eHabitat+: Modelling habitat functional types in protected areas globally

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European Commission – Joint Research Centre
Institute for Environment and Sustainability
Land Resource Management Unit

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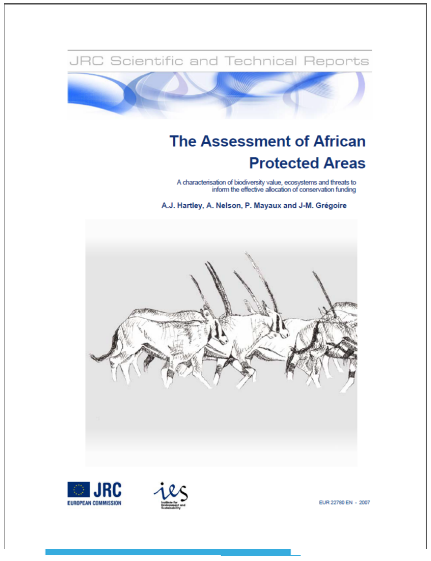
- The Joint Research Centre (JRC) provides scientific and technical support to the European Commission
- An overall objective of the EC is to assist developing countries in preventing environmental degradation and biodiversity loss

Life in harmony, into the future
COP10/MOP5 AICHI-NAGOYA, JAPAN 2010



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Protected Areas & Biodiversity

The Digital Observatory for Protected Areas (DOPA)

- to provide an assessment of the state of PAs globally
- to prioritize them according to biodiversity/ecological values and threats
- to support decision making and funding allocation processes

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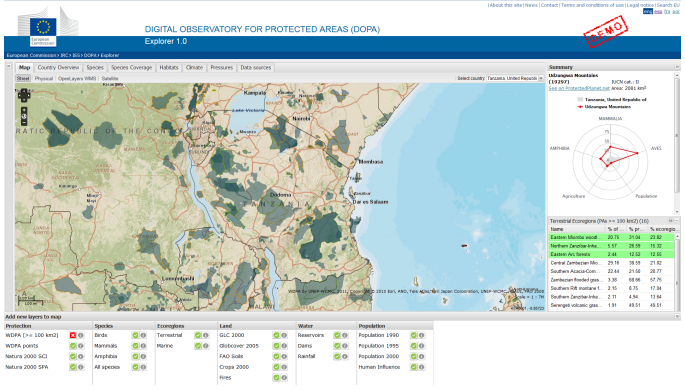
DOPA Explorer 1.0

- Covers aprox. 16,000 marine and terrestrial protected areas (WDPA) that are larger than 100 km^2
- Assessment of the **pressures** they are exposed to due to human development (Population, Agriculture and Roads)
- Characterization of their **species** (IUCN maps) and marine and terrestrial **habitats**



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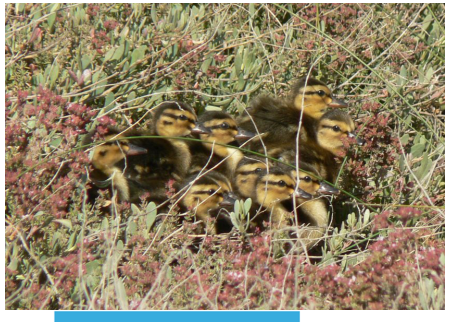
Terrestrial Habitats

- Large scale assessments (*e.g.* globally, Africa,etc.) require objective continent-wide data sets and methodologies as opposed to case studies on individual parks
- Global biodiversity inventories show limitations for ecological studies related to conservation (sampling effort bias)
- Natural habitats offer refuge for different species and those can be systematically characterized by means of RS and ecological modelling using global climatic and biotic datasets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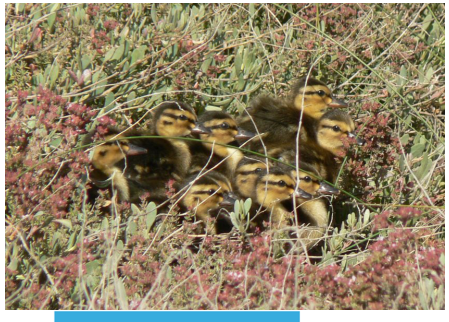


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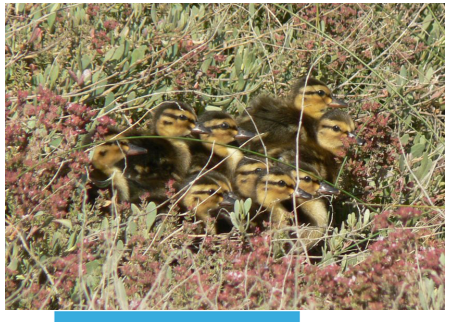


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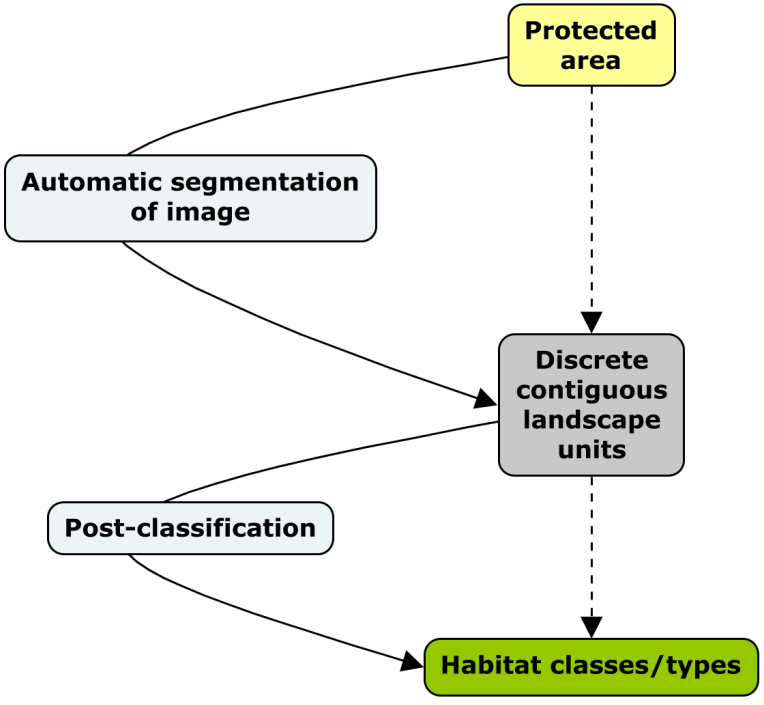
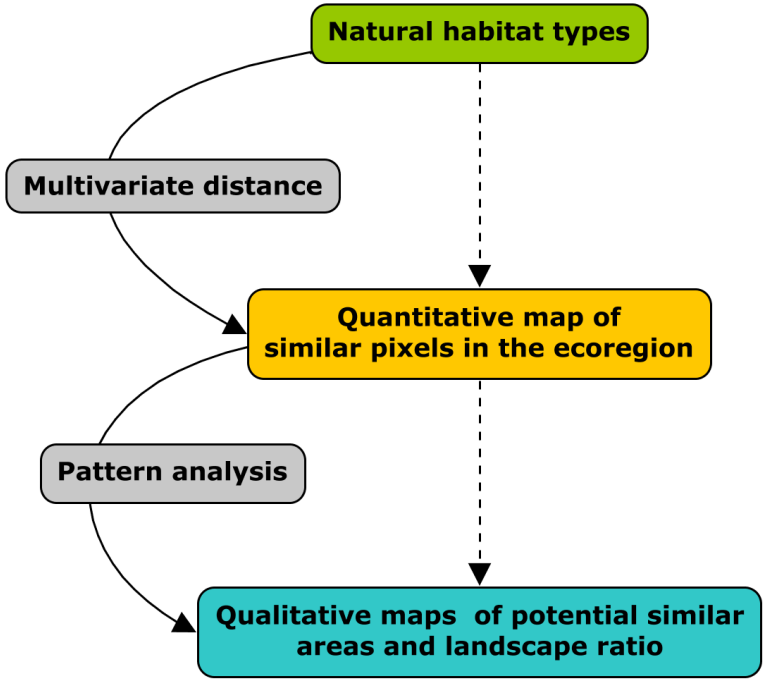
eHabitat+ overview

I. Heterogeneity of habitats



II. Similar areas and singularity



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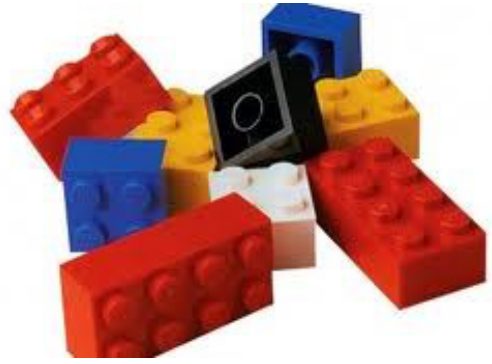
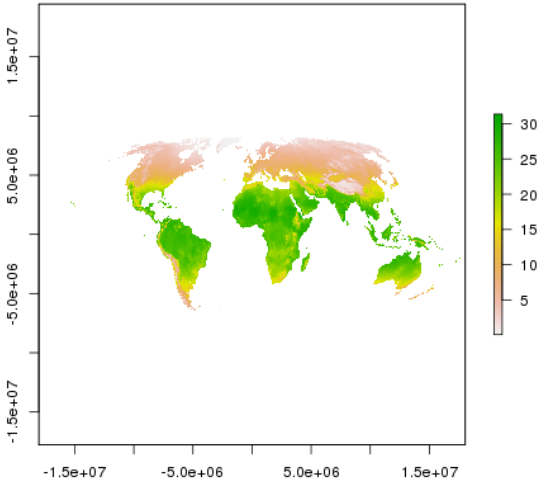
Global datasets

Protected Areas (UNEP-WCMC) > 100 km^2 (aprox. 16,000; res. 1 km^2)





1. % Woody vegetation cover
2. % Grassland cover
3. Slope
4. Aridity index
5. Biotemperature
6. Precipitation
7. NDVI (MAX and MIN)
8. NDWI

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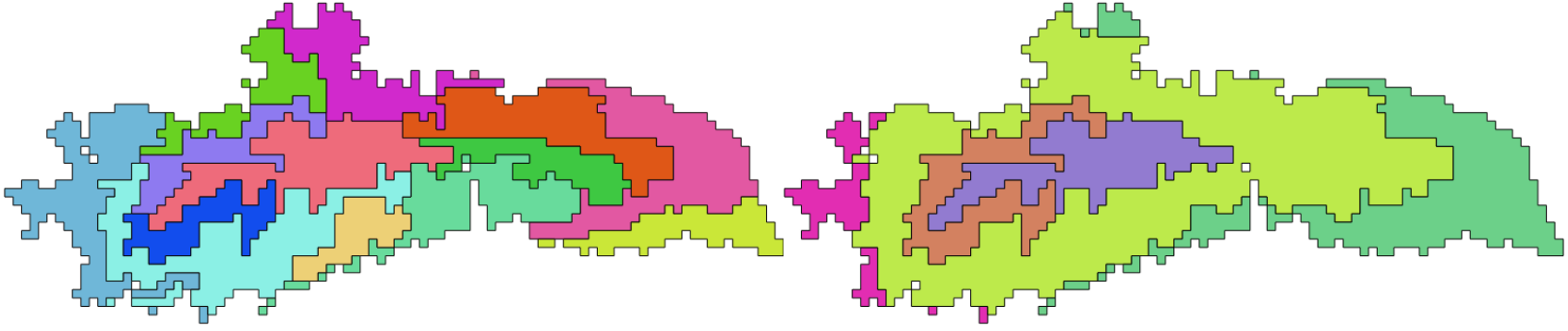
I. How heterogeneous are PAs in terms of natural habitat types ?

- Characterize biophysical gradients in PAs and stratify them accordingly
- Relationship between species composition and environmental conditions
- Classification of PAs based on habitat composition

Landscape units (LU)

Automatic segmentation of PAs into contiguous and homogeneous LUs:

- Input: First 3 PCA axes of the 9 environmental variables
- *GRASS GIS 7* with a *region growing* segmentation algorithm and 2 main parameters:
- **Minimum area**: proportional to the size of the PA
- **Similarity threshold (ST)** (0 = merges only identical segments; 1 = merges all)



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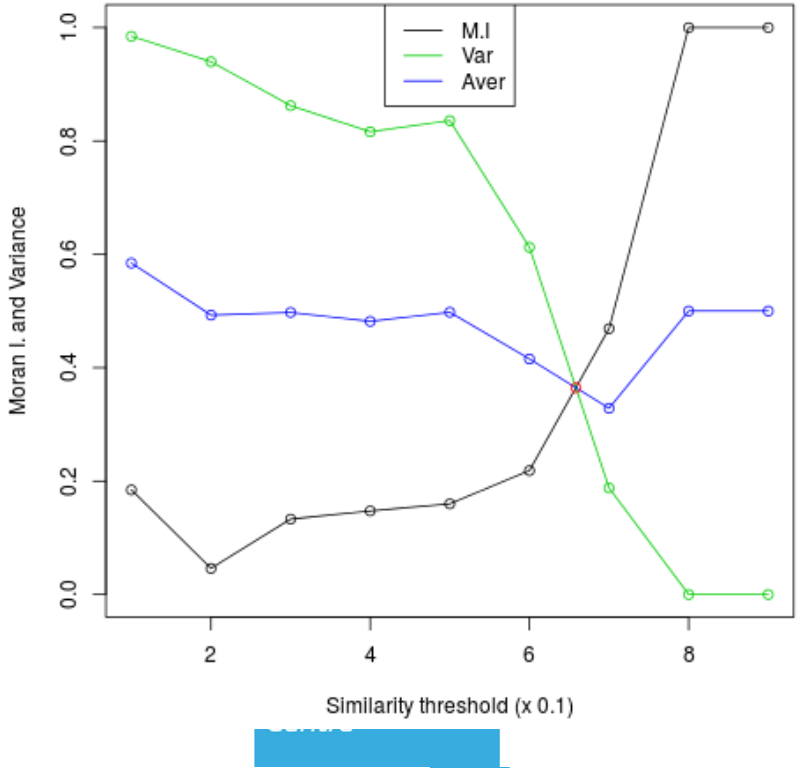
Optimum ST?

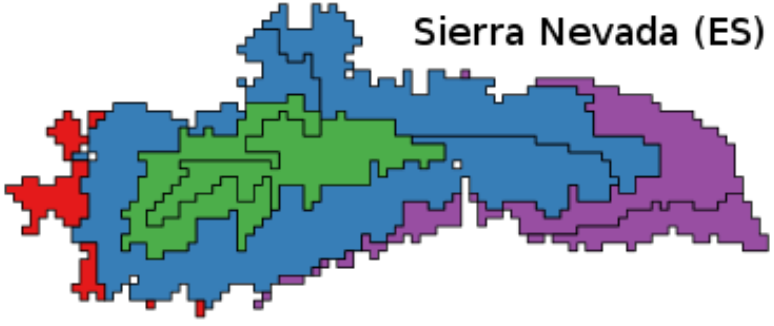
- For each PA 10 **hierarchical** segmentations with increasing ST (0.1 – 0.9)
- Trade-off between keeping: **(a)** a low number of LUs, **(b)** a low autocorrelation (Moran's I) and **(c)** a high internal homogeneity (1-variance)

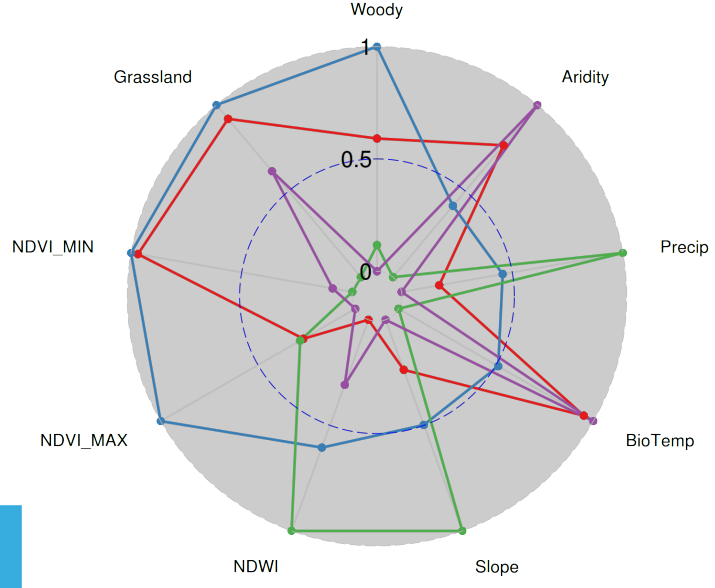


Final habitat types

Post-classification of the resulting landscape units (LU) into natural habitat types

- Input: Mean and variance of the 9 environmental variables from each LU
- Hierarchical clustering using *euclidean* distance
- Nr. of classes based on a similarity of 25% (max. 8)





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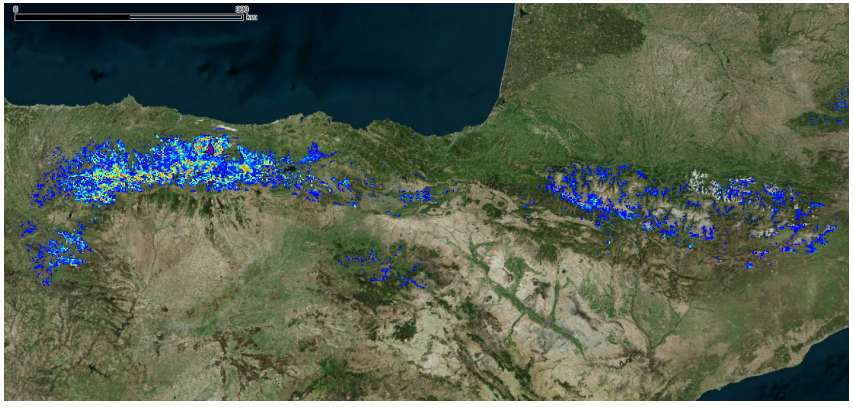
II. How likely is it to find similar habitats outside PAs ?

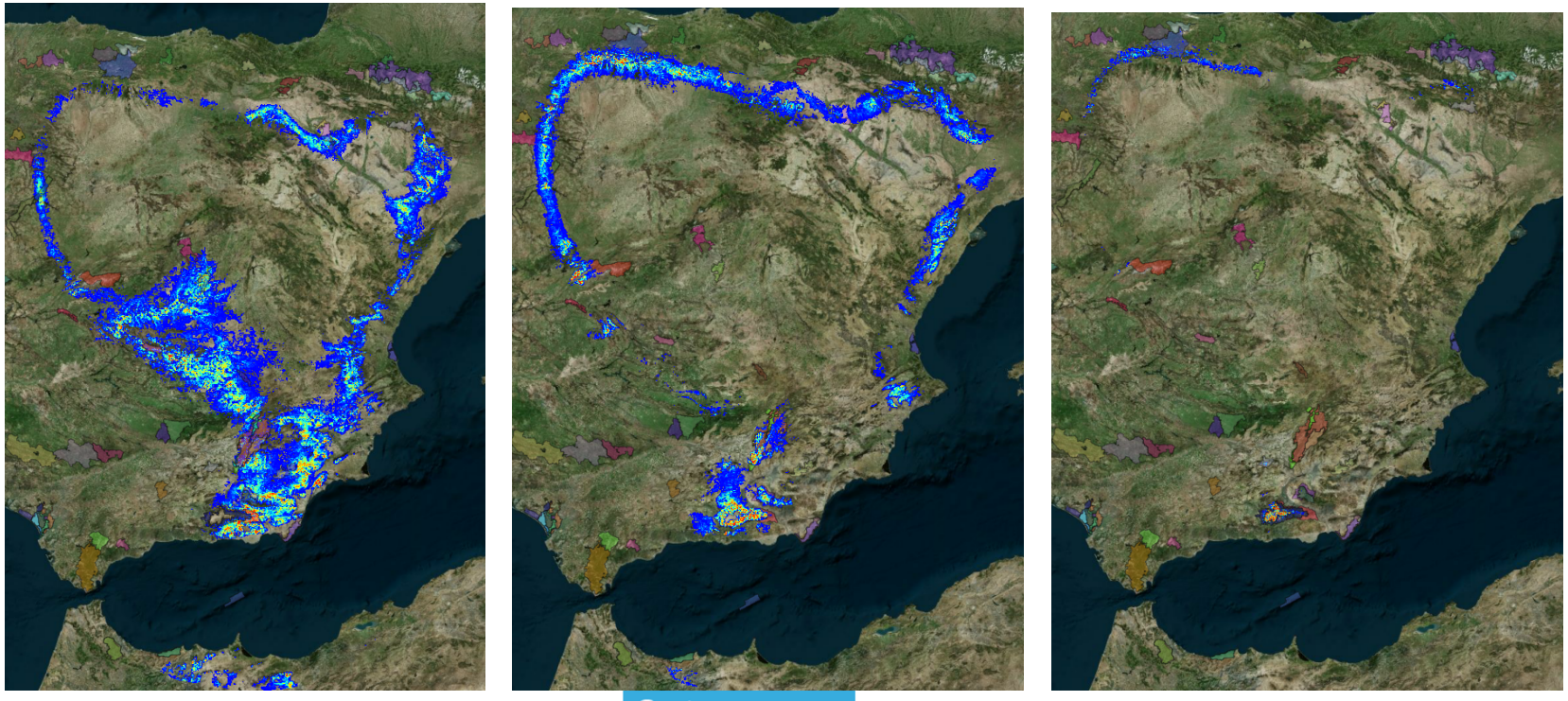
- Map similar areas (potential new PAs)
- Assess the singularity of a specific HNT (indices)
- Study fragmentation/connectivity among HNT/PAs



Similarity maps

For each natural habitat type found on each PA a map of similar pixels is computed using multivariate statistics in the **ecoregion** where it belongs

- *Mahalanobis* distance based on the 9 environmental variables
- Map of similarities (0 – 1)



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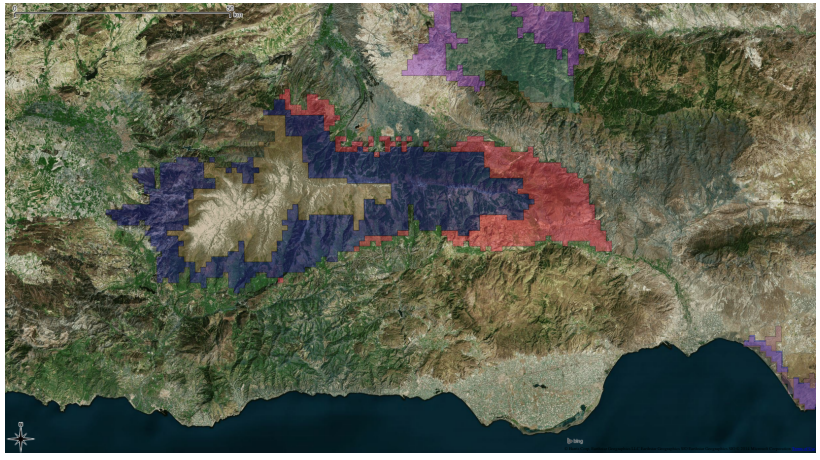
Landscape similarity ratio

Similar patches: continuous areas with at least the same size and averge similarity values as the reference HNT (if any)

$$LSR(HNT) = \frac{\sum \text{Area simil. patch(es)}}{\text{Ref. patch area}}$$



HNT	Landsc. simil. ratio
SN 1 (top)	0.02
SN 2 (middle)	0.23
SN 3 (bottom)	2.79

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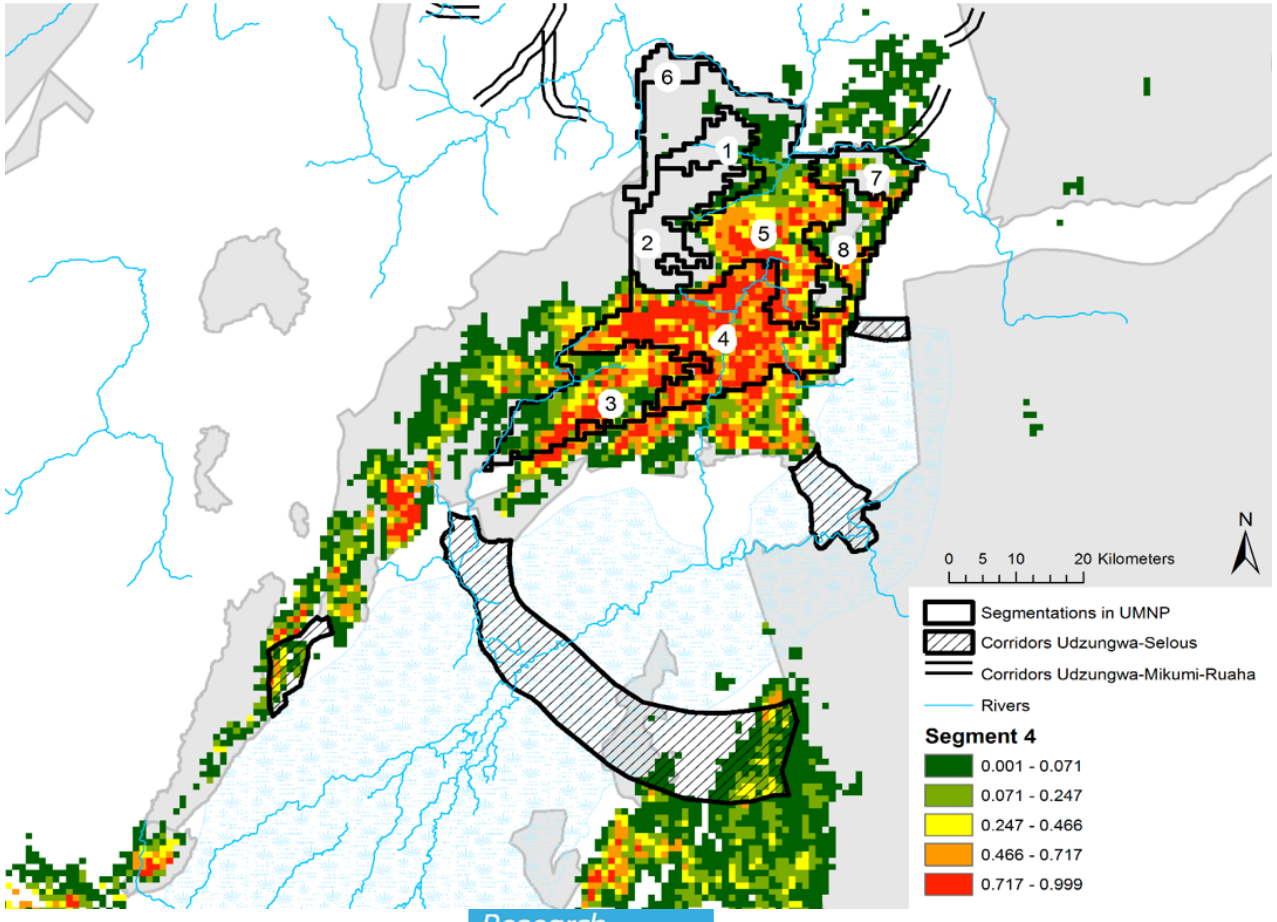
Connectivity

Connectivity between (similar habitats) PAs



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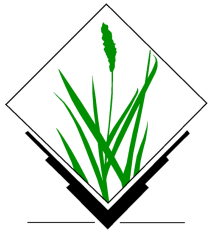
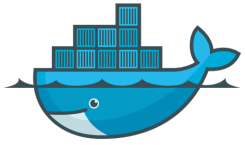
Try it yourself!







R + Python + GRASS GIS 7 + Docker

- Parallel computing
- Web Processing Service (WPS)
- Interoperability
- Standalone tool
- Source code available

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Ongoing/future work

- Testing the correlation between habitats environmental conditions and species composition
- Testing habitat stratification in local case studies using different variables/higher resolution
- Validation of the similarity maps
- Development of a composite index of PA singularity based on LSR values and habitat composition
- Engagement of the research and conservation communities through a new web interface with global results and the DOPA Analyst (WPS)

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