Geospatial Habitat Assessment Tool "GeoHAT"

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Overview

Q: What is *GeoHAT*?

A: Broadly speaking…

A prototype for a coherent framework for evaluating sites based on value in ecosystem service provision

Overview

Q: What is *GeoHAT*?

A: More precisely…

A map-based tool that evaluates biodiversity support under alternative landscape scenarios

Strengths of *GeoHAT*

- Uses readily available national scale data

NLCD

DEM

NHD+

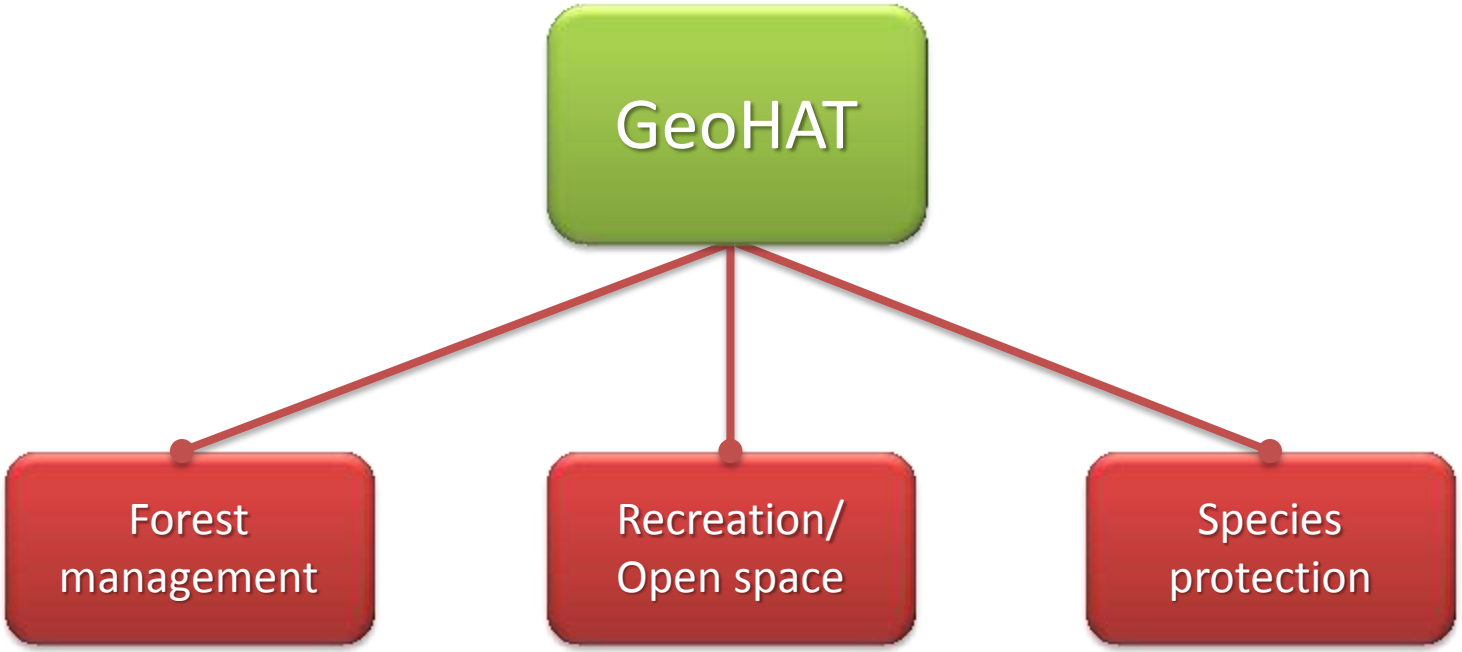
Element Occurrences

Protected Areas

SSURGO

Strengths of *GeoHAT*

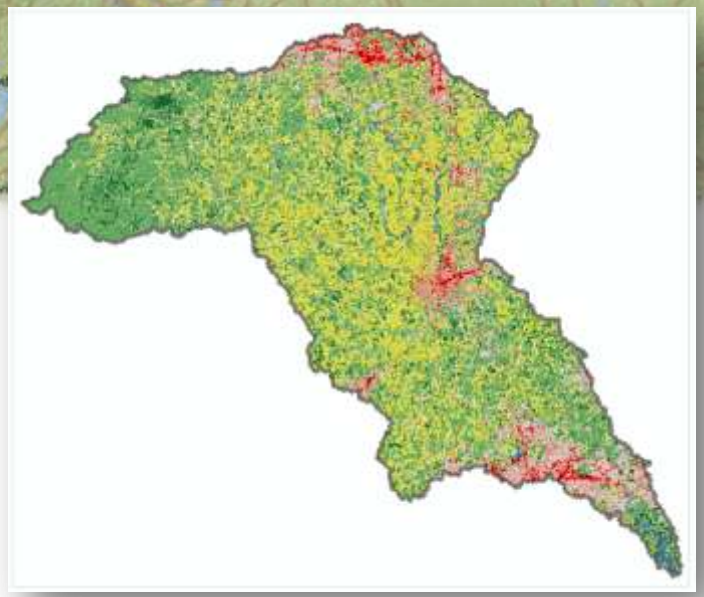
- Flexible - can be adapted to different objectives



Workflow

1. Define the study area & extract base data
2. Create habitat patches
3. Calculate patch attributes
   A. *Size/shape*
   B. *Spatial context*
   C. *Vulnerability*
   D. *Biodiversity support*
4. Apply a decision hierarchy
5. View the results

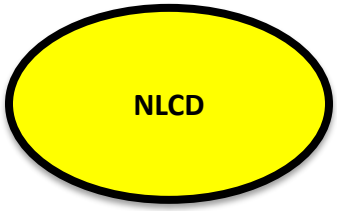
Case study: ***S. Fork Catawba River***



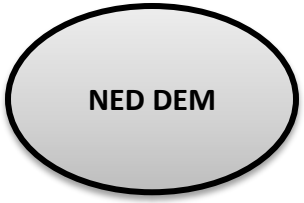
LandCover

- Open water
- Developed, open space
- Developed, low intensity
- Developed, medium intensity
- Developed, high intensity
- Barren land
- Deciduous forest
- Mixed forest
- Evergreen forest
- Shrub/scrub
- Herbaceous
- Hay/pasture
- Cultivated crops
- Woody wetlands
- Emergent herbacious wetlands

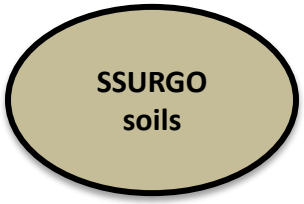
1. Define study area/extract data



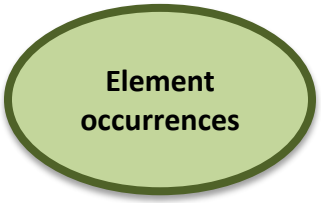
- Habitat
  - Patches
- Resistance surface
  - Context
- Development threat
  - Vulnerability



- Solar radiation
  - Abiotic zipcodes
- Topographic convergence
  - Abiotic zipcodes
- Relative slope position
  - Abiotic zipcodes



- Soil pH
  - Abiotic zipcodes
- Percent sand
  - Abiotic zipcodes



- Biodiversity support
  - Context

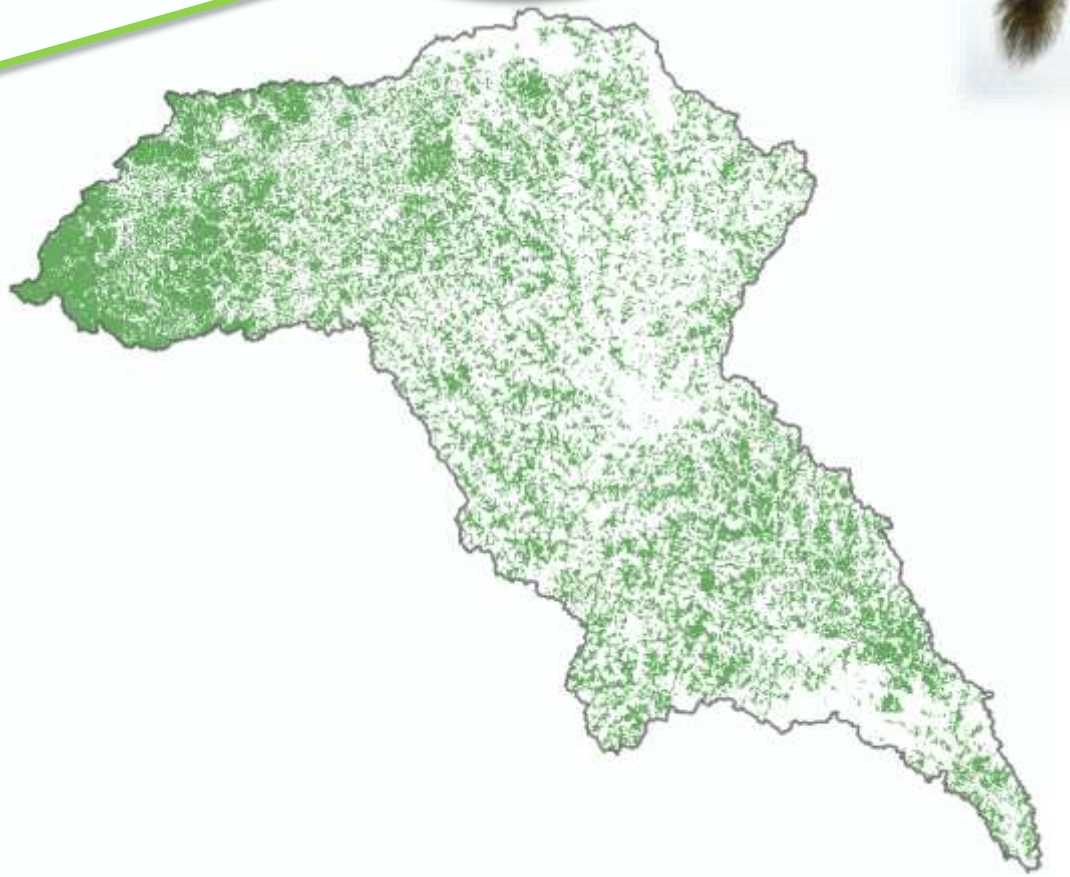
- Distance from…
  - Context
- Area within distance
  - Context

2a. Define “Habitat”

Habitat modeling

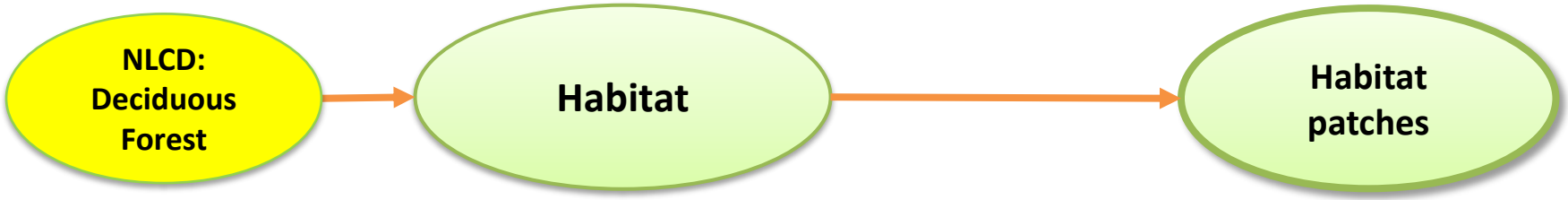
Habitat

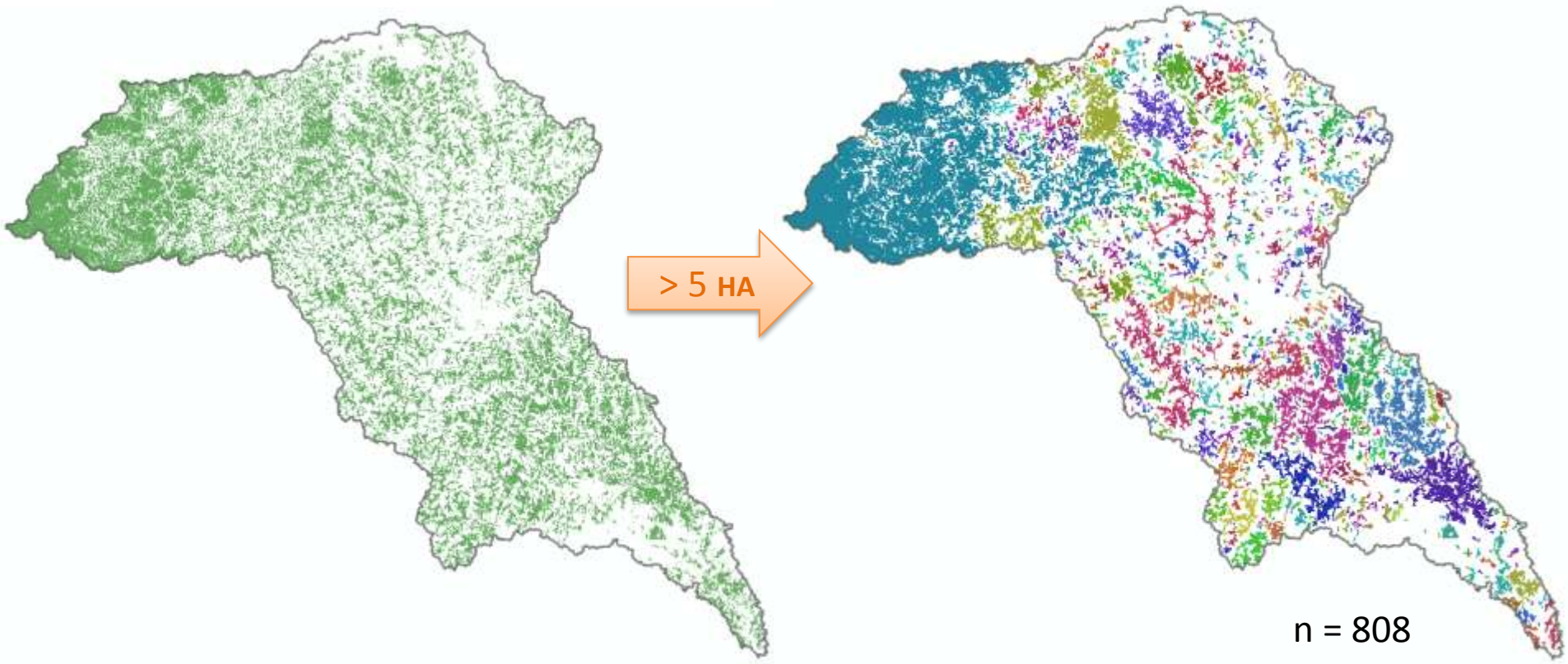
National Land Cover Dataset



Deciduous forest (NLCD = 41)

2b. Create habitat patches



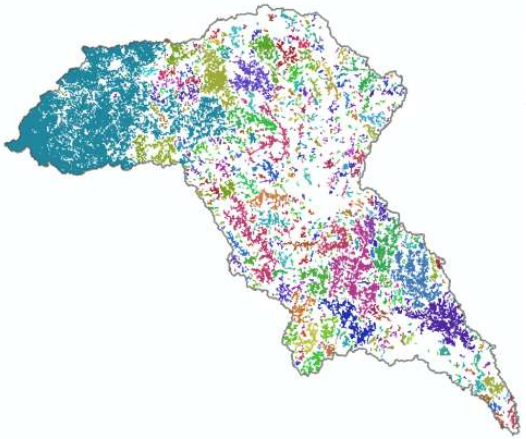


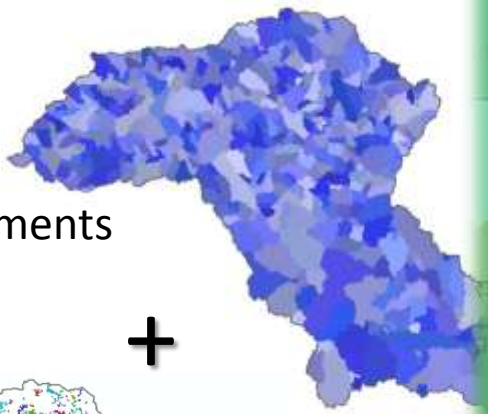
2c. Create habitat *sub*-patches

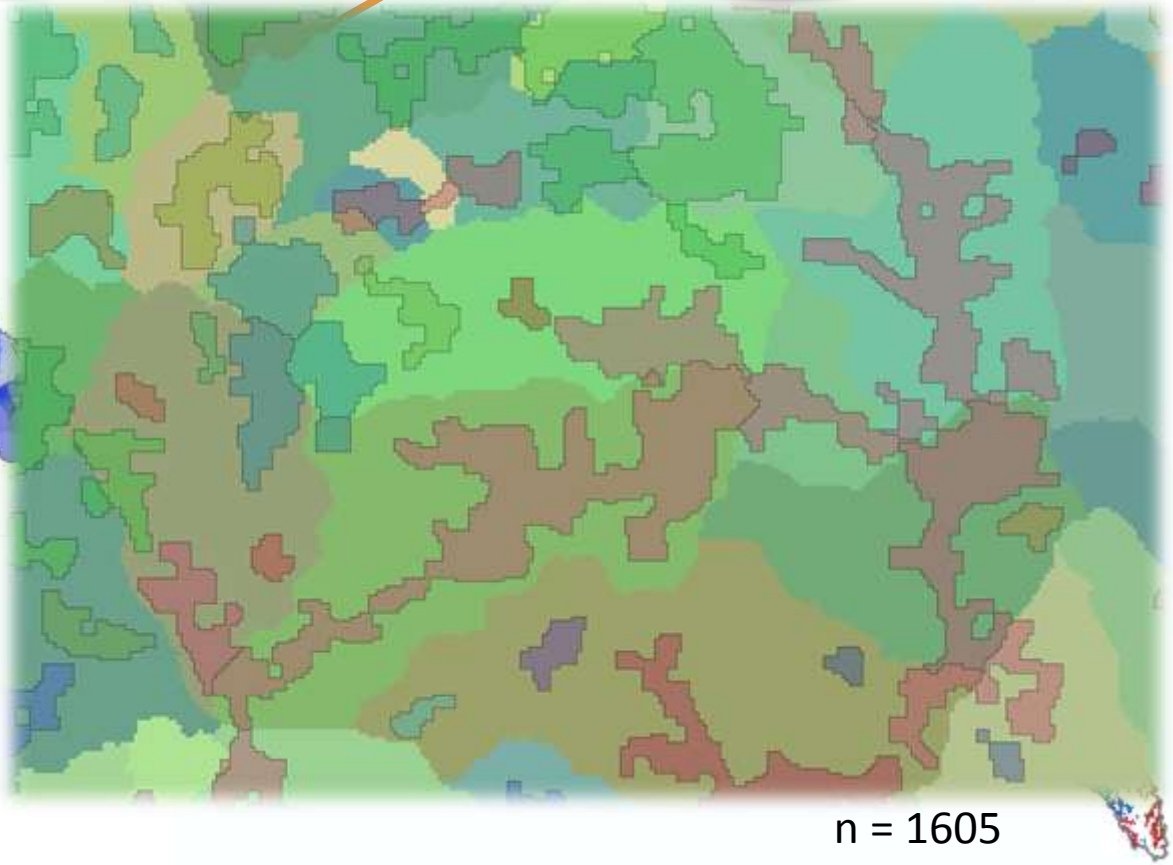
Habitat → **Habitat patches** → **Habitat *sub*-patches**

NHD catchments

+







n = 1605

3. Evaluate patches

A. Size & shape

B. Spatial context

C. Vulnerability

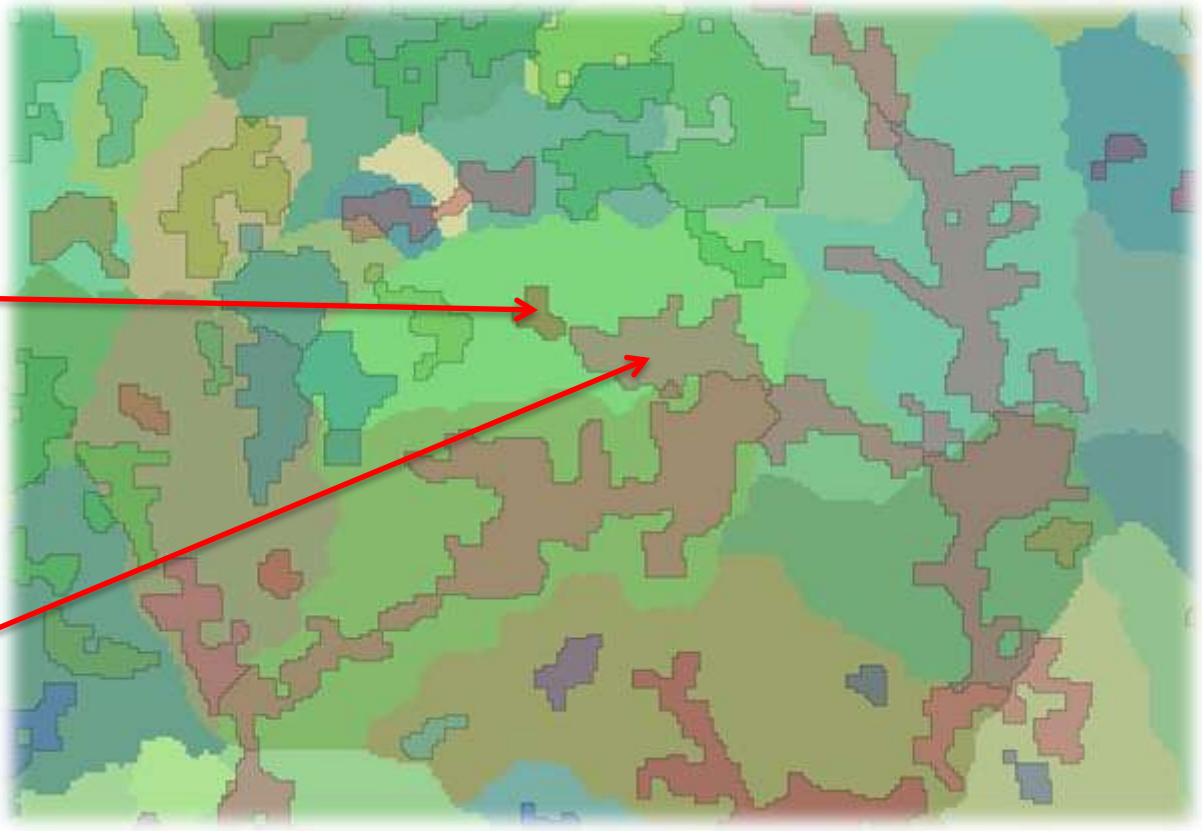
D. Biodiversity support

3A. Patch size & shape

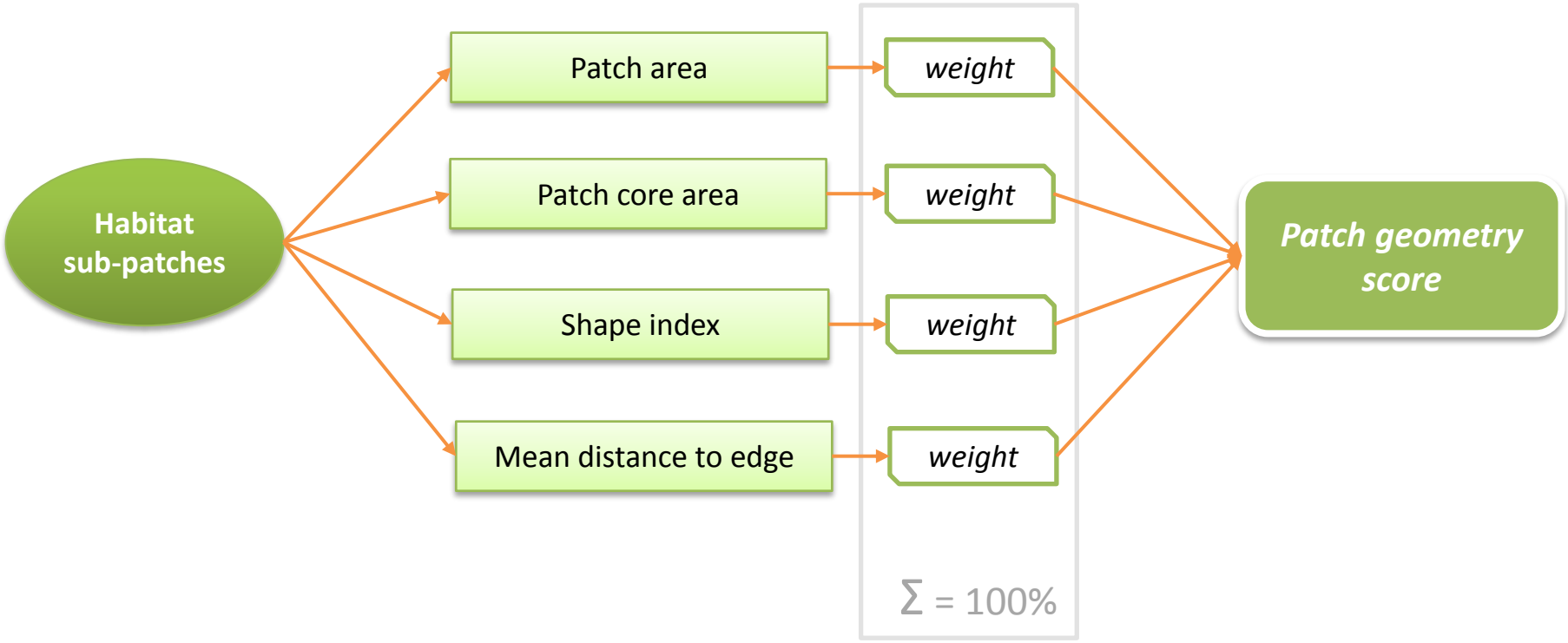
- Patch area
- Patch core area (edge = 60m)
- Core:Area ratio
- Shape index

PatchID	166
PatchArea_HA	7
CoreArea_HA	2
CoreAreaRatio	0.2841
ShapeIndex	0.75047

PatchID	175
PatchArea_HA	35
CoreArea_HA	18
CoreAreaRatio	0.5302
ShapeIndex	0.60454



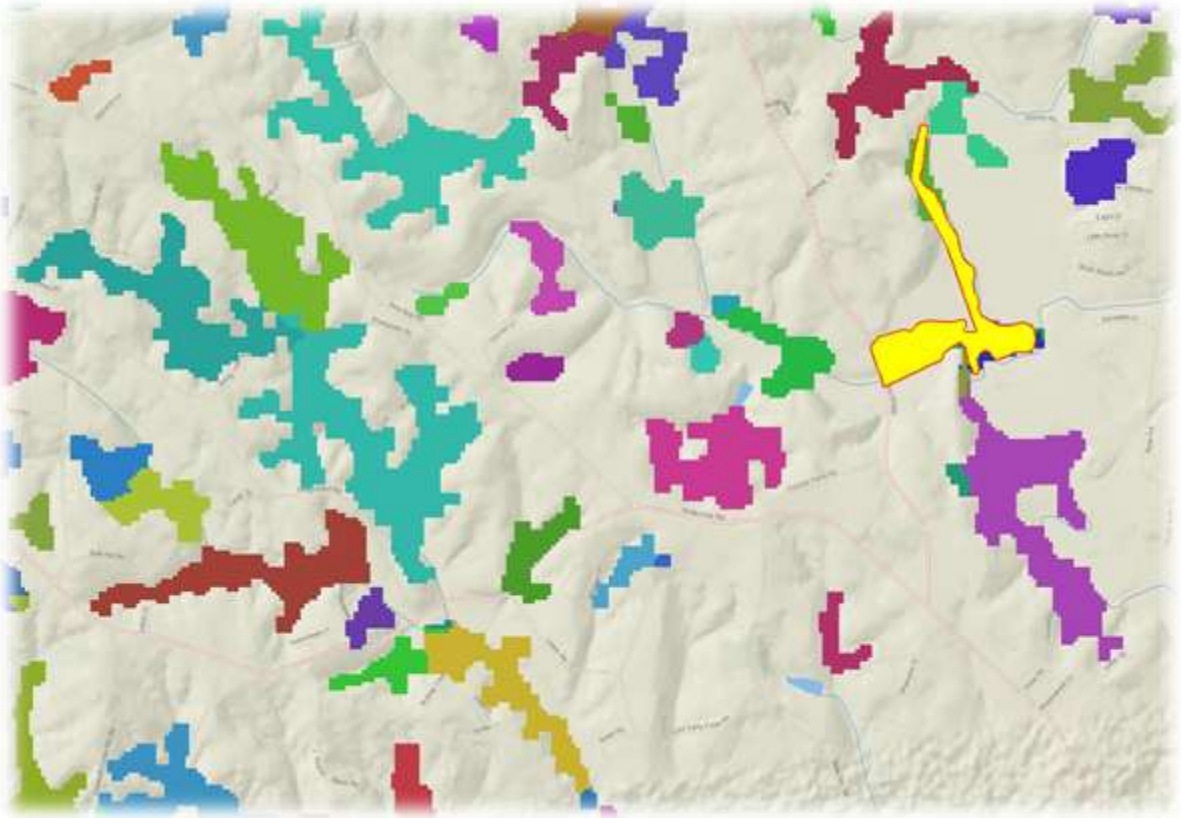
3A. Patch size & shape



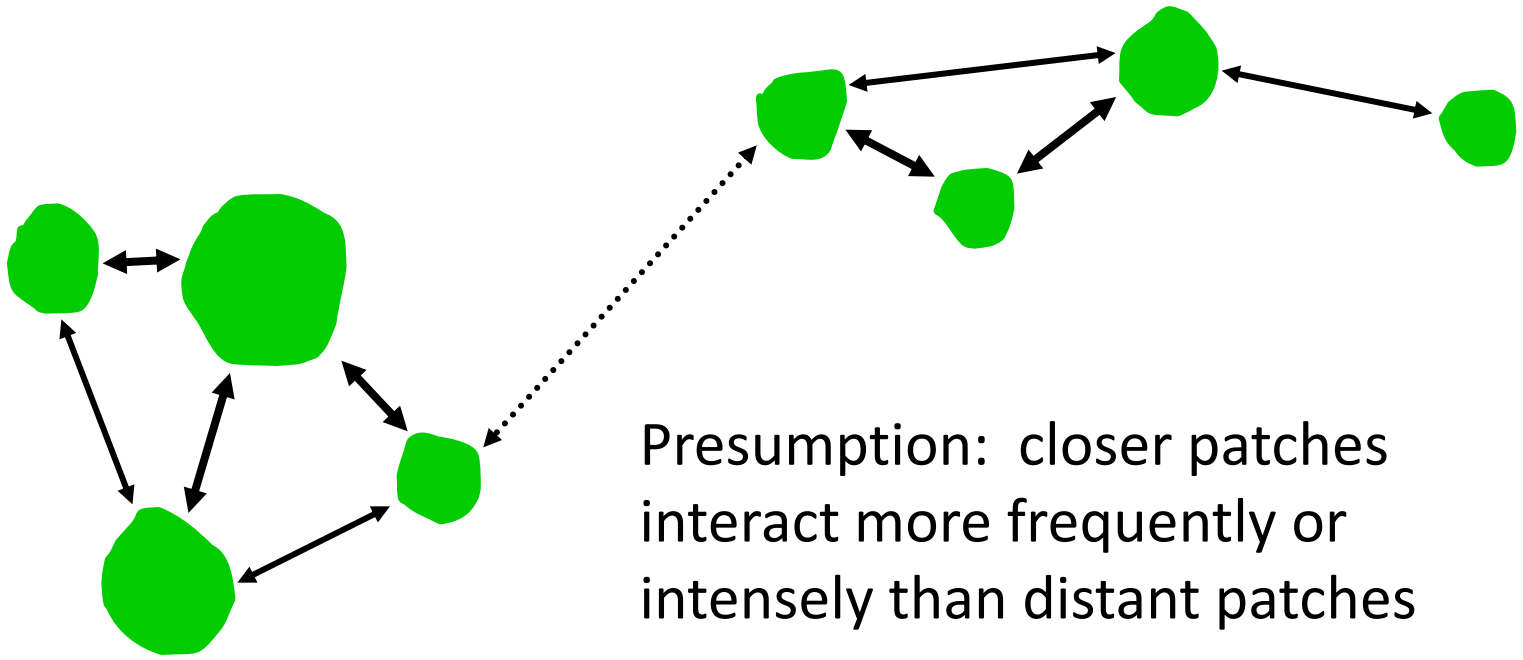
3B. Spatial context

i. Patch position relative to other patches – “Connectivity”

ii. Distance to existing protected areas – “Efficiency”



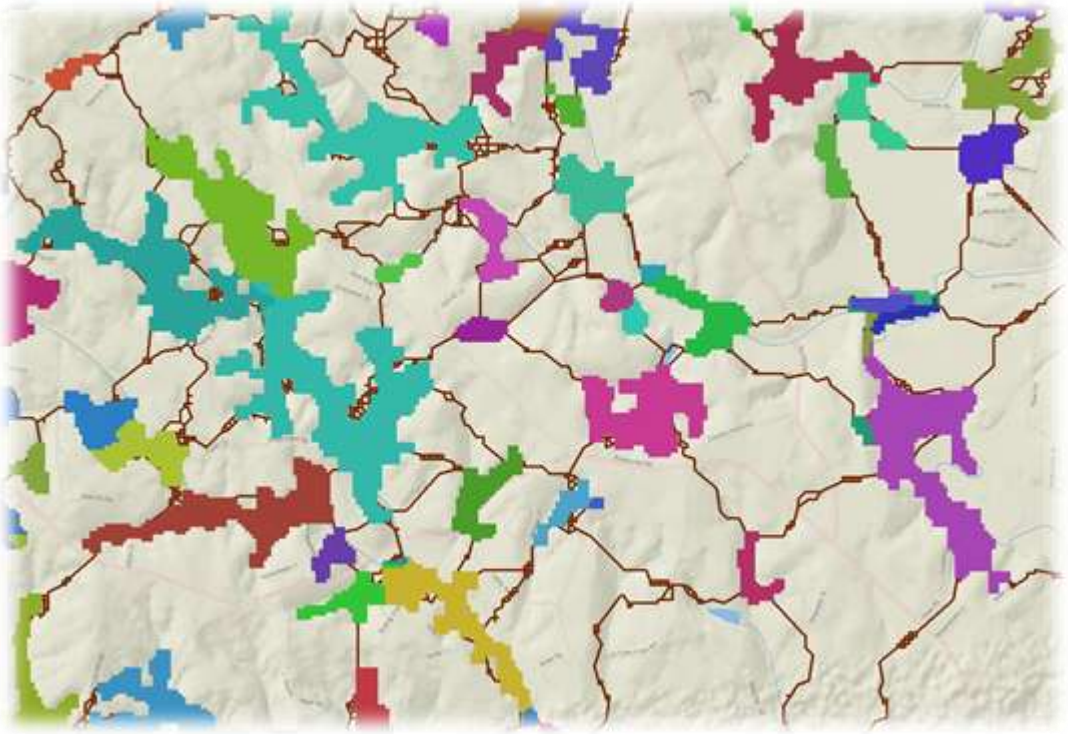
Patch connectivity



Presumption: closer patches interact more frequently or intensely than distant patches

Patch connectivity

Least cost paths among patch pairs



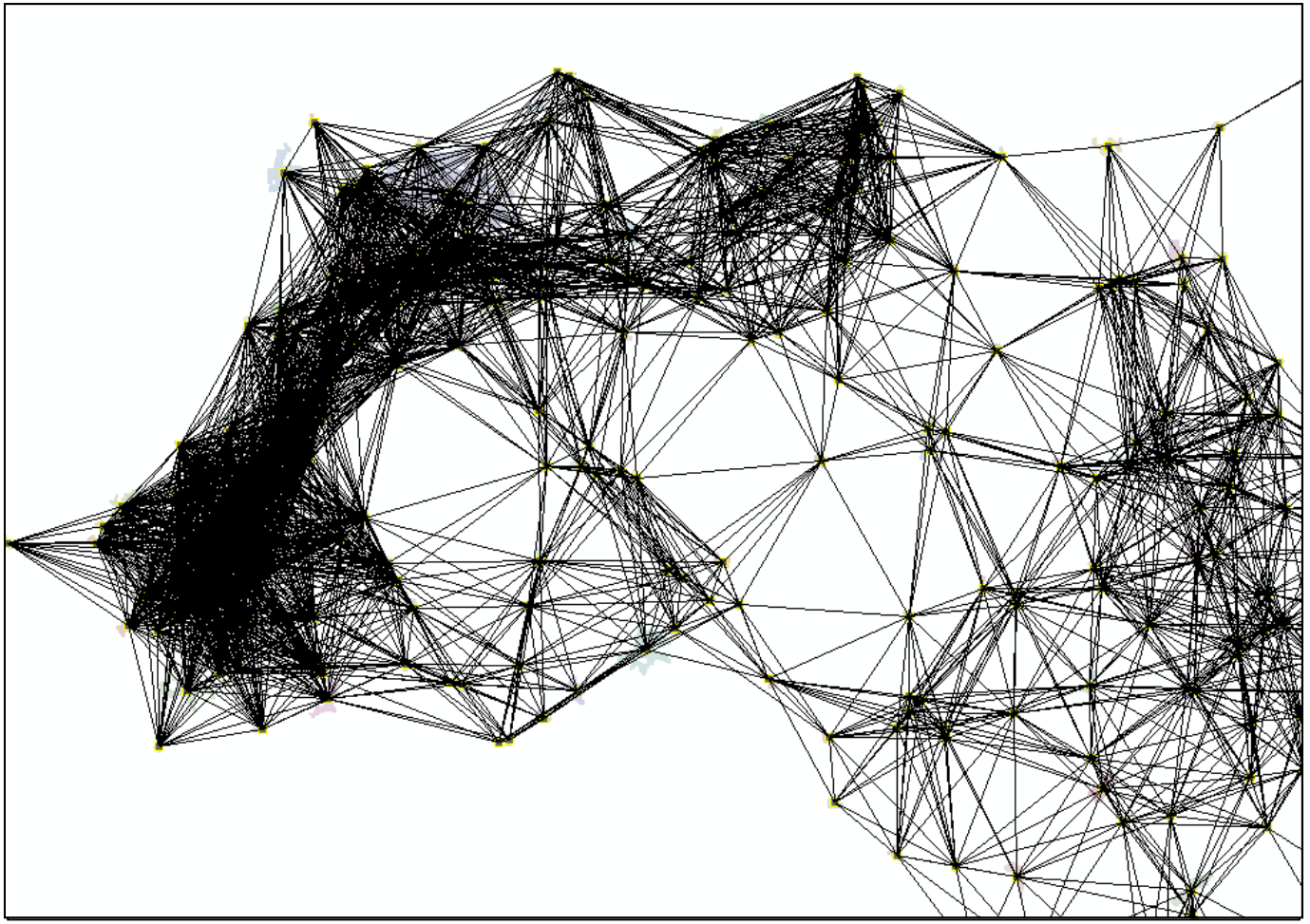
Edge list

FromID	ToID	Cost
2	4	434.56
2	5	180
6	8	180
9	14	0
17	20	127.28
18	19	90
18	34	0
18	35	307.28
20	29	974.57
23	26	1018.24
28	55	217.28
28	67	0
29	30	180
31	32	60
34	35	180
35	39	180
36	69	180
36	82	180
40	41	180
40	44	180
41	44	434.56
43	45	0
44	49	180
44	57	180

Graph analysis

Centrality metrics

Patch connectivity

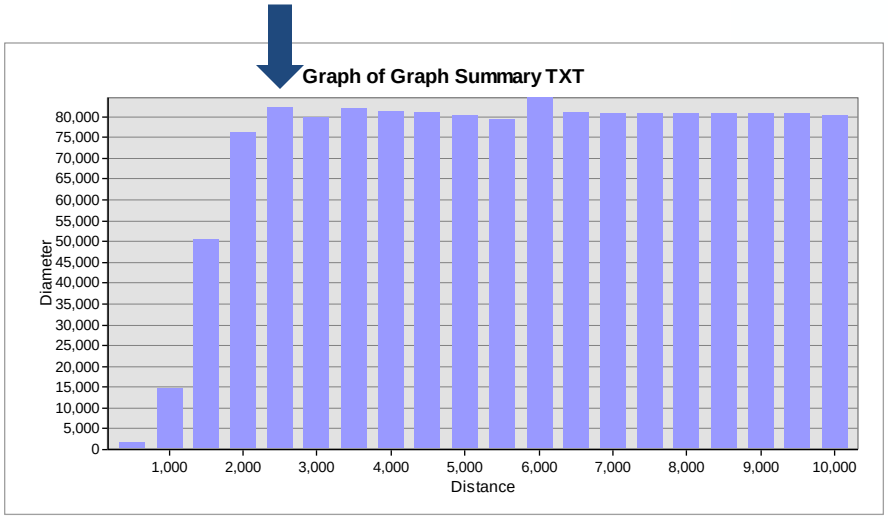


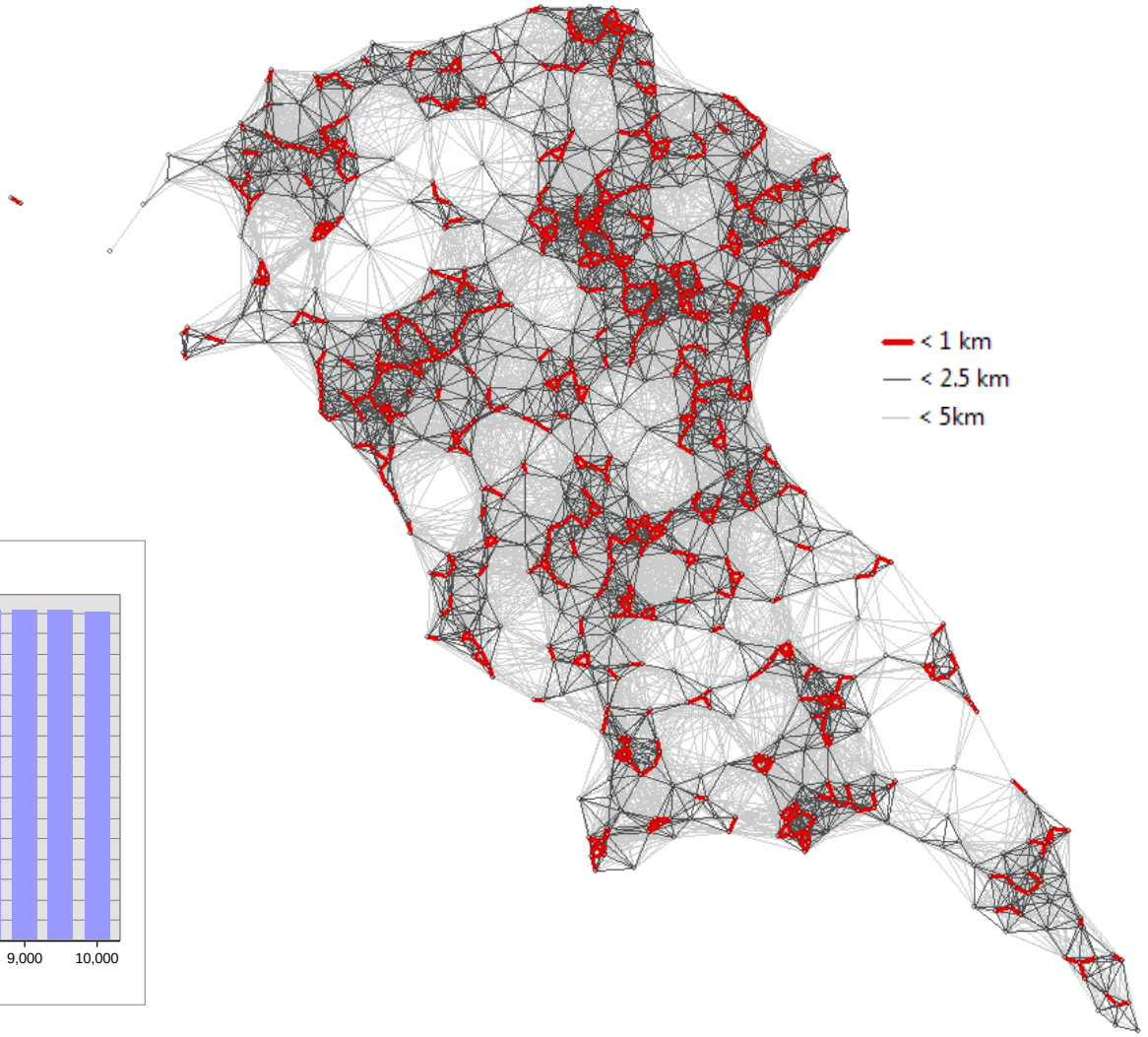
Threshold = **5** km; Diameter = **20**; # Components = **1**

Patch connectivity

Graph Summary TXT

	Distance	NComps	Diameter
	500	744	1614
	1000	267	14503
	1500	61	50475
	2000	16	75907
	2500	4	82253
	3000	3	79453
	3500	2	81836
	4000	2	81237
	4500	2	80894
	5000	2	80219
	5500	2	79394
	6000	1	84390
	6500	1	80761

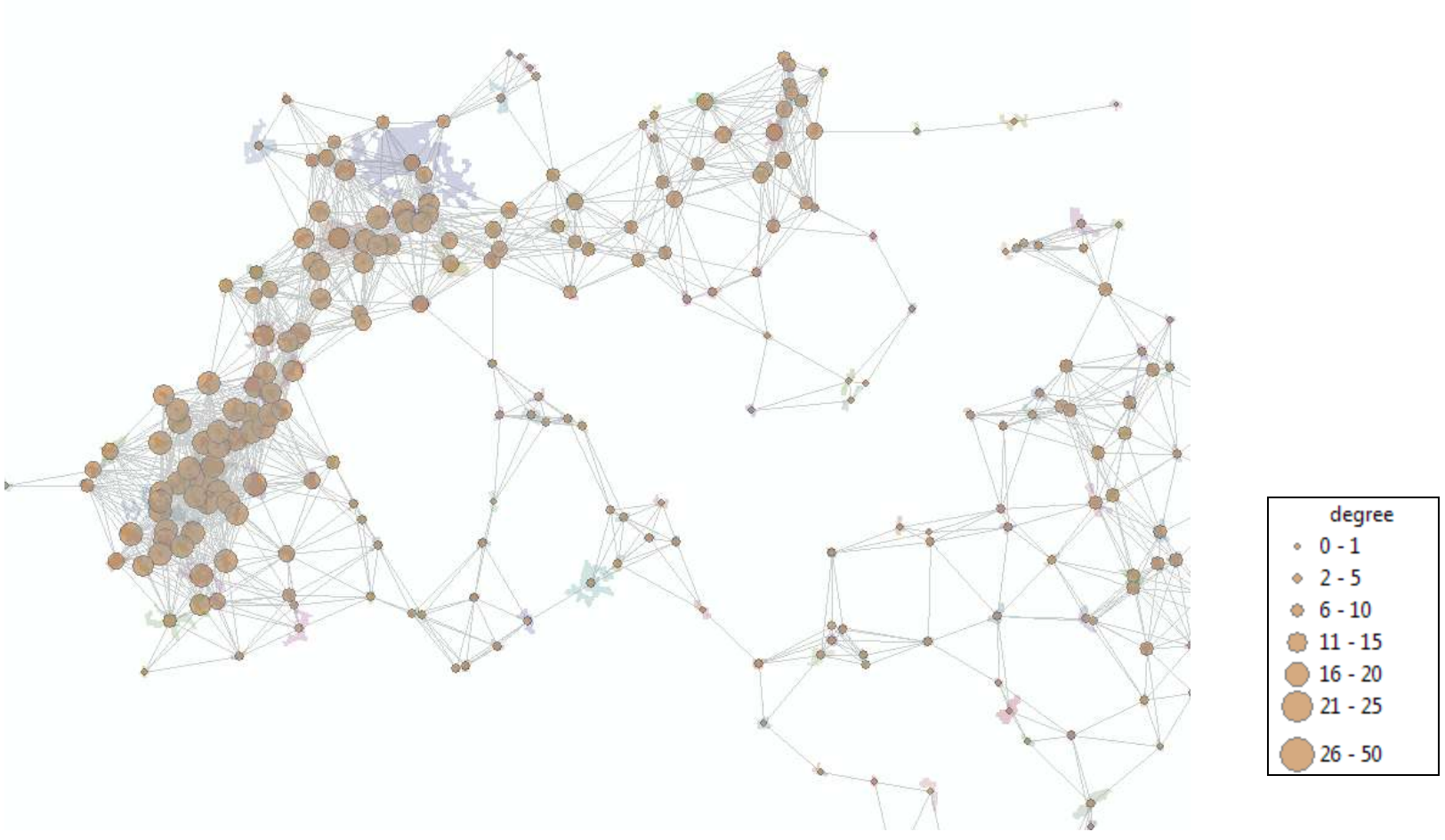




Centrality metrics

- Degree centrality:

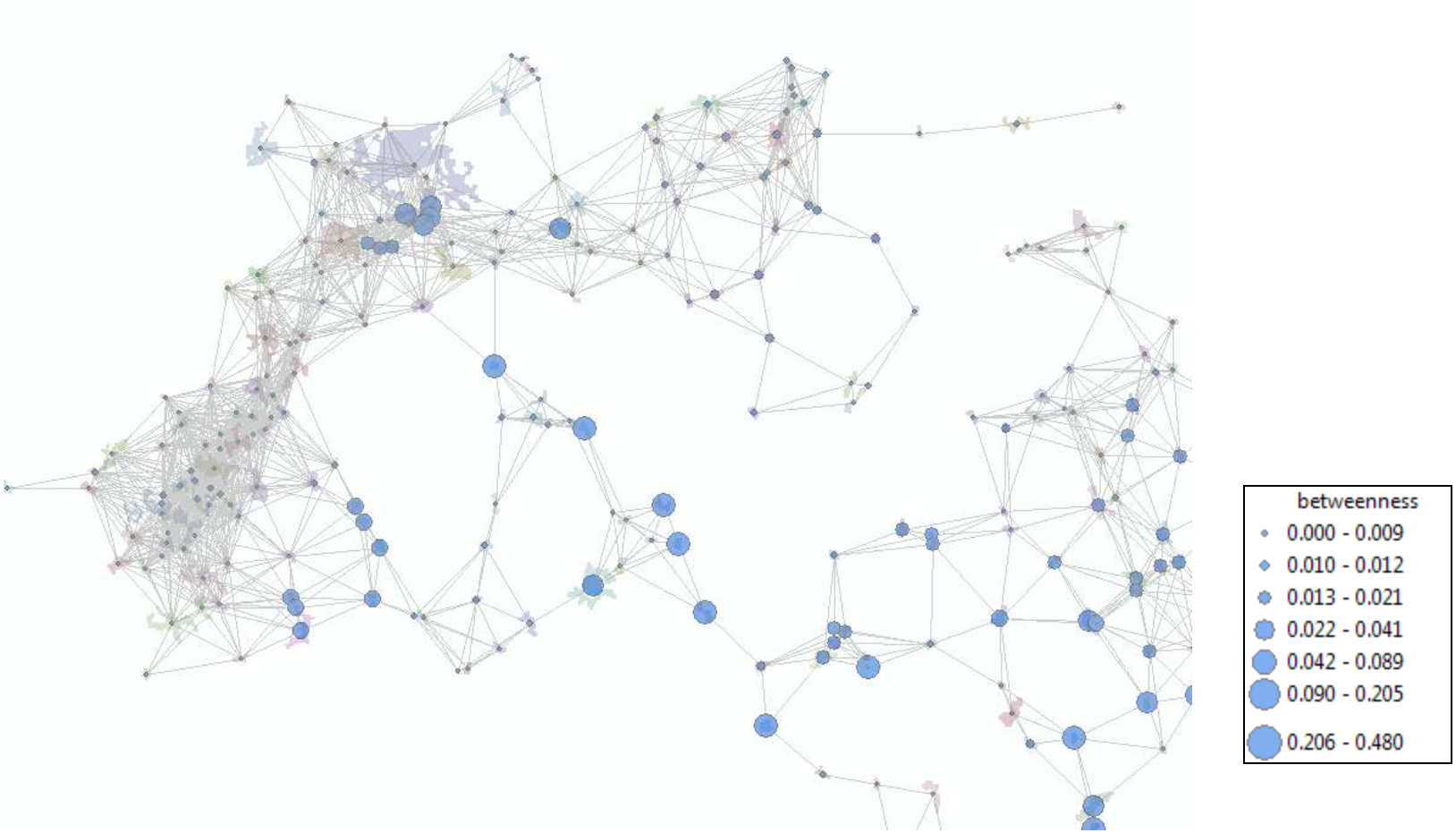
  # patches within connectivity threshold to a given patch



Centrality metrics

- Betweenness centrality:

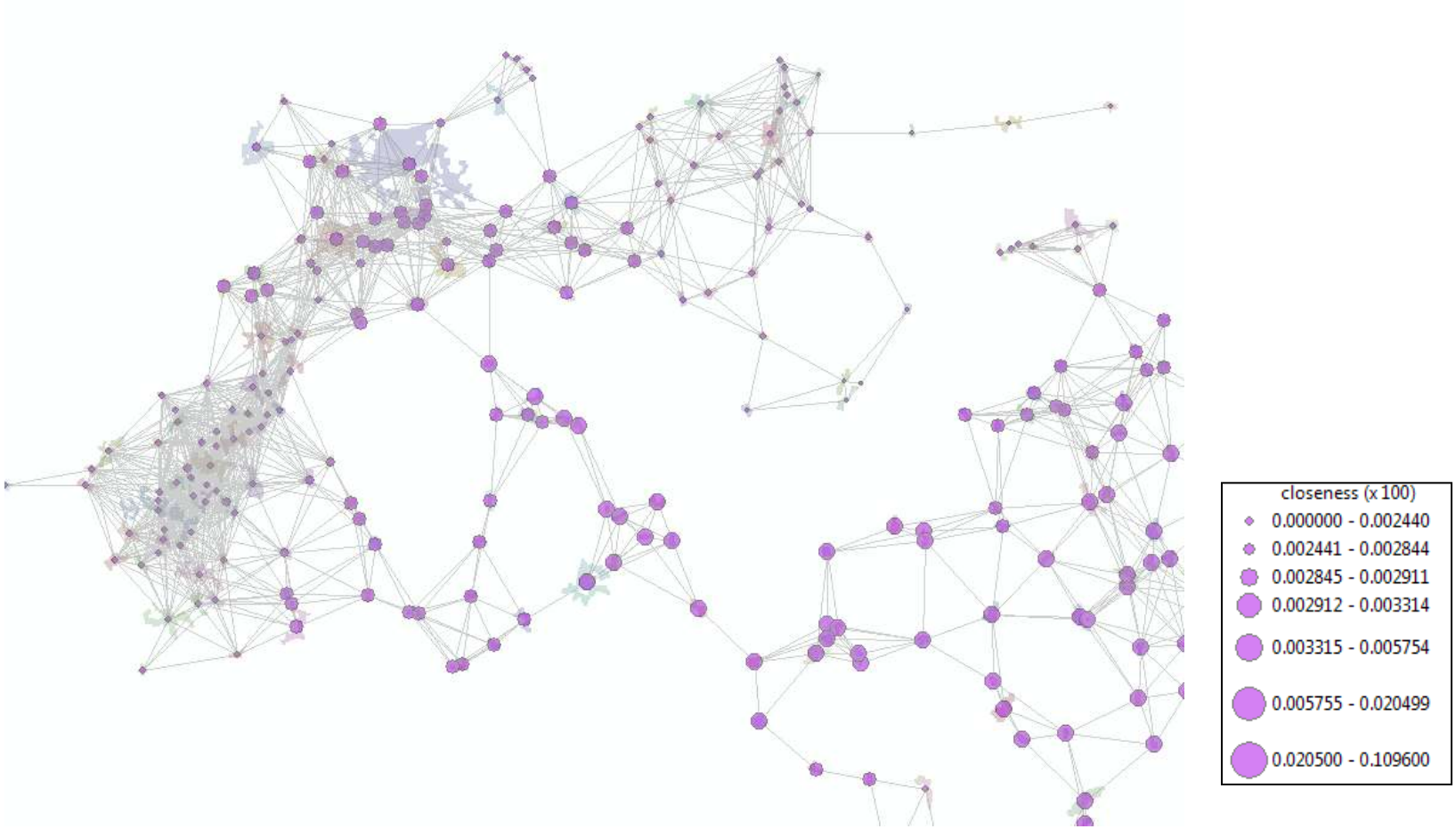
  Frequency a patch is found in the LCP between other patches



Centrality metrics

- Closeness centrality:

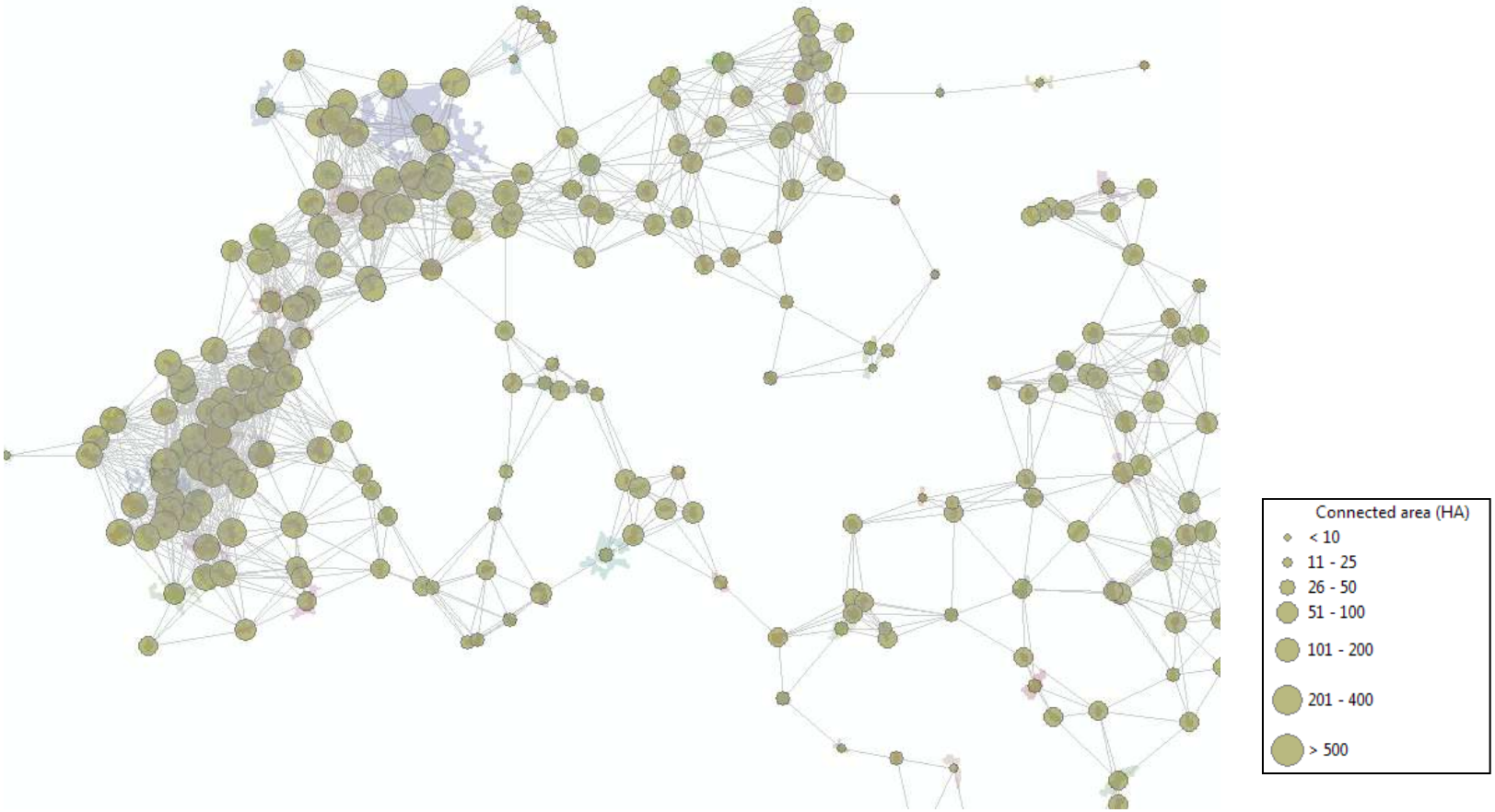
  Avg. distance to neighbors relative to other patches



Centrality metrics

- Connected area (HA):

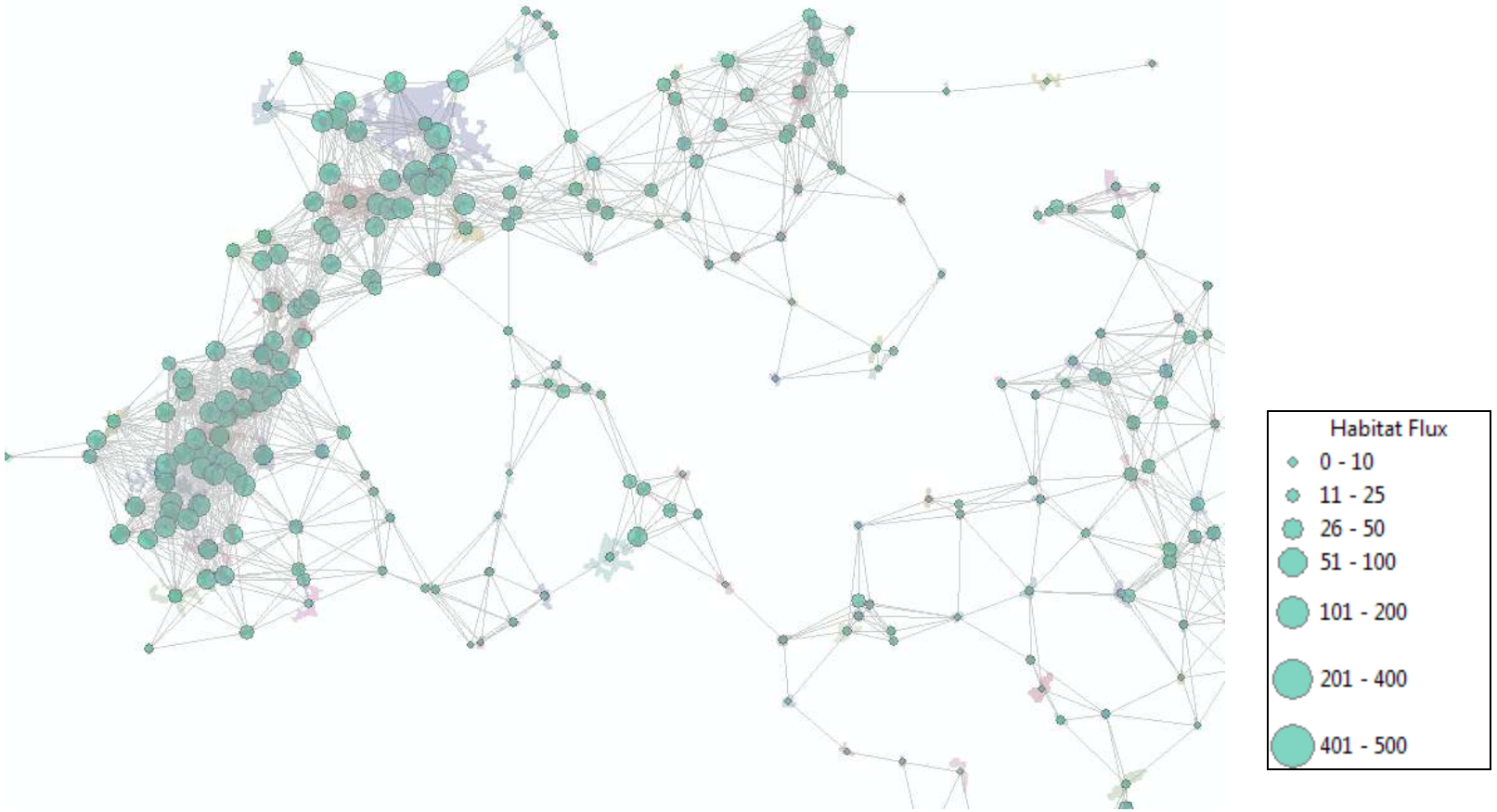
  Total patch area within the connectivity threshold (3 km)



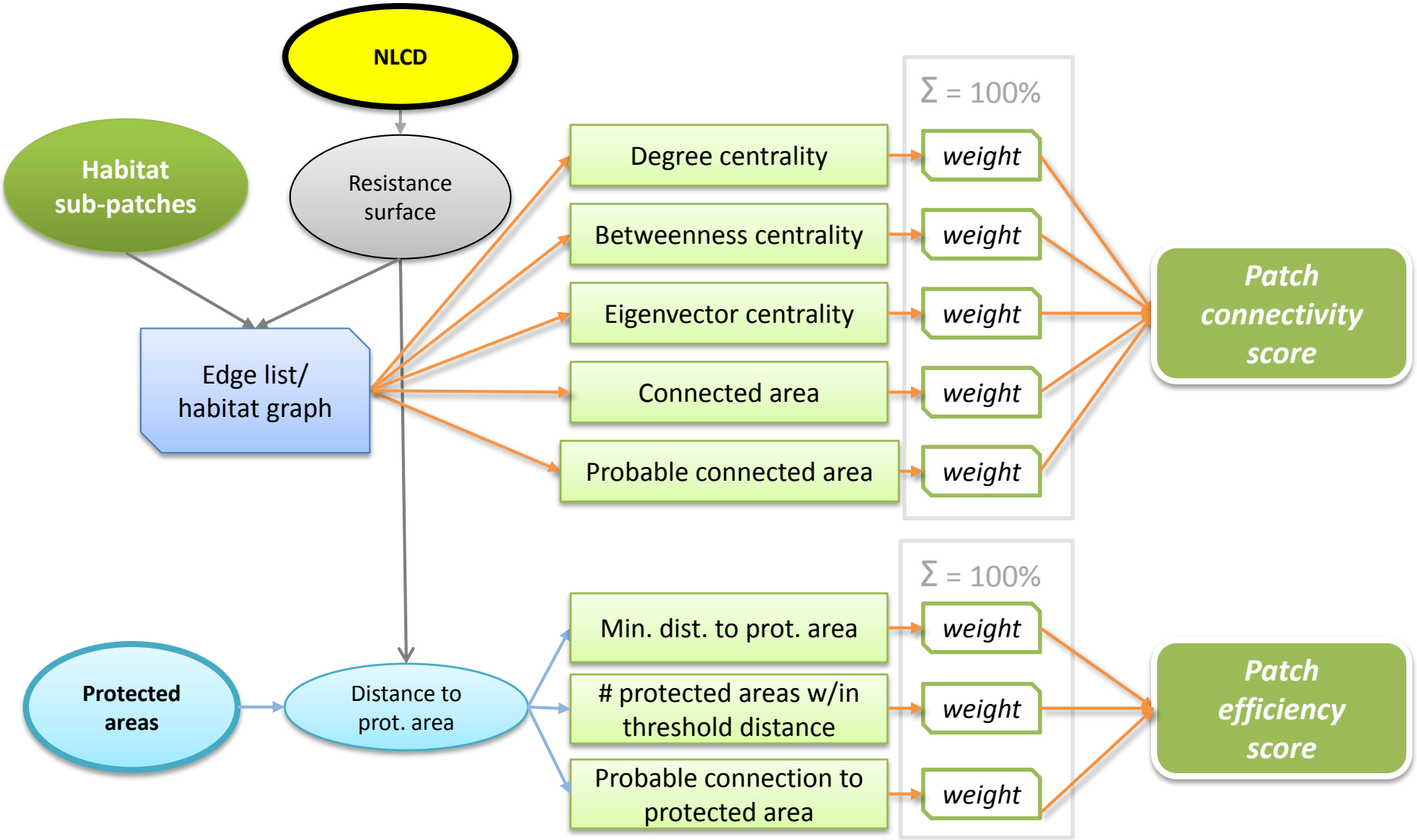
Centrality metrics

- Probably connected area:

  Inverse distance weighted area within connectivity threshold (3 km)

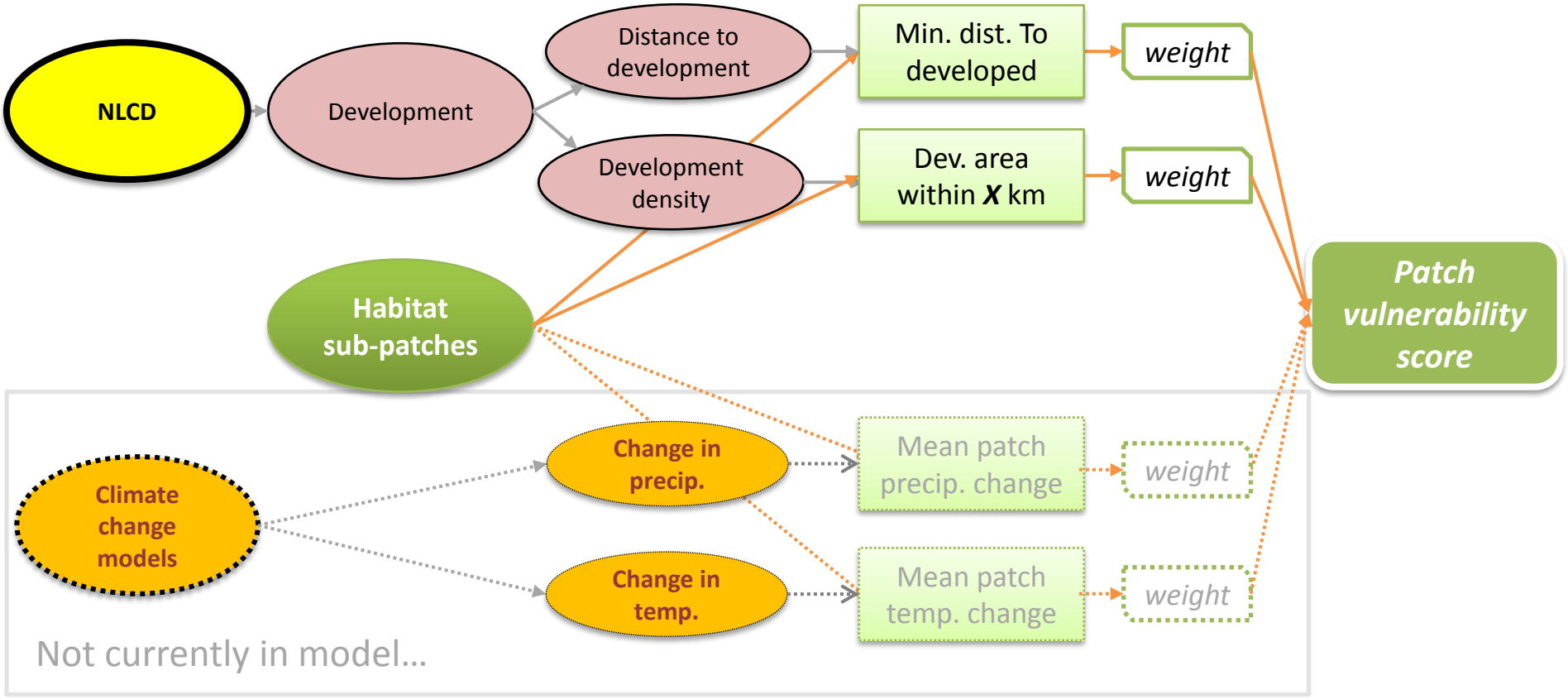


3B. Spatial context



3C. Vulnerability

Patch proximity and sensitivity to threats



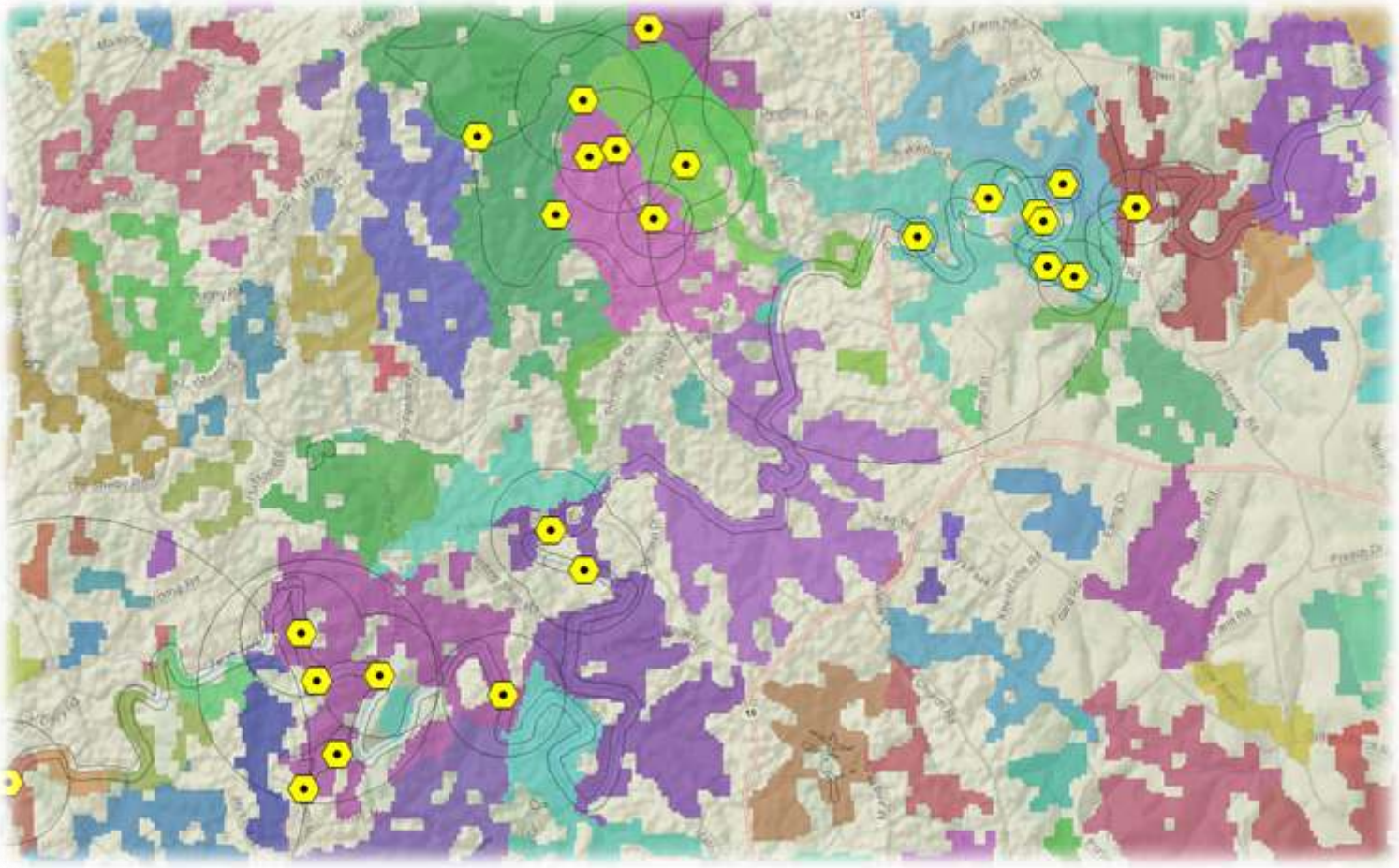
3D. Biodiversity support

Patch overlap with areas of biological importance

- Known occurrences (EO data)
- Predicted occurrences
  - Distribution models
  - Inhabited “abiotic zipcodes”
- Ecological buffering/support potential
  - Diversity of “abiotic zipcodes”

Known biodiversity support

Density of element occurrence observations



NatureServe

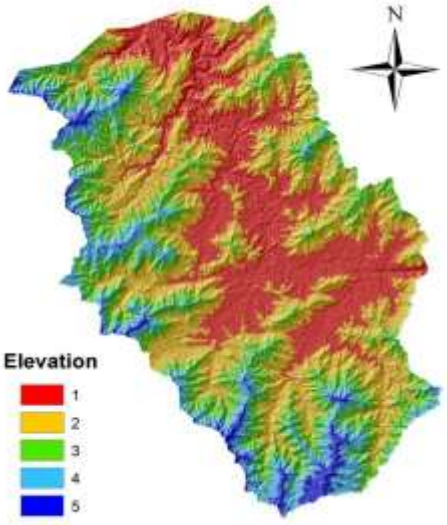
NORTH CAROLINA Natural Heritage Program
SCIENCE GUIDING CONSERVATION

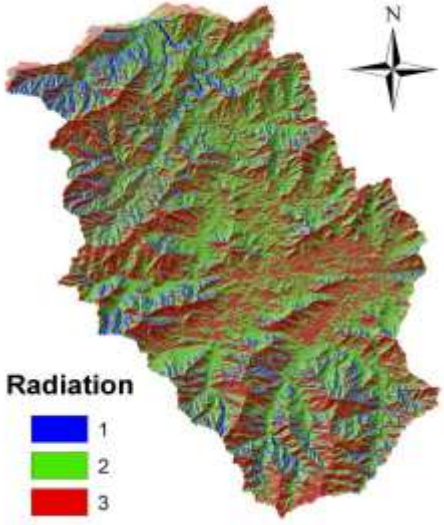
Potential biodiversity support

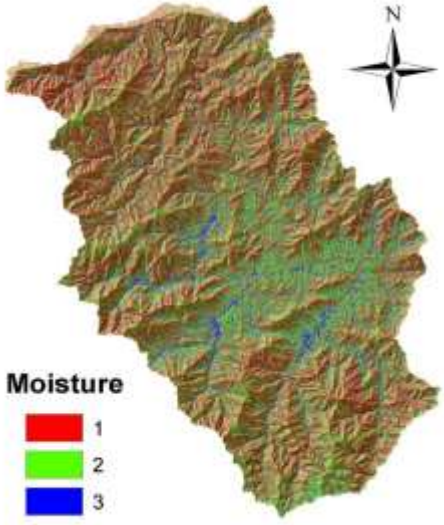
- Abiotic “zip codes”

DEM

SSURGO

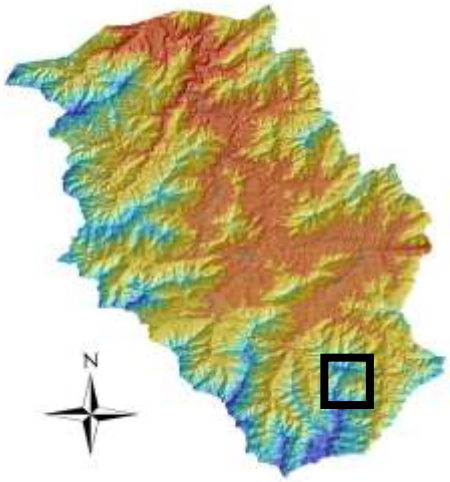


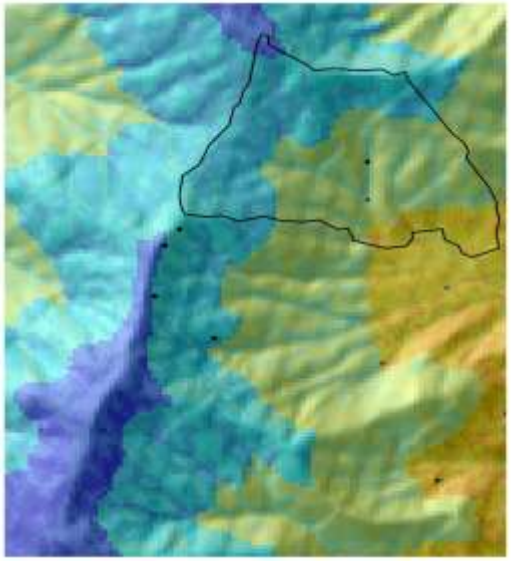




Potential biodiversity support

Abiotic “zip codes”



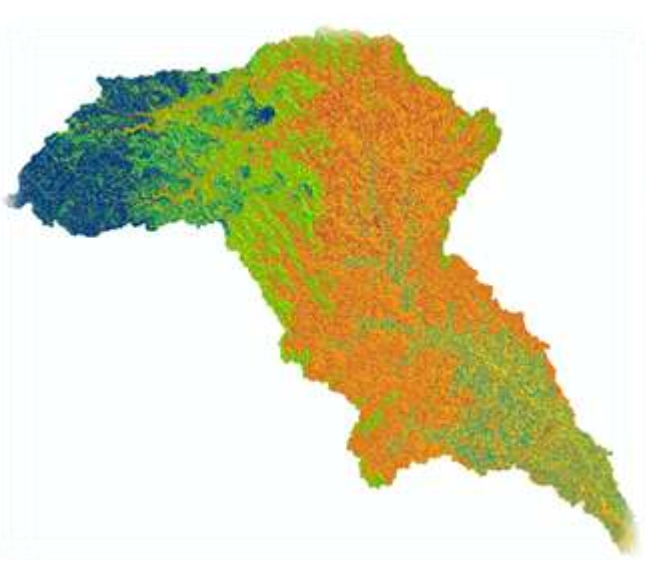


For each zip-code:

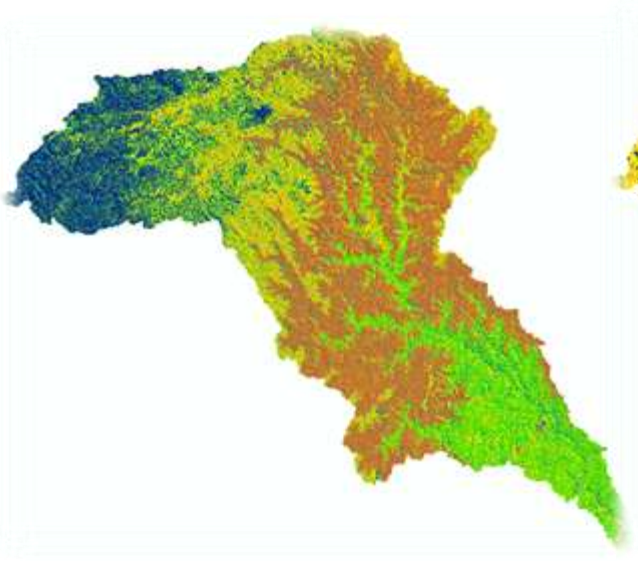
- Tally the number of element occurrences (count)
- Divide by zip code area (density)
- Rank zip codes from 0 to 5, based on element occurrence density (rank)

Potential biodiversity support

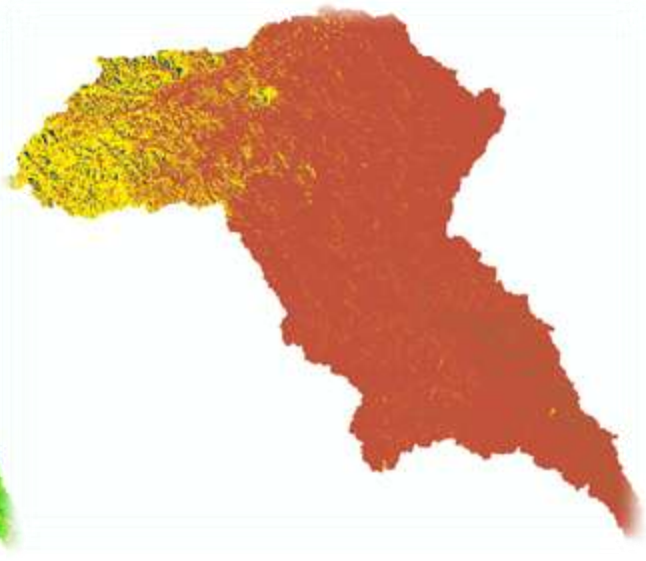
Abiotic "zip codes"



Count:
EOs/zip code



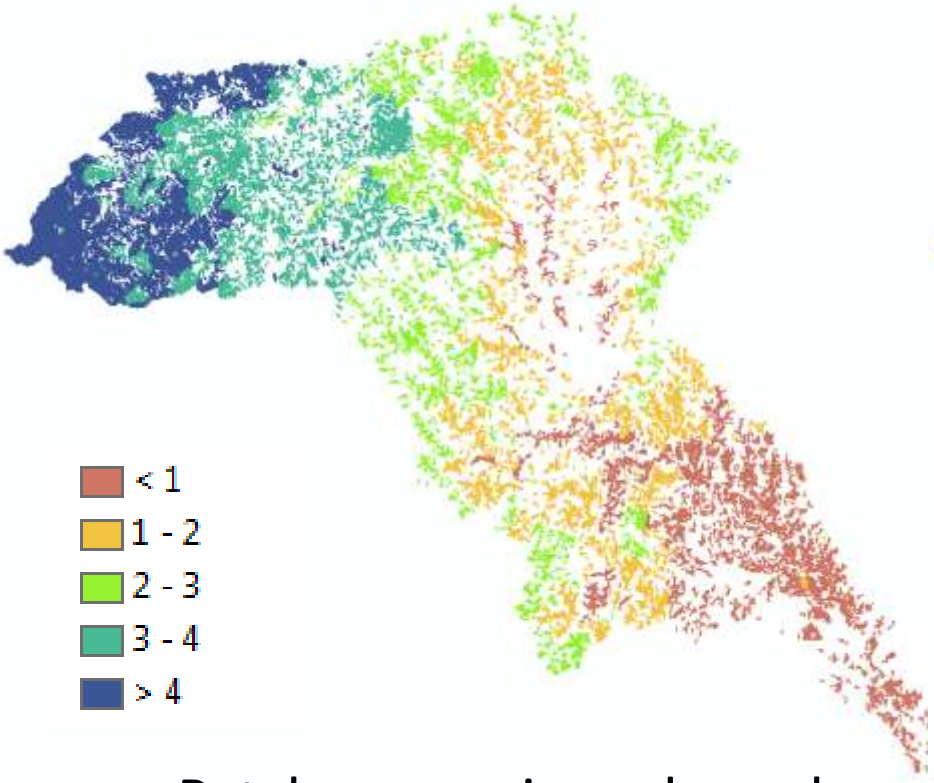
Density:
$\frac{\text{\# EOs/zip code}}{\text{zip area}}$



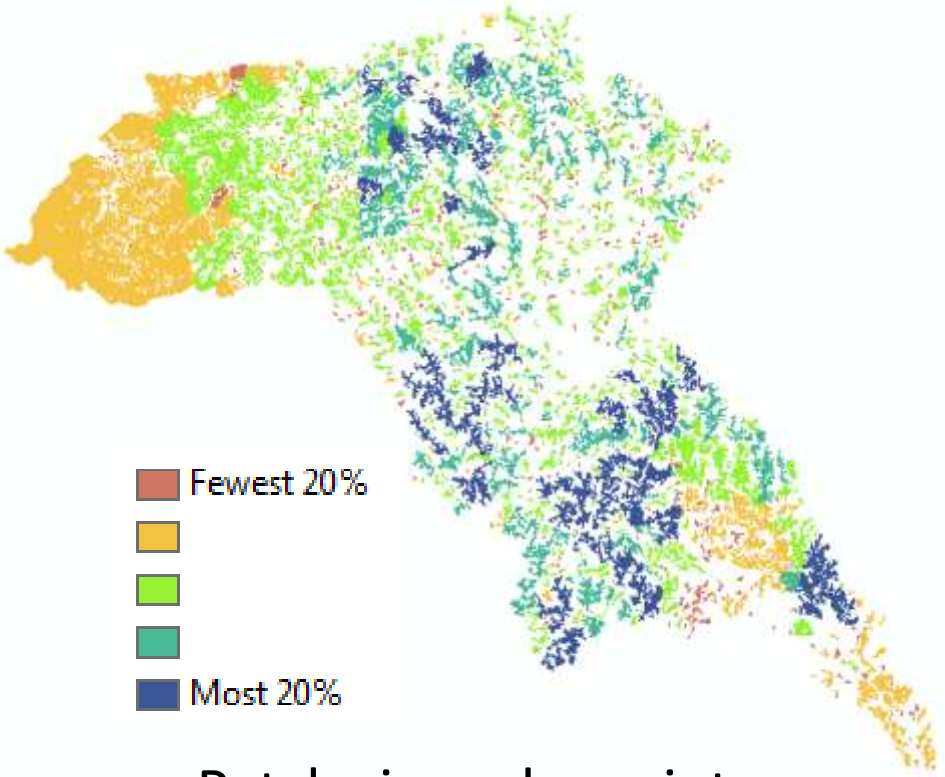
Rank:
Zip code Rank (1-5)

Potential biodiversity support

Zip code patch summaries



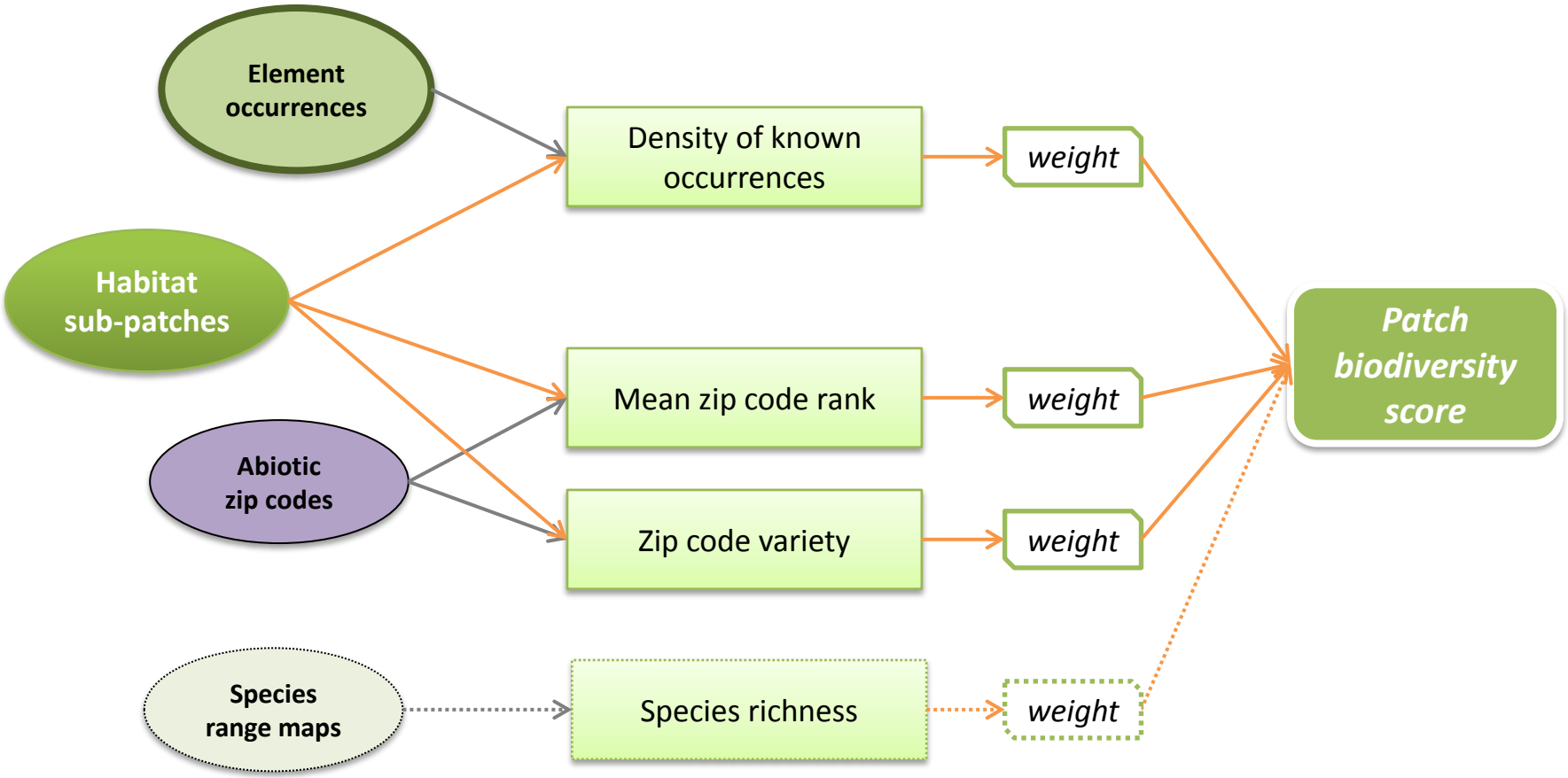
Patch mean zip code rank



Patch zip code variety

3D. Biodiversity support

Patch overlap with known species occurrences



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    D. *Biodiversity support*
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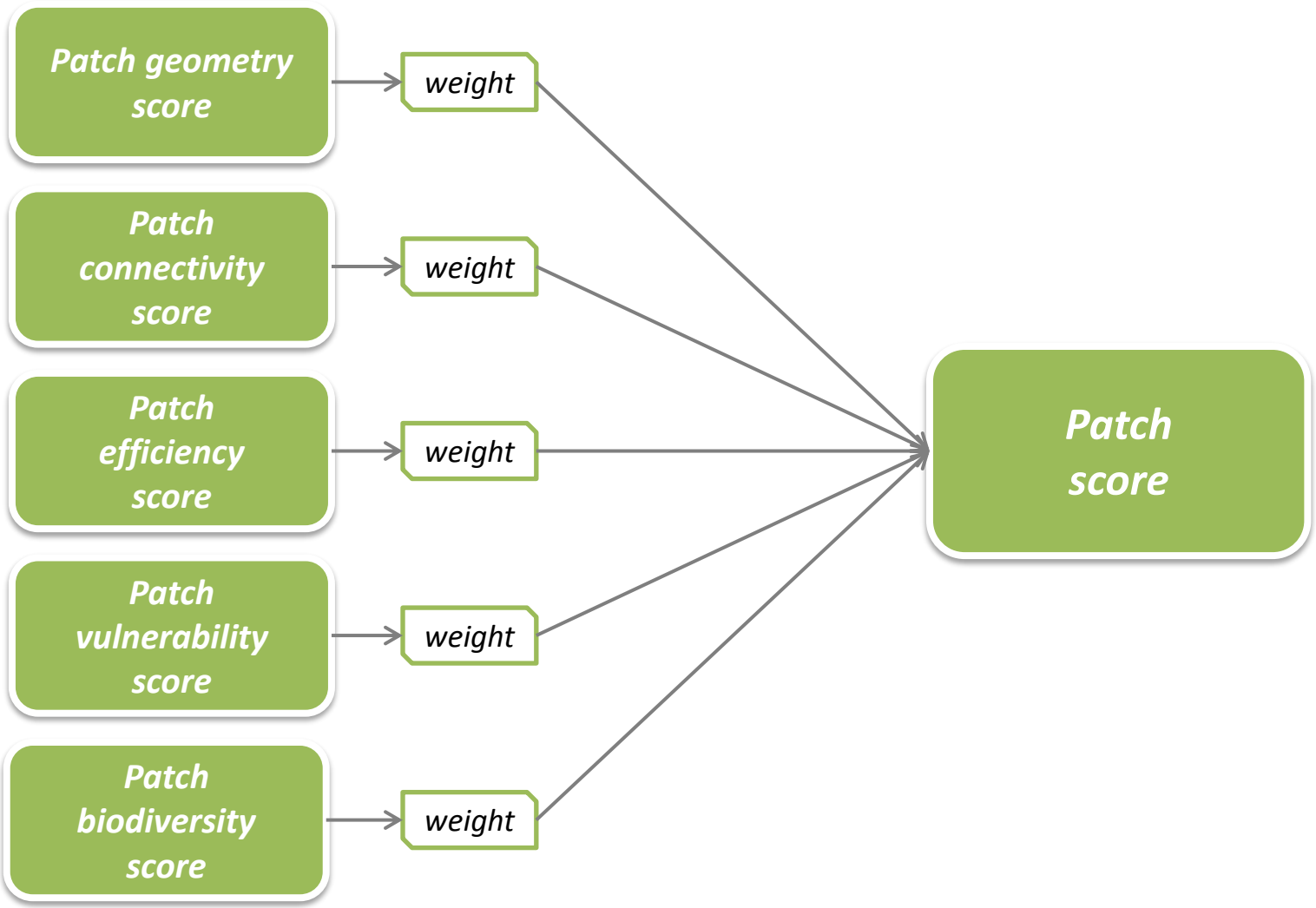
Multi-attribute synthesis



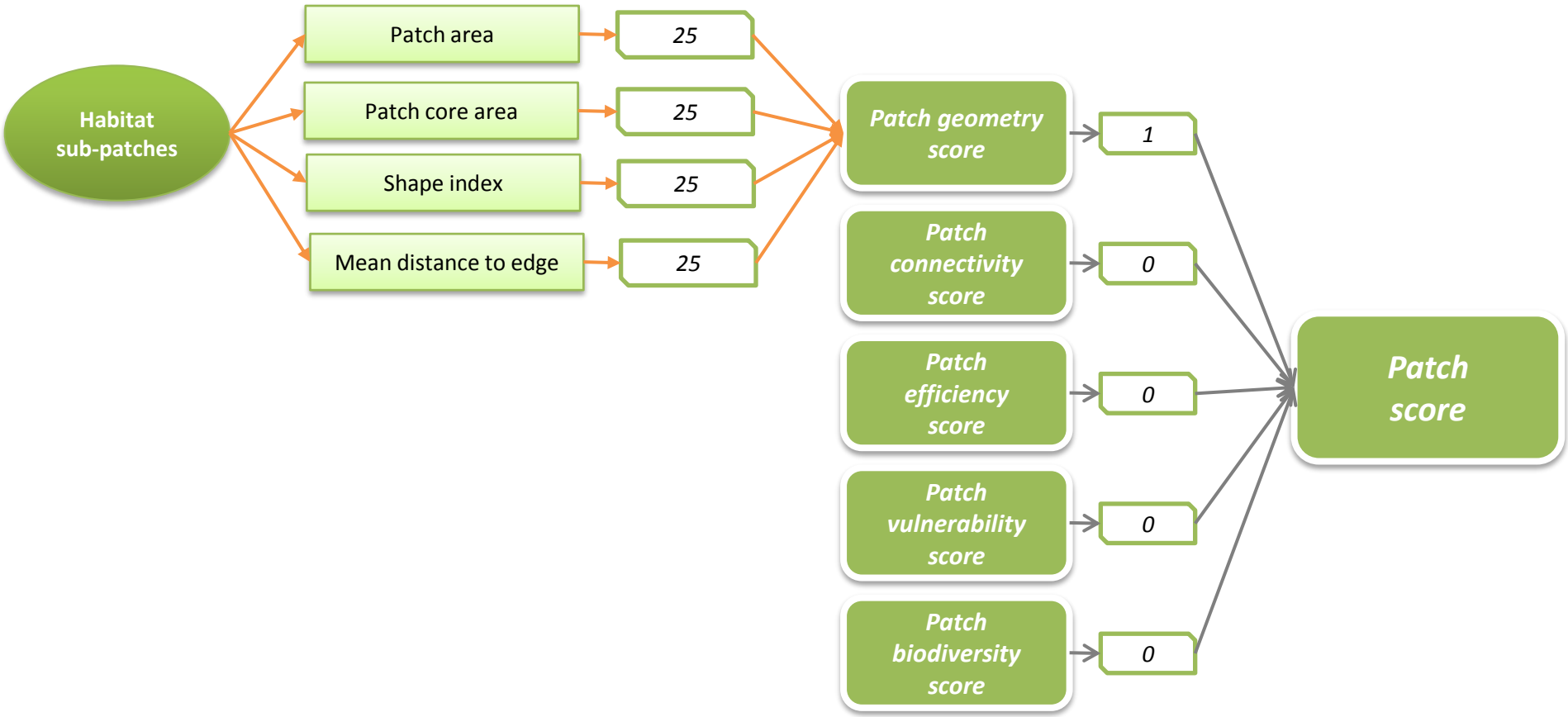
Scenarios

I. Favor patch size/shape
II. Favor patch connectivity
III. Favor patch biodiversity
IV. Reduce patch threat

V. Equal importance among all 4

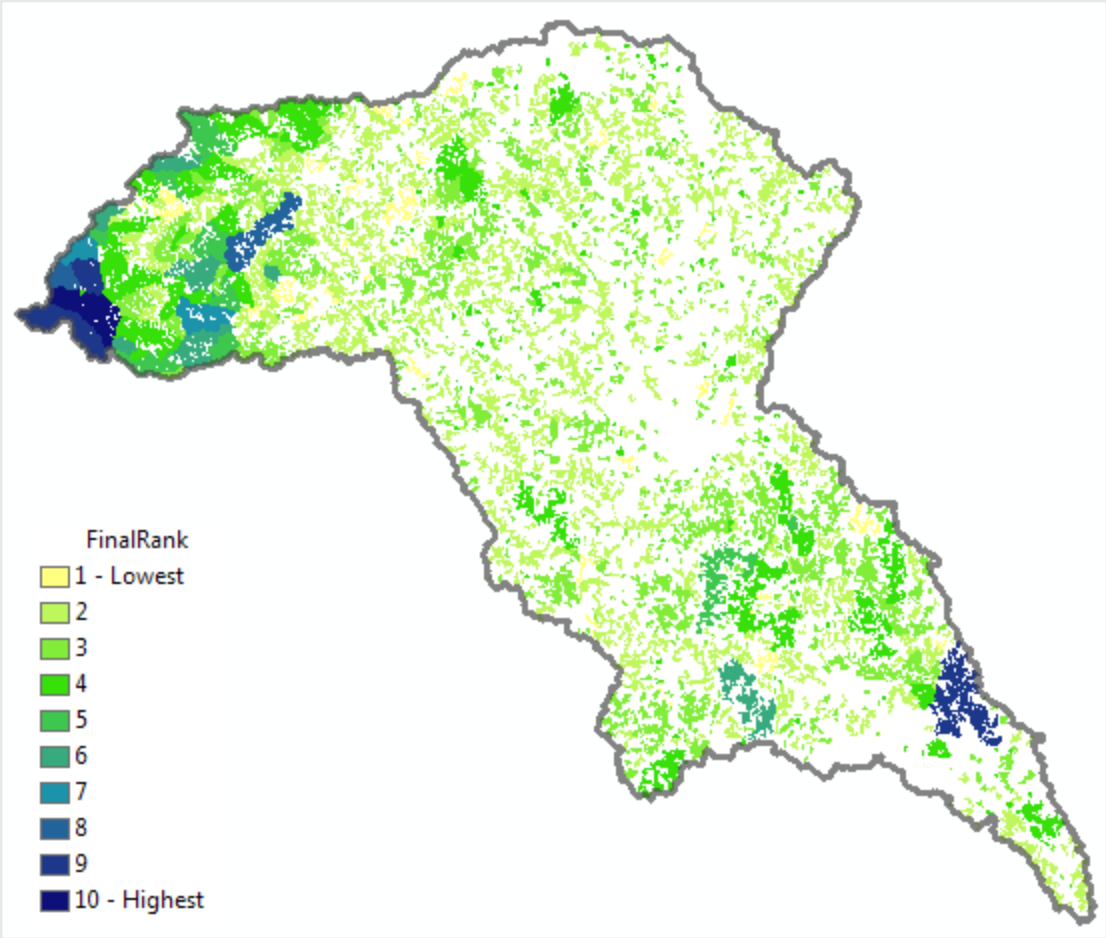
Scenario I

- Favor shape/size



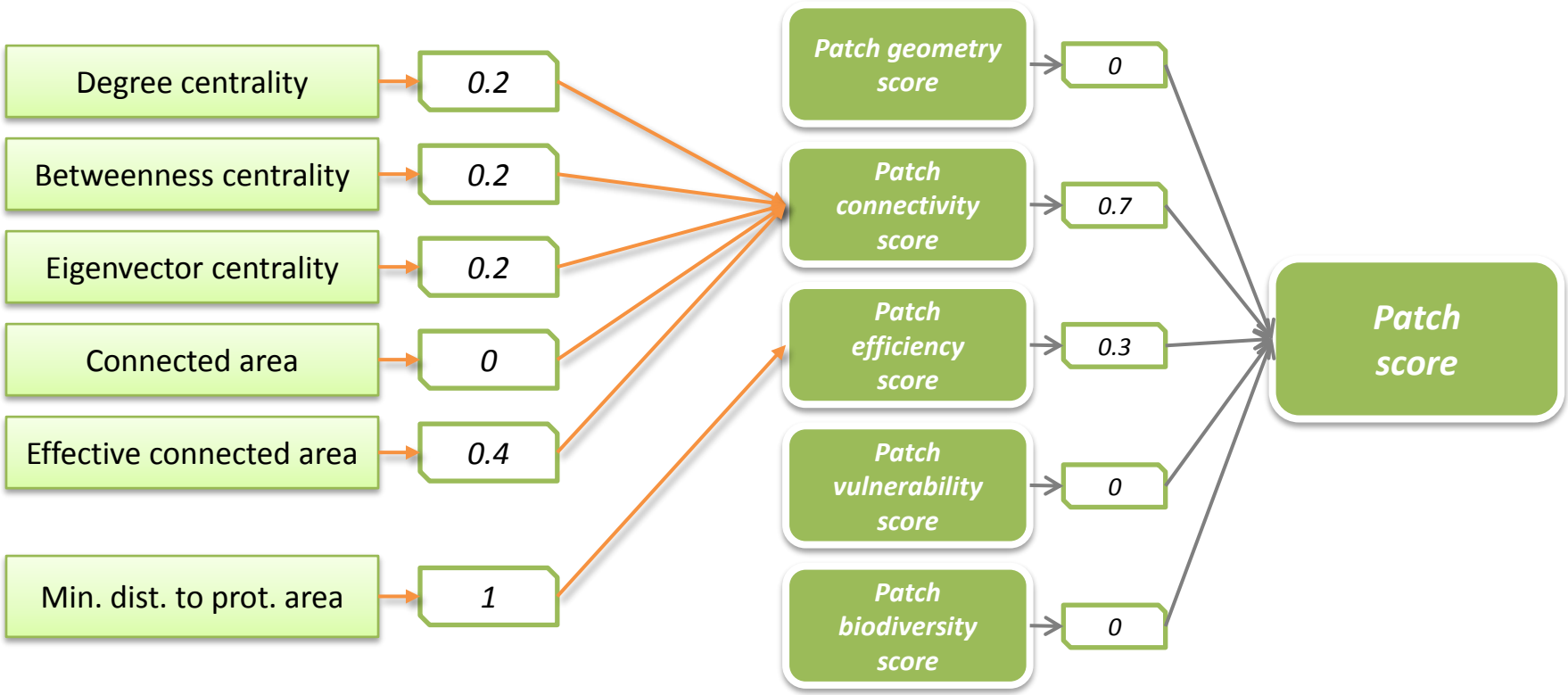
Scenario I

- Favor shape/size



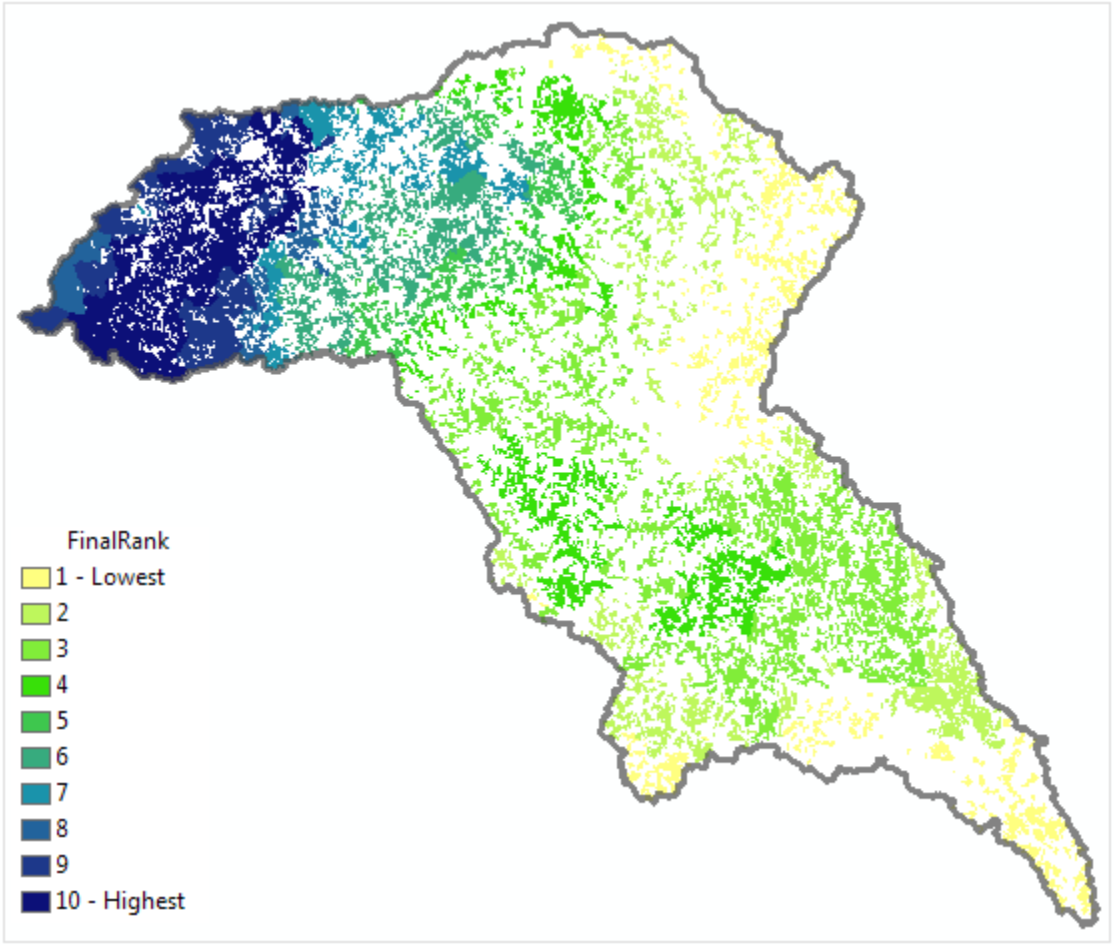
Scenario II

- Favor patch connectivity



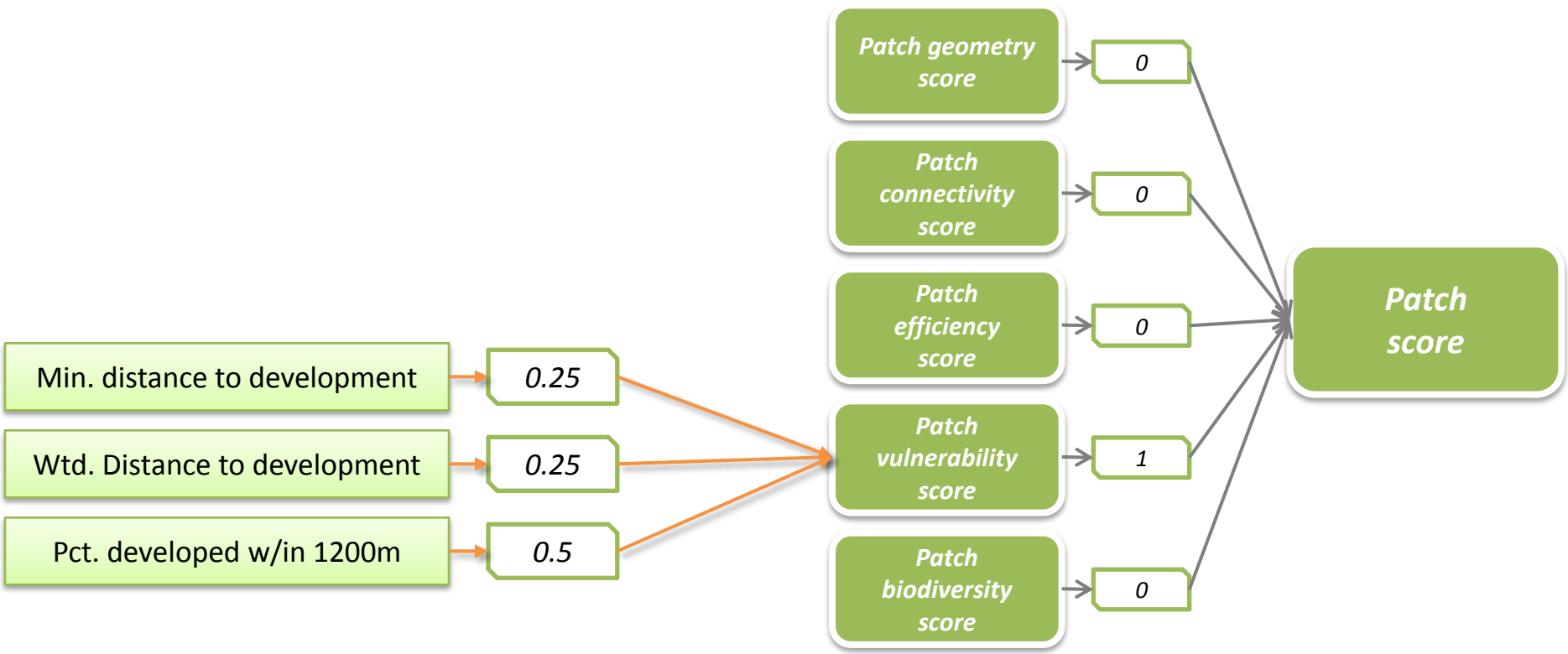
Scenario II

- Favor patch connectivity



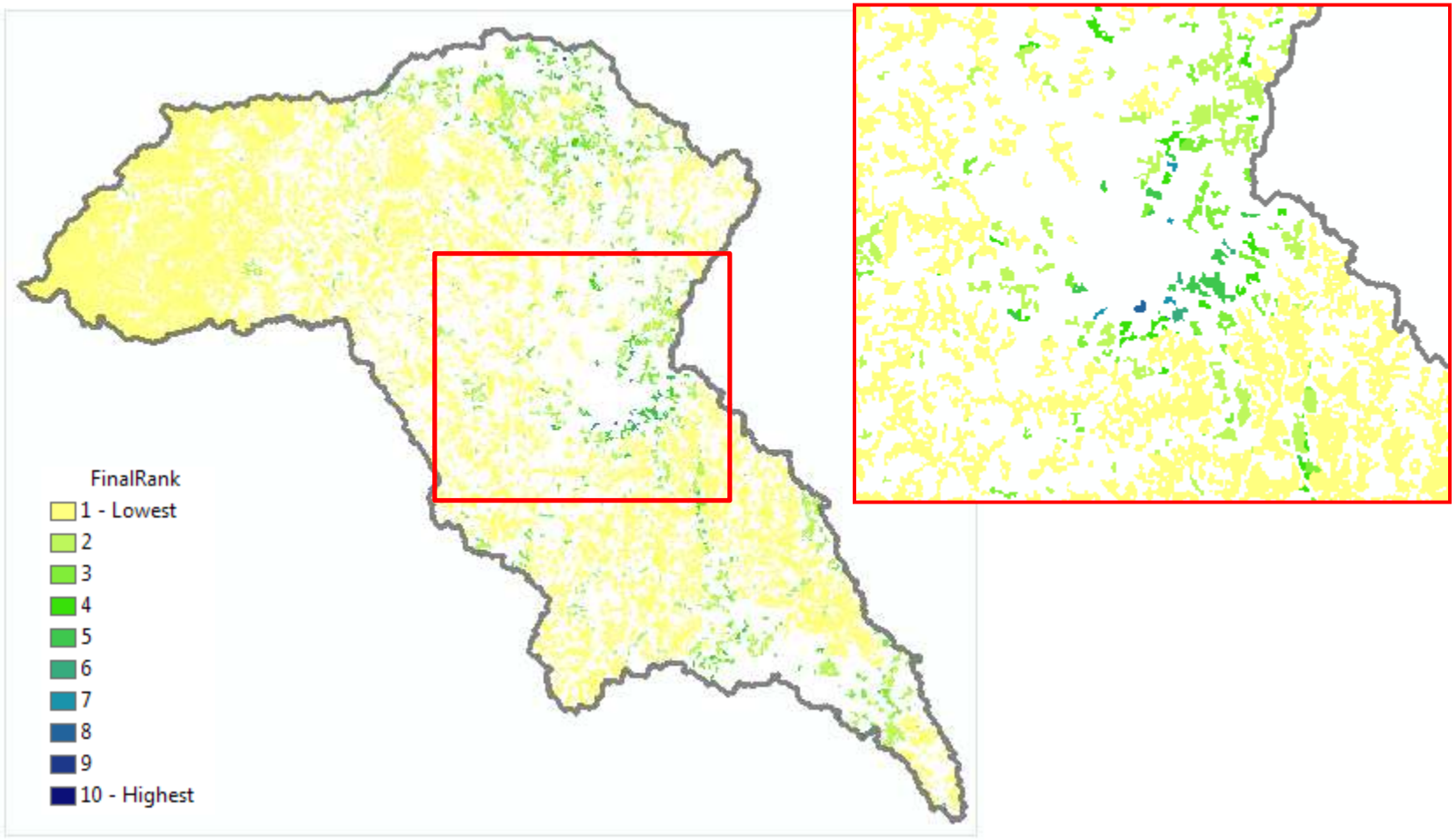
Scenario III

- Favor patch vulnerability



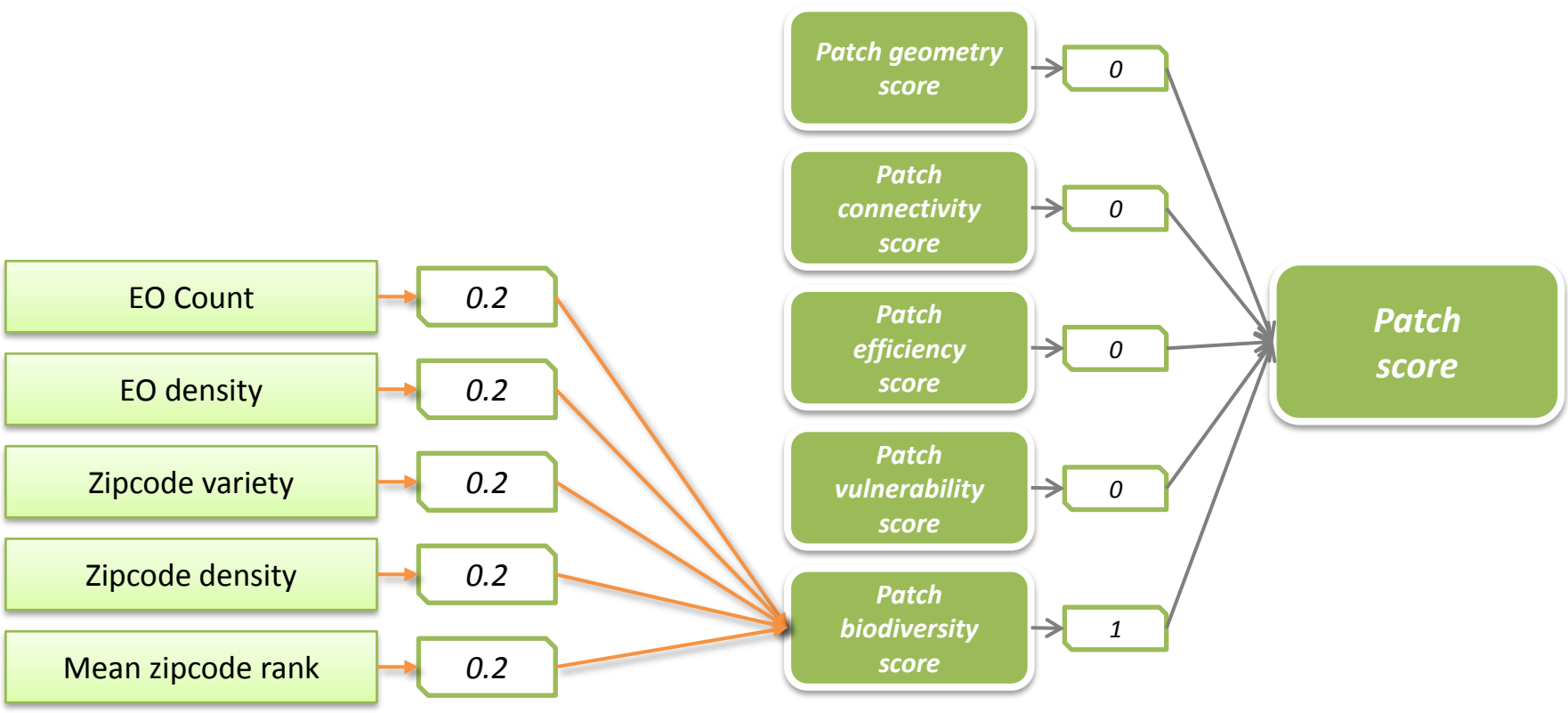
Scenario III

- Favor patch vulnerability



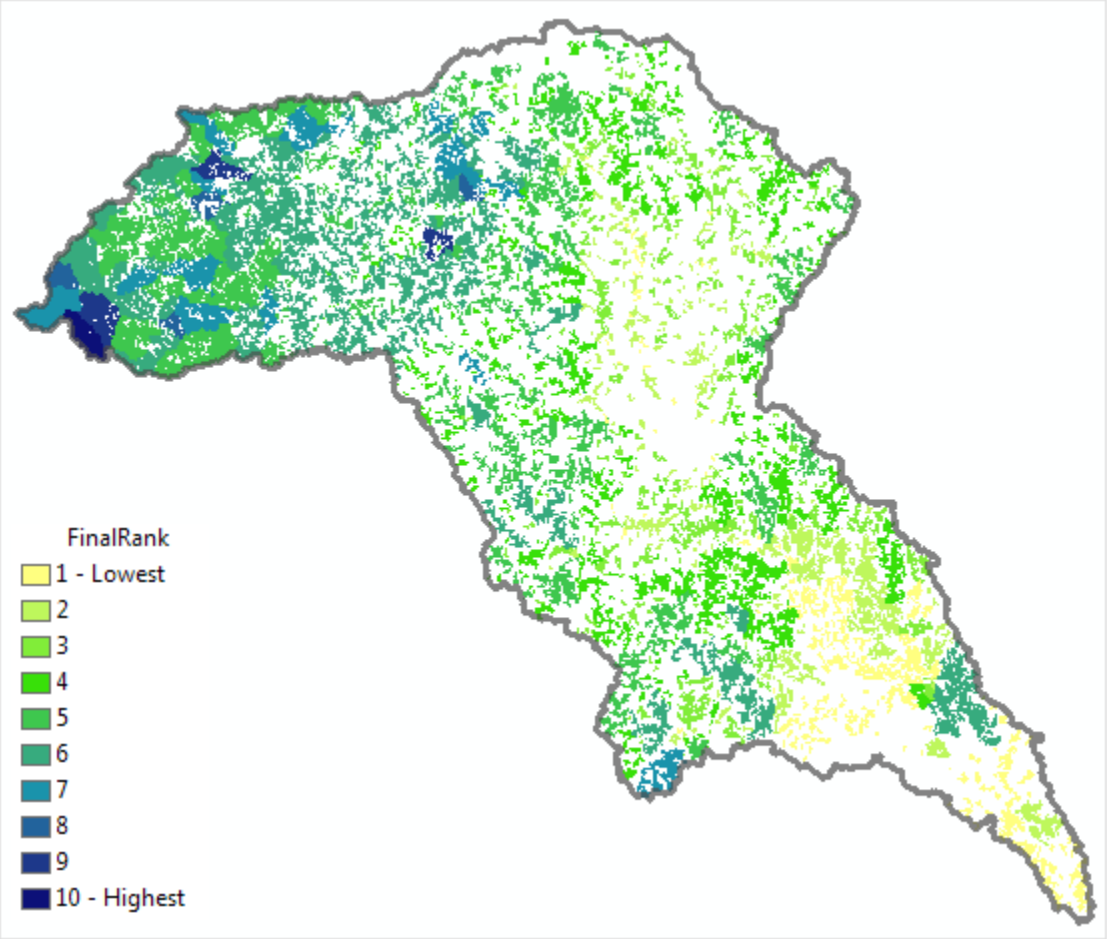
Scenario IV

- Favor patch biodiversity



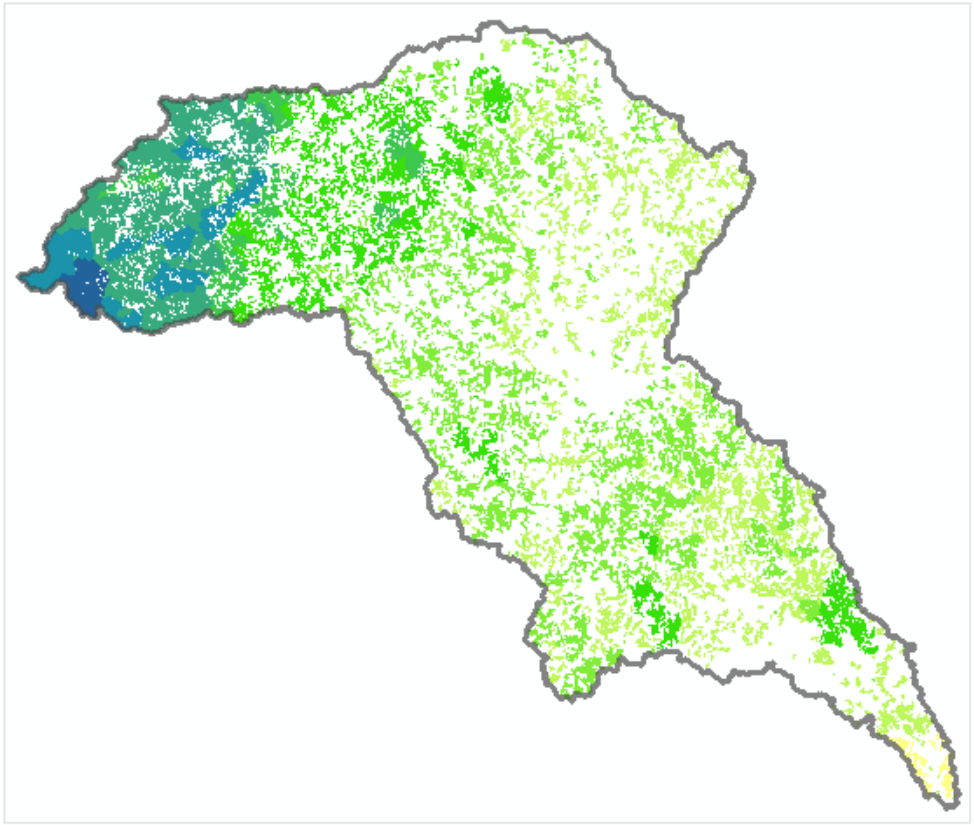
Scenario IV

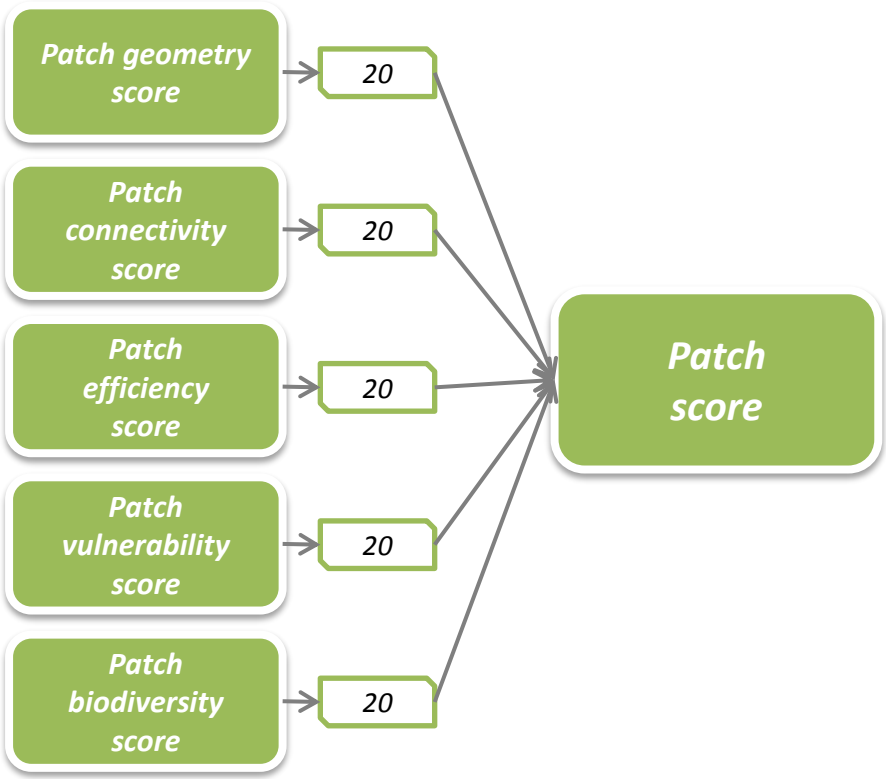
- Favor patch biodiversity



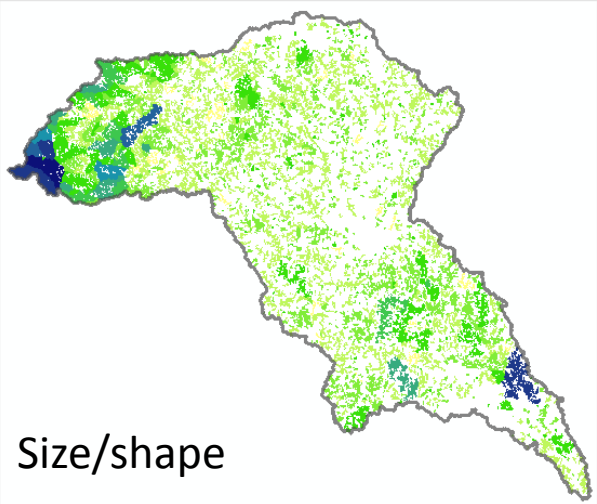
Scenario V

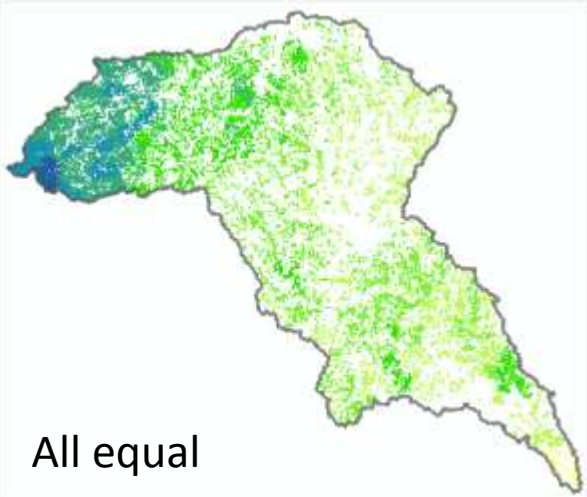
- Equal importance

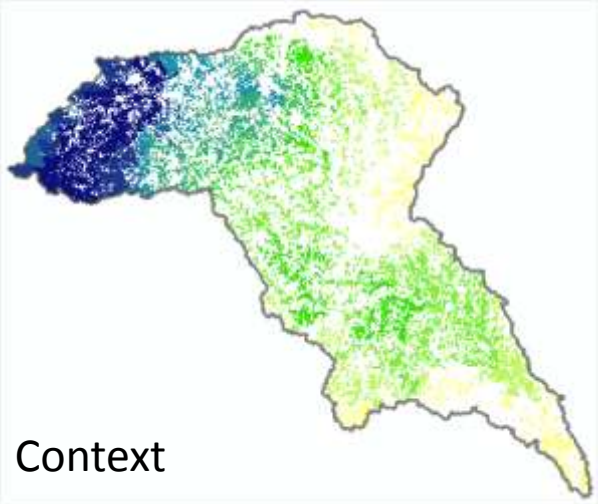


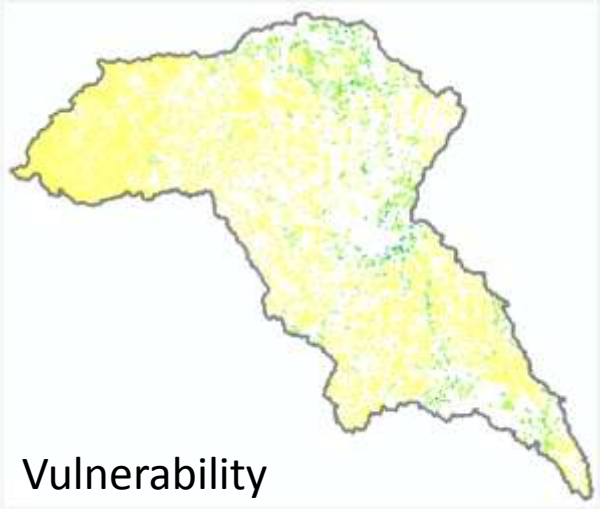


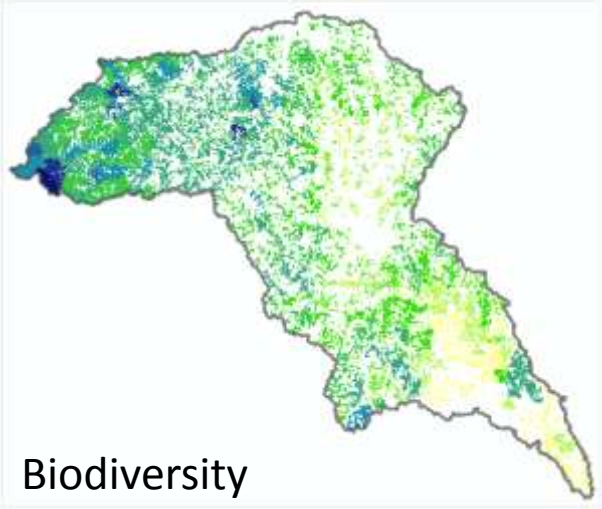
Scenario comparison



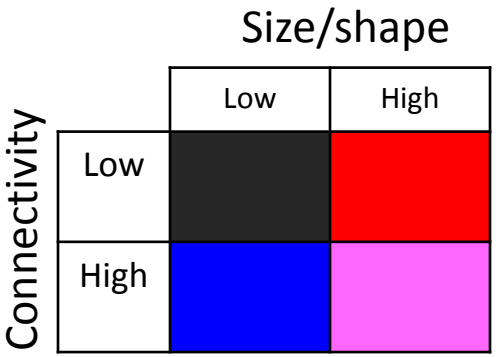


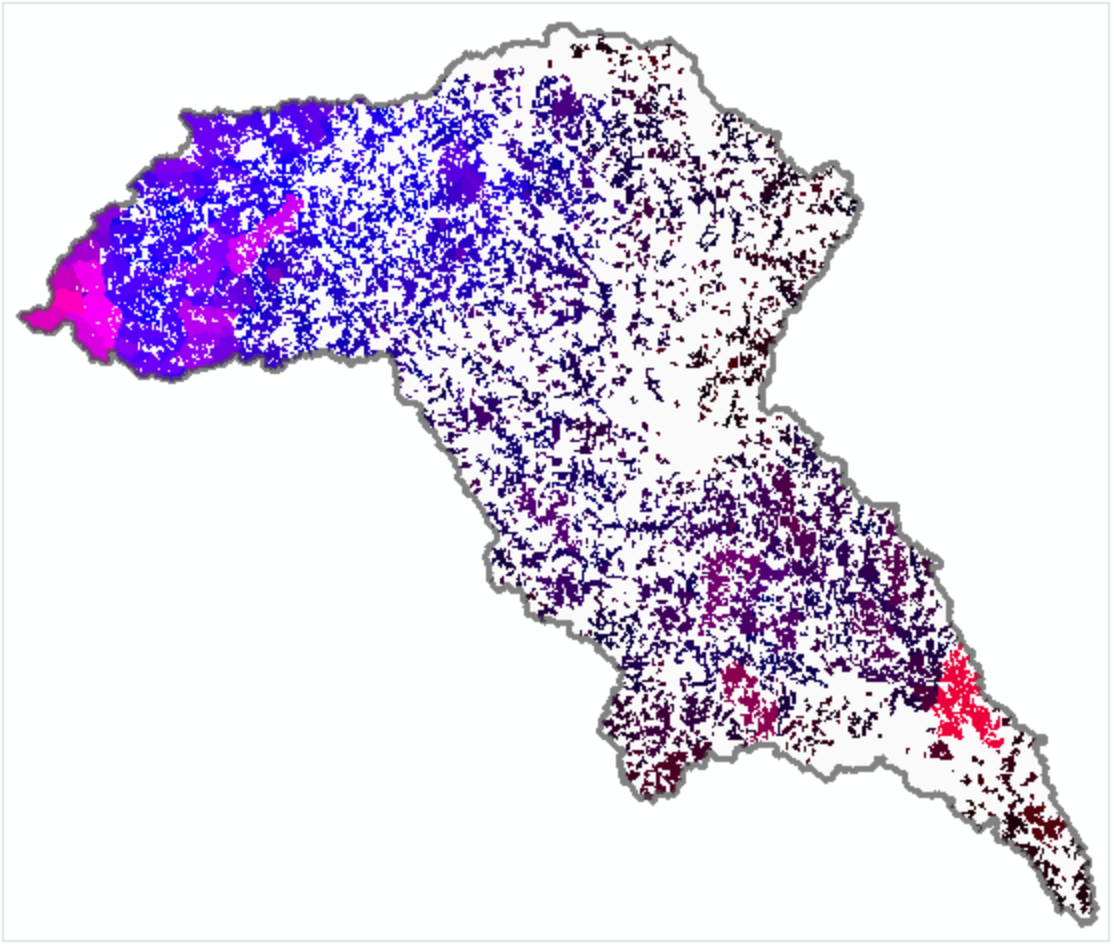




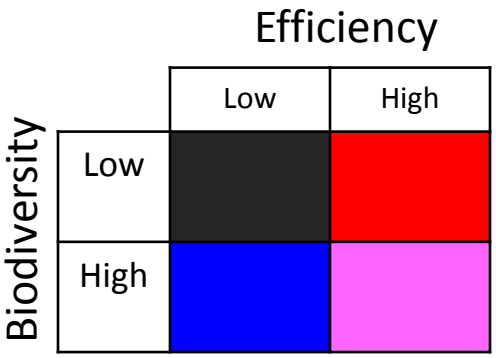


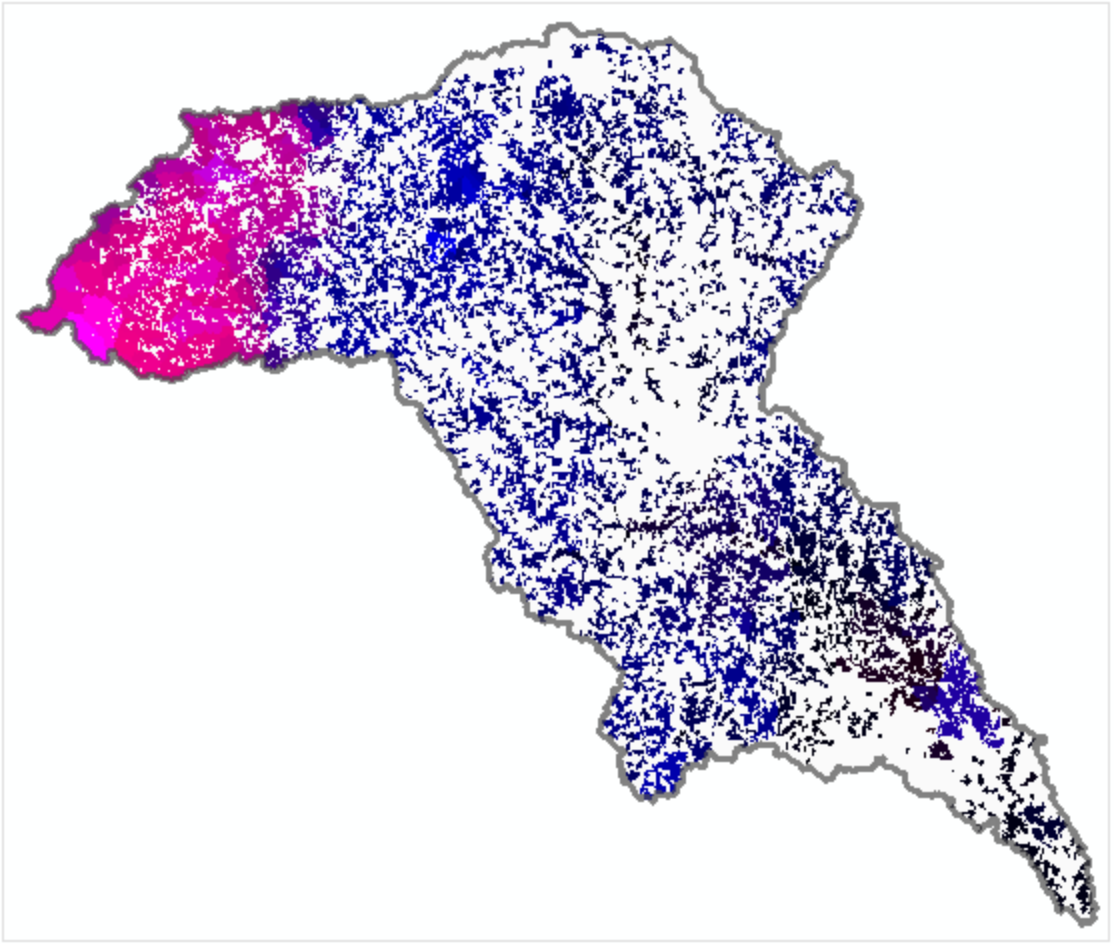
Multi-attribute visualization





Multi-attribute visualization





Future directions

- Additional habitat patch assessments
  - Climate adaptation
- Merge with other assessments
  - Water quality
  - Recreation
- Improve interface and access to tool

Recap

- Easy to assemble
- Room to maneuver:
  - Intragroup weightings (e.g. area vs. shape index)
  - Intergroup weightings (e.g. connectivity vs vulnerability)
- Room to grow: