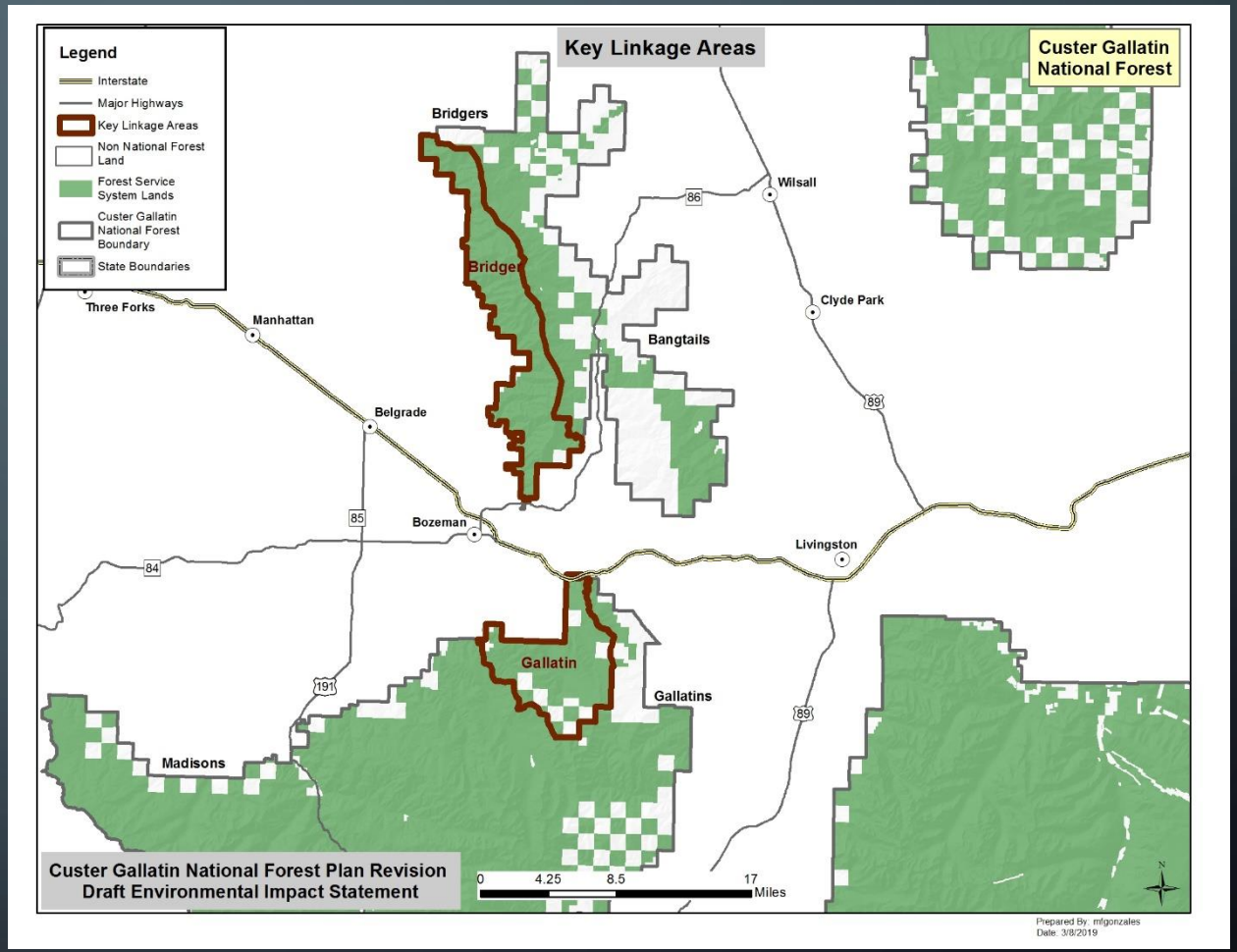
Table shows top 1 percentile of connected habitats for large species

KEY LINKAGE AREAS: Alternatives B, C and D

Areas of high connectivity value; terrain naturally influences ecological flow patterns

More development outside FS boundaries

Higher potential for management actions



Plan Components for Key Linkage Areas

Alternatives B, C and D

Guidelines:

- Vegetation management actions include design features to restore, maintain or enhance habitat connectivity for long distance range shifts of wide-ranging wildlife species
- New permanent features should not be constructed unless needed to address on-going or imminent resource concerns within the key linkage area
- Key linkage areas should be free of substantial disturbance (i.e. major projects) for at least four years out of every ten-year period, including at least two consecutive years of no substantial disturbance*

*Substantial disturbance includes the use of heavy equipment or low-level helicopter flights for vegetation management for a total of more than 30 days throughout the entire key linkage area in any calendar year.

Fine Filter Plan Components

(Generally apply forest-wide, Alternatives B-E)

Bats: Minimize risk of disease transmission

Bats and Birds: Wind energy developments located and designed to minimize impacts

Big Game: Maintain habitat security during hunting seasons

Bighorn Sheep: Minimize risk of disease transmission from domestic livestock

Bison: Facilitate progressive expansion of bison use areas

Canada Lynx: Maintain habitat connectivity within and between lynx analysis areas

Greater Sage-grouse: No net loss of priority or general habitat

Grizzly Bears: Maintain secure habitat; limit human development; limit livestock presence

Prairie Dogs: Limit new construction near colonies and restrict use of toxicants for control

Reptiles & Amphibians: Avoid ground disturbance near reproductive areas and hibernacula

Wolverine: No increase in winter special use permits or designated routes in maternal habitat

ACKNOWLEDGEMENTS

GREATER YELLOWSTONE COORDINATING COMMITTEE

CINNABAR FOUNDATION

Great Northern LANDSCAPE CONSERVATION COOPERATIVE

Custer Gallatin National Forest

THE CENTER FOR LARGE LANDSCAPE CONSERVATION

ANY QUESTIONS?