CORRIDOR PLANS

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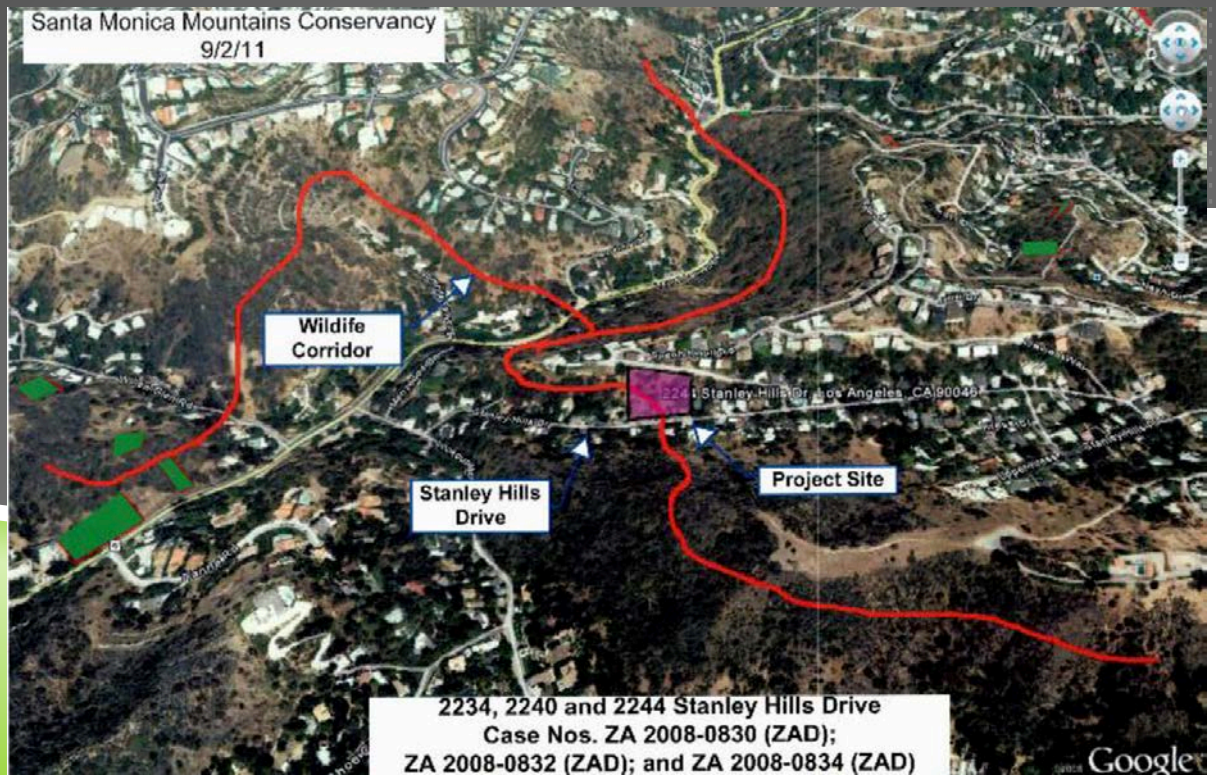
HISTORY

- As learned about effect of habitat loss and fragmentation, realized this is an area where land use management could positively influence outcomes
- As development has increased, becoming more important
- With climate change, connectivity seen as a factor that may increase resiliency, allow species to move as their habitat moves



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DEFINITIONS

Structural connectivity: Mostly continuous vegetation or protected lands (e.g., no roads) that we can see/map

Functional connectivity: An animal, plant, or process (e.g. fire) of interest uses the connection with characteristics that may be defined based on things can see or other characteristics (e.g. low human use). This is specific to a conservation target.

Conservation Target	Advantages	Disadvantages
Individual species or process of high importance	Robust science to support decisions.	Time-consuming/costly.

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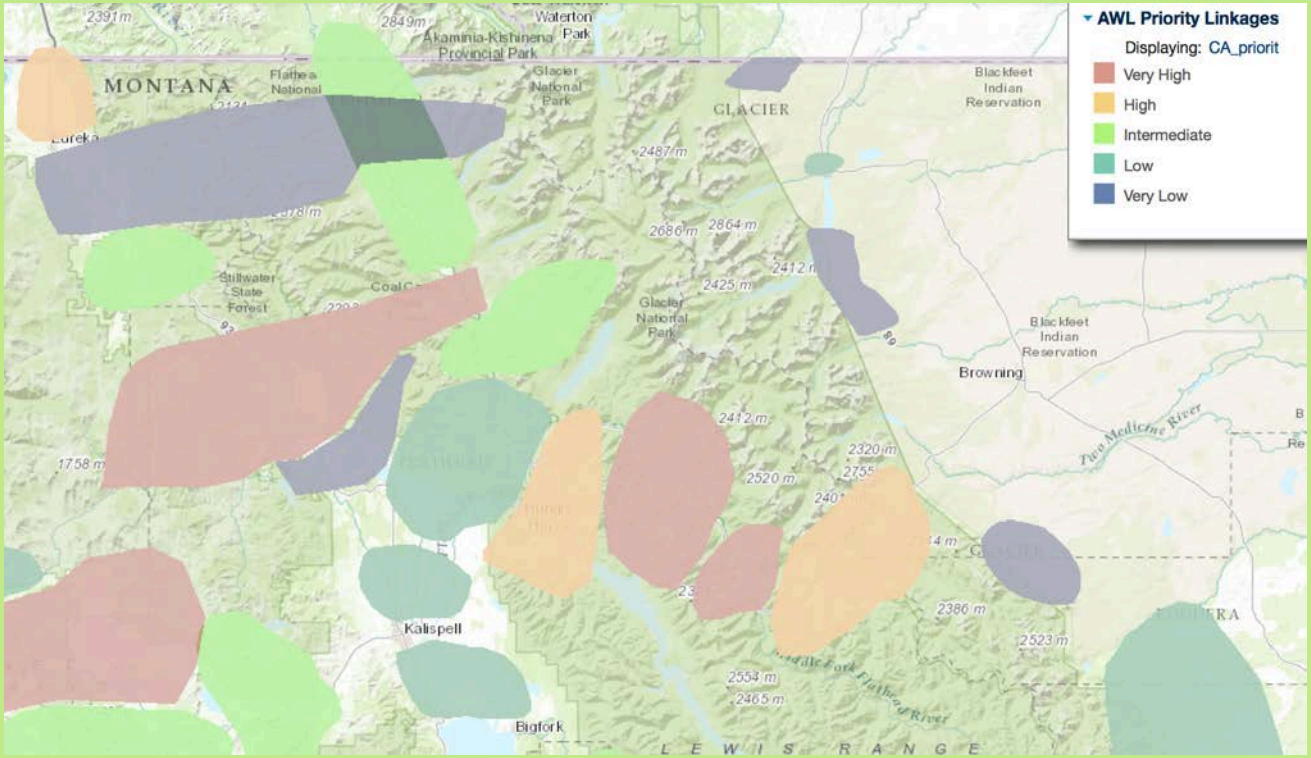
Land facets: i.e., connect similar topographic characteristics	Relatively fast, cheap. Topography unlikely to change quickly (potentially buffers corridor from climate effects).	High uncertainty as to connection of particular species/processes.

CONSERVING CONNECTIVITY

- Possible to create corridors that connect populations of animals
- Broad-scale/regional level often involves identifying general areas where connectivity is important- big circles, polygons, large arrows



- At the finer scale, when want to manage land use, many approaches but all share an underlying cost, or resistance surface.

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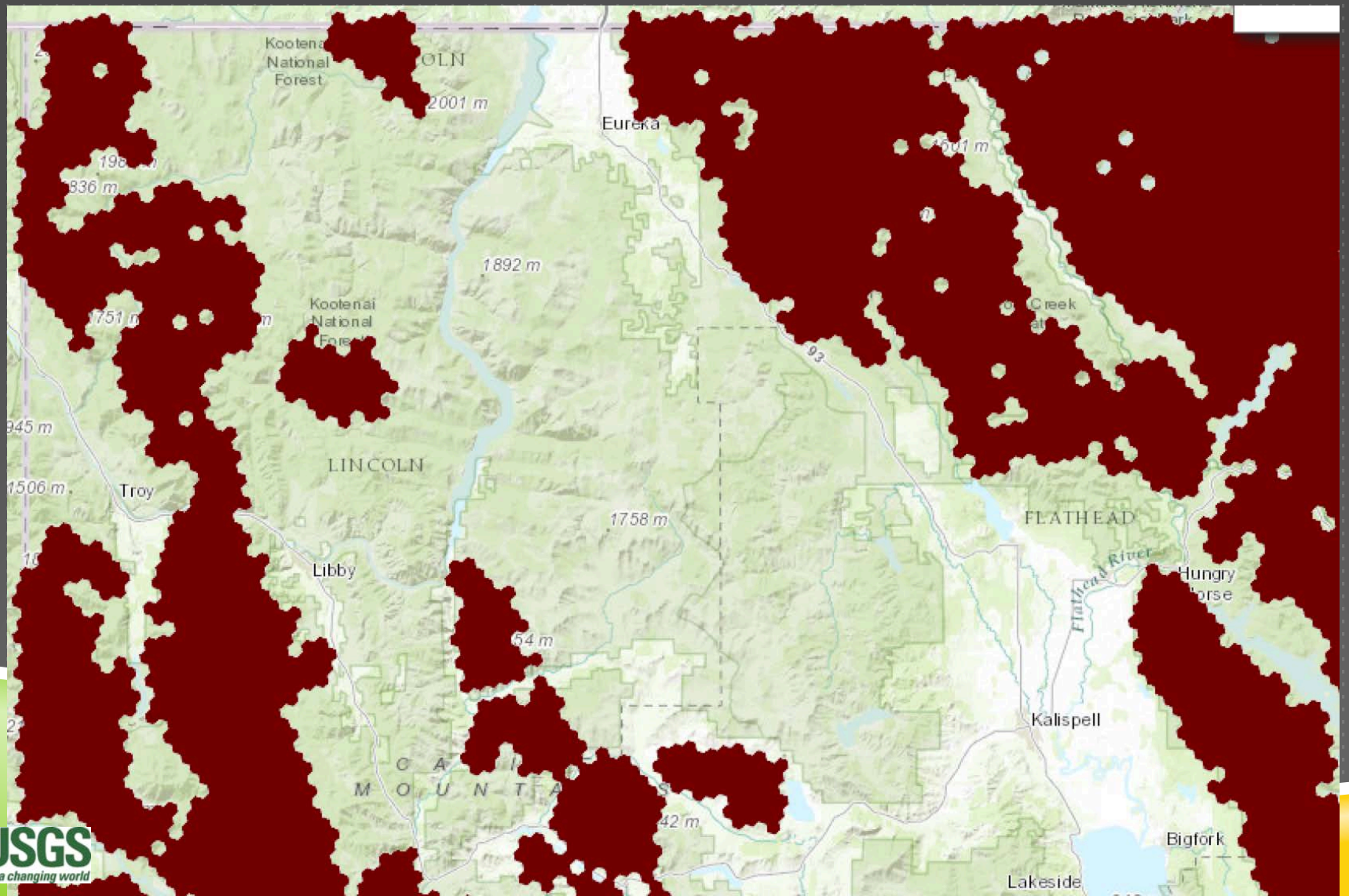
CORRIDOR PLANS

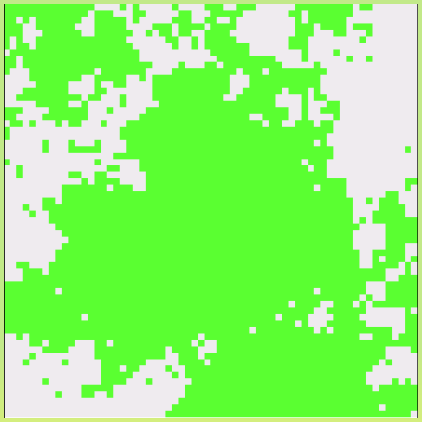
1) Choose places to connect (e.g., wildland blocks)



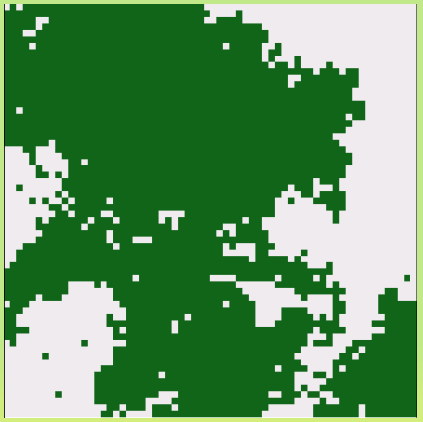
CORRIDOR PLANS

1) Choose places to connect (e.g., wildland blocks)
2) Identify variables influencing movement and survival (if a species)

Berry presence=0
Berry absence=1



Meadow=0
Forest=1



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CORRIDOR PLANS

1) Choose places to connect (e.g., wildland blocks)
2) Identify variables influencing movement and survival
3) Guess at or quantify the strength of those influences for each variable to get **resistance per pixel**

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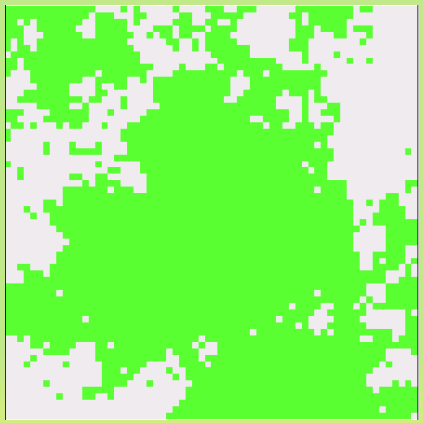

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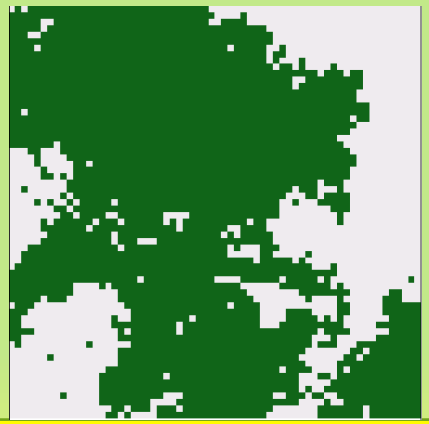

Resistance per pixel:

Berry presence=1
Berry absence=5

Meadow=1
Forest=20

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CORRIDOR PLANS

1) Choose places to connect (e.g. wildland blocks)
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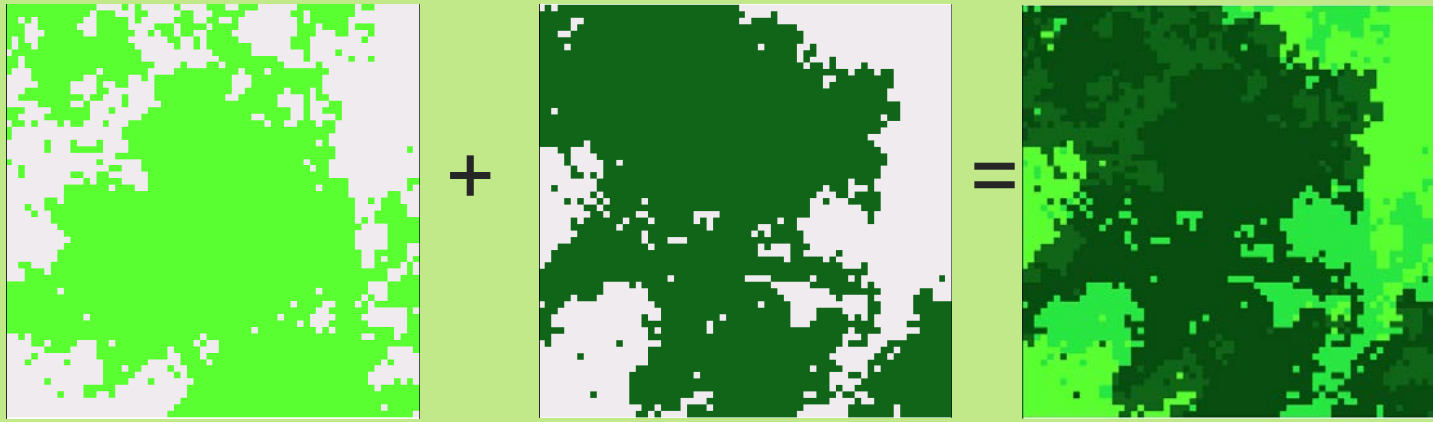
4) Combine costs across variables to get a **resistance surface**



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$2 to $25

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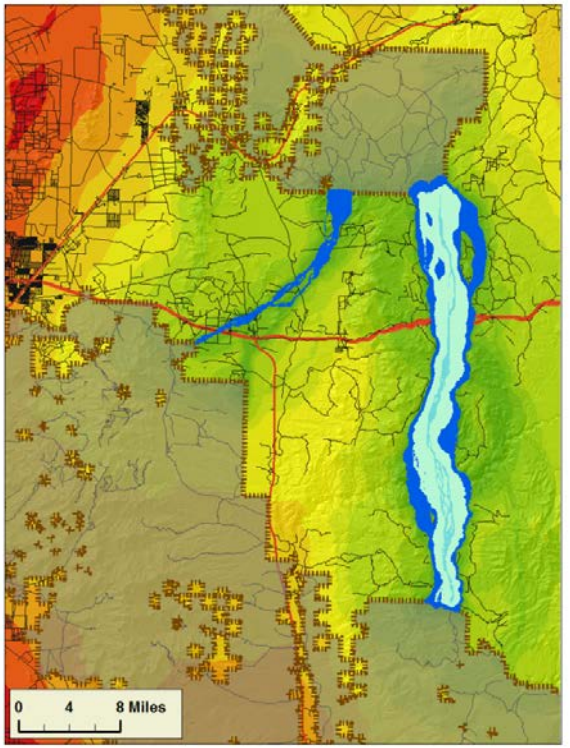
4) Combine costs across variables to get a resistance surface
5) Find routes that minimize cost distance
    a) Least cost paths or corridors
    (based on route with lowest cost to traverse)
    b) Individual based simulations
    (retaining simulations that reach the other side)



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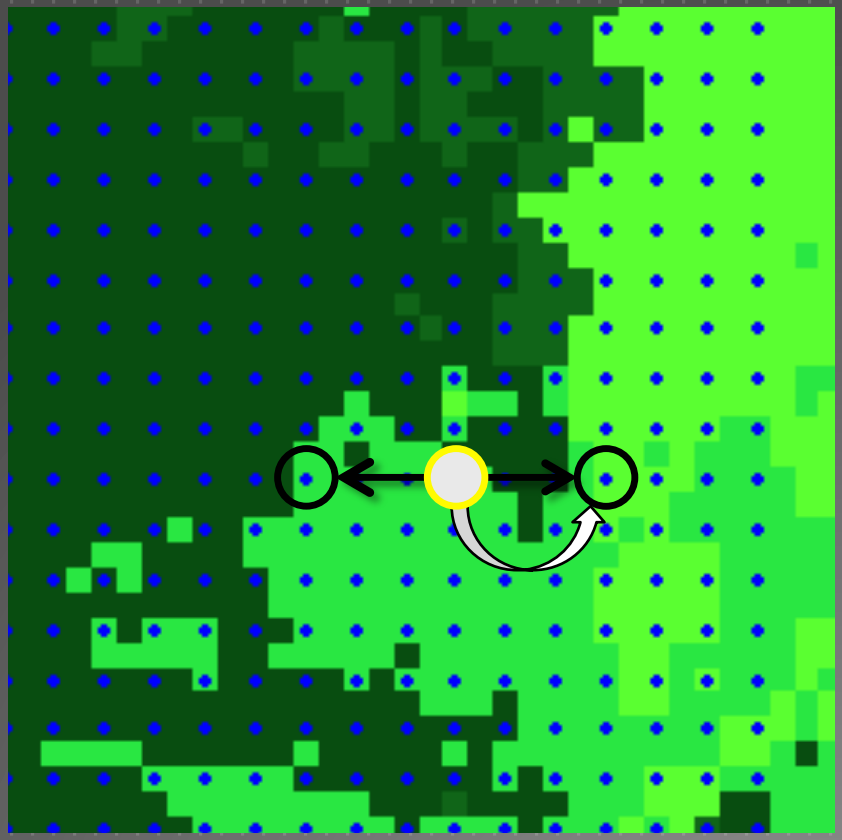
LEAST COST DISTANCE



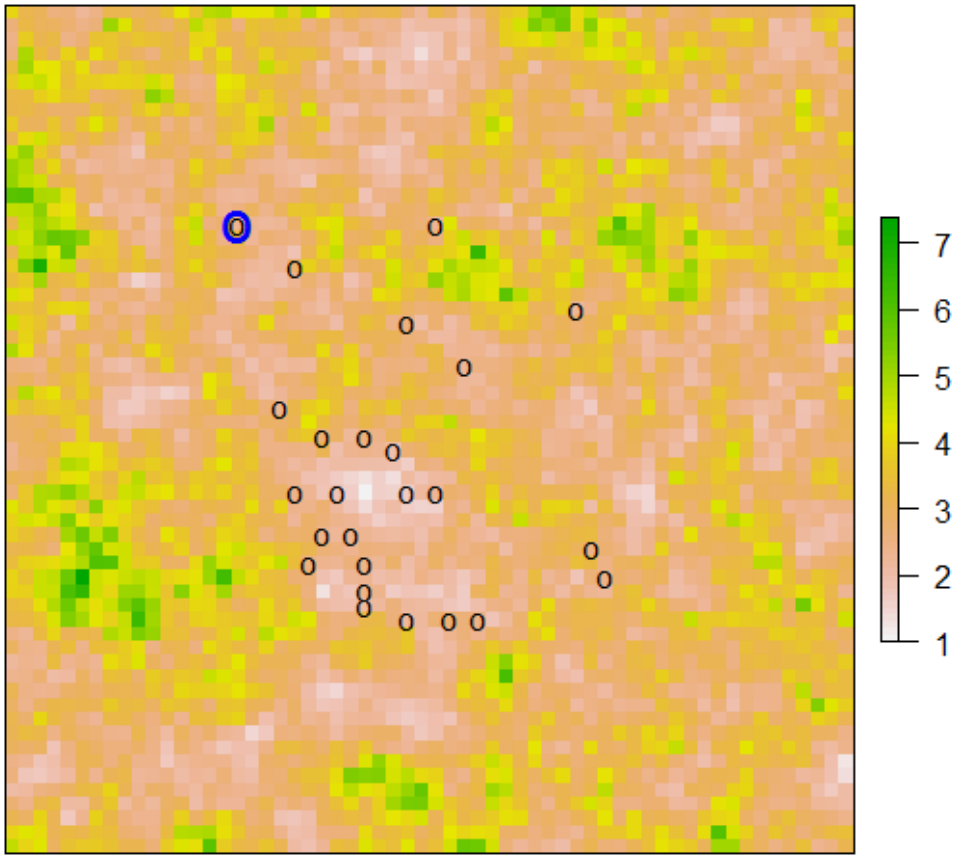
3 distance units * $2/unit = $6

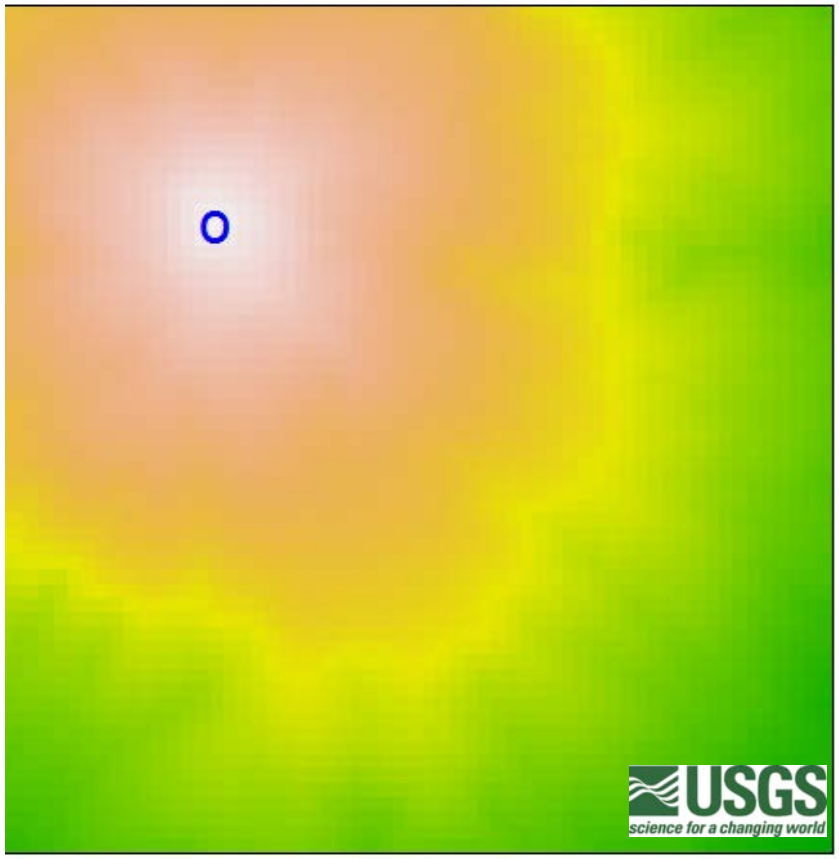
2 distance units*$20 + 1*$2 = $42

6 distance units * $2/unit = $12

LEAST COST PATH

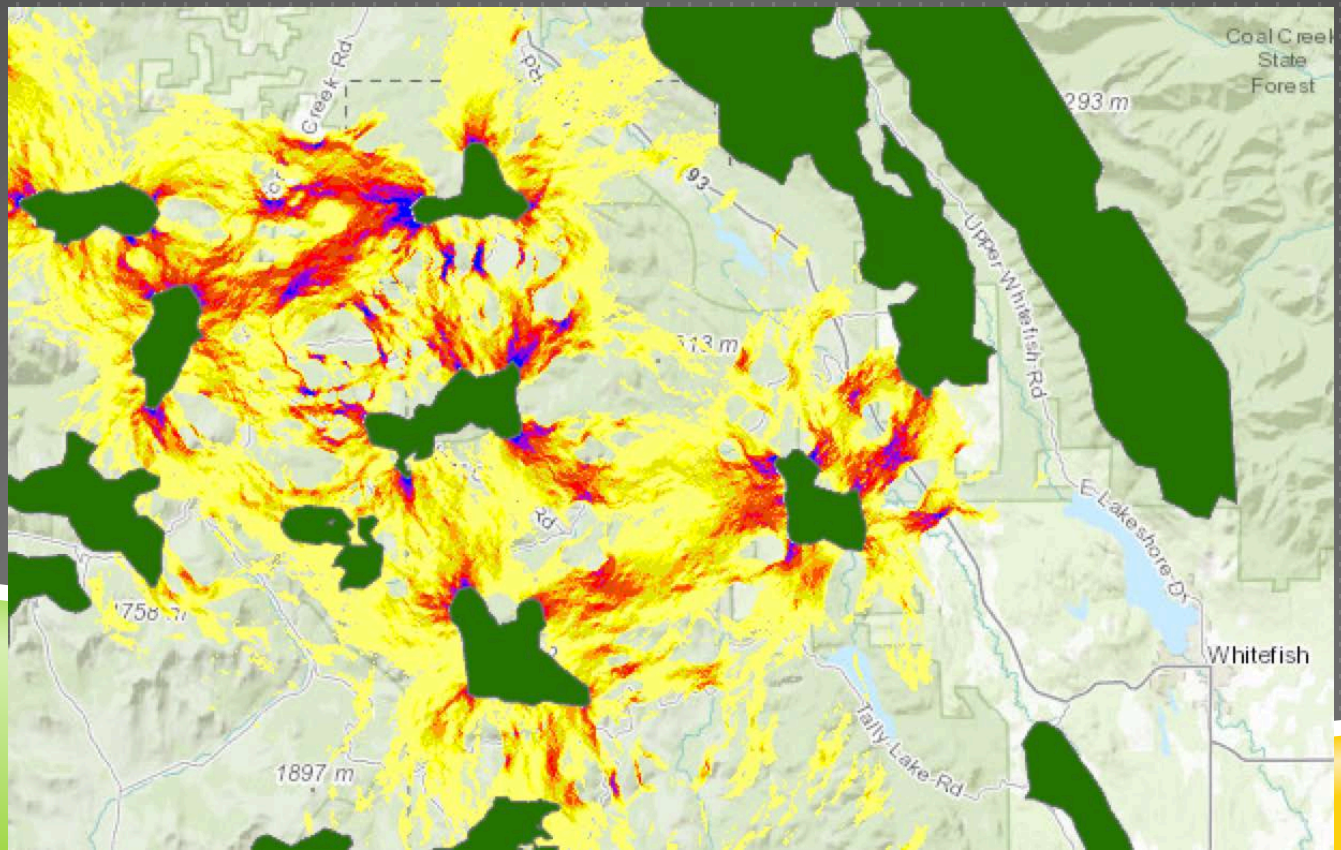
- Assumes species has 'knowledge' of best path
- Does not indicate whether the least cost distance along that path is short enough for animals/plants to use it





CIRCUIT THEORY

- Treat movement/dispersal like an electrical circuit where
  - More paths means lower total **Resistance Distance** between places
- Can use for landscape planning (see pinchpoints and alternate paths)
- Assumes random movement



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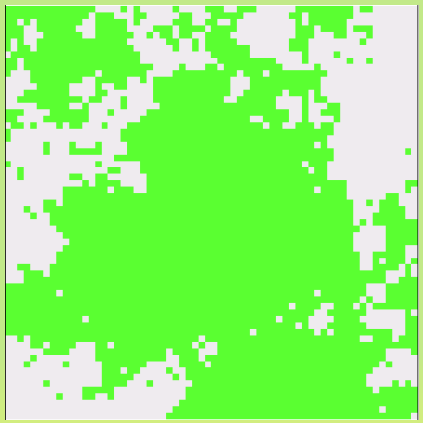

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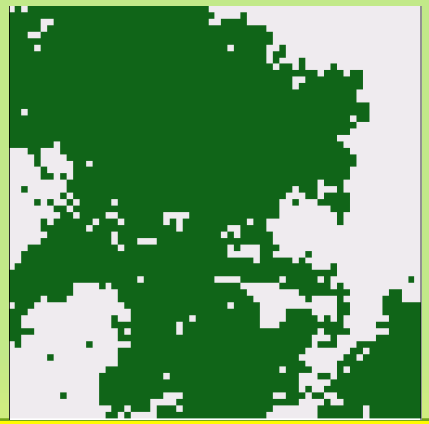

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DATA-DRIVEN APPROACHES

Focal process	Data
Occupancy	Presence/Absence
Habitat	Telemetry/GPS
Individual movement	Telemetry/GPS (more complex analysis than habitat)
Gene flow	Genetic sampling in different areas want to connect
Dispersal	Telemetry on dispersing individuals; genetic parentage

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DATA-DRIVEN APPROACHES

Focal process	Data	Convert to Resistance
Occupancy	Presence/Absence	Assumptions vary
Habitat	Telemetry/GPS	Typically assume inverse relationship
Individual movement	Telemetry/GPS (more complex analysis than habitat)	Assume dispersal is similar to daily movement
Gene flow	Genetic sampling in different areas want to connect	Estimates likely biased and may not identify subtle factors, but likely identifies major factors
Dispersal	Telemetry on dispersing individuals; genetic parentage	Can estimate it or 'know' specific paths, assume reproduction happens with enough dispersal

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DATA-DRIVEN APPROACHES

Focal process	Data	Convert to Resistance	Cost/certainty
Occupancy	Presence/Absence	Assumptions vary	Low/moderate
Habitat	Telemetry/GPS	Typically assume inverse relationship	Moderate/moderate (unless extrapolate)
Individual movement	Telemetry/GPS (more complex analysis than habitat)	Assume dispersal is similar to daily movement	Moderate/moderate
Gene flow	Genetic sampling in different areas want to connect	Estimates likely biased and may not identify subtle factors, but likely identifies major factors	Low-moderate/ moderate
Dispersal	Telemetry on dispersing individuals; genetic parentage	Can estimate it or 'know' specific paths, assume reproduction happens with enough dispersal	High/high

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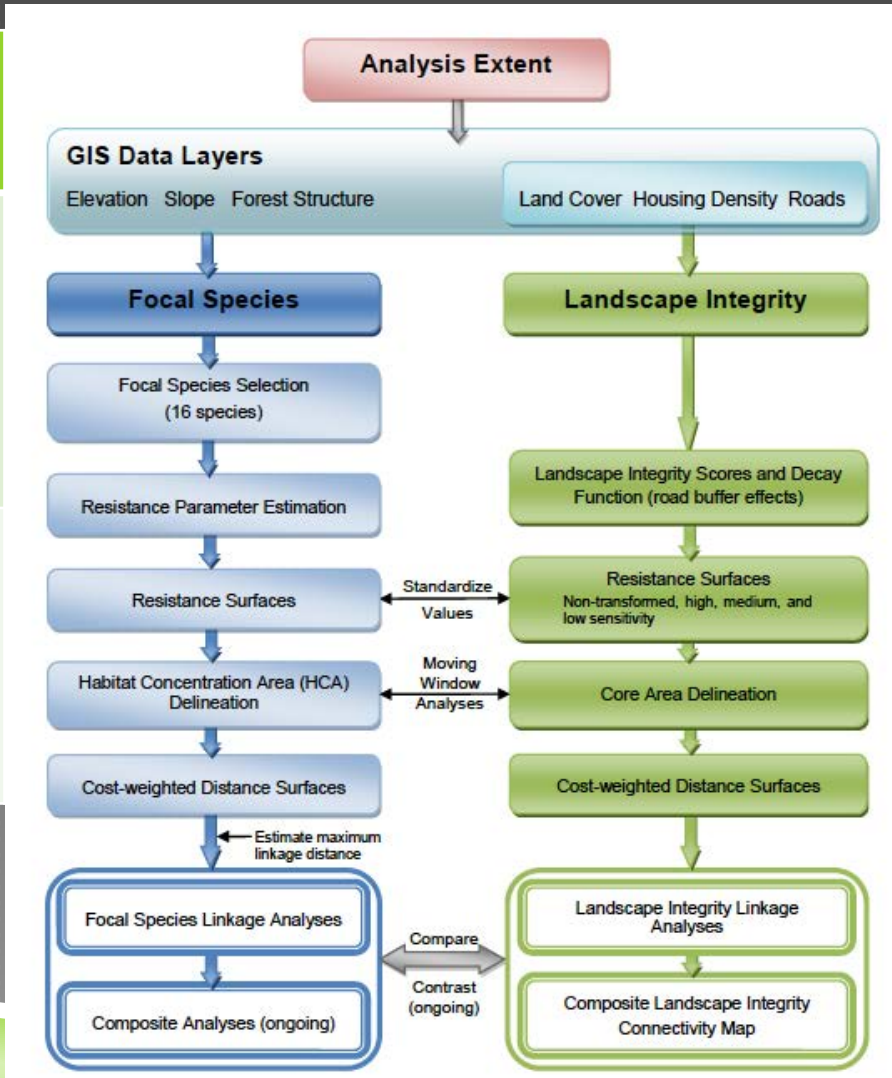
EXPERT-DRIVEN APPROACHES

Ideal	Approaches
Based on best available research/data	Provide literature to experts prior to asking them to rate the costs
Confront uncertainty	Ask experts to weight strength of knowledge; use species with strong structural association; conduct sensitivity analysis
Transparent	Fully describe process in plain speak and make intermediate and final products available to public
Inclusive	Invite all stakeholders so can incorporate local knowledge and build investment
Described use of math / statistics appropriately	Make assumptions clear, use calculate vs. estimate appropriately

WASHINGTON CONNECTED EXAMPLE

Ideal	Approaches
Confront uncertainty	Used species with strong vegetation association
Transparent	Fully describe process



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VALIDATION- CONSISTENCY

- Especially important for expert-opinion based approaches, but also important to examine assumptions made in data-based approaches such as extrapolation to areas not sampled and changes in processes over time (e.g., habituation to road-crossing structures, increase in human activities precluding use)
- Also important to understanding what works and doesn't work into the future.

BEAR PROJECTS

Focal process	Data	Convert to Resistance	Cost/certainty
Gene flow	Genetic sampling in different areas want to connect	Estimates likely biased and may not identify subtle factors, but likely identifies major factors	Low-moderate/ moderate

- Validated with GPS telemetry data

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