Landscape and Fragmentation Analysis

- Patch Analyst
- Patch Analyst (Grid)
Crash Course in...

Landscape Ecology

- Study of landscape patterns
- Interaction among patches within a landscape
- Dynamics and change in landscape patterns over time
- Flows of energy, nutrients, and species among landscape elements

REM429
Landscape - a mosaic of patches
Patches can represent.....

- Cover types
- Habitat types
- Structural stages of cover types
- Urban development
- Physiographic features

...etc
Hurry Back Creek

Landsat 5 imagery, July 1992

116° W Long, 43° N Lat
Elevation 800-2500 m
Precip. 250 – 1000 mm

Current Creek

Smith Creek

Red Canyon Creek

130,000 ha
Succession in a Western Juniper Community

Grassland after fire

Mountain big sagebrush steppe

Stand initiation juniper (Phase 1)

Open young juniper (Phase 2)

Young multistory juniper (Phase 3)

Mature juniper woodland
From Air Photo to GIS Vegetation Layer
From Satellite Image to GIS Vegetation Layer
Photo interpretation

Satellite data
Landscape Characteristics

- Patch size and Edge density
- Patch richness
- Shape
- Patch diversity
- Patch evenness
- Spatial distribution / Interspersion
- Nearest neighbor / Proximity
- Core area metrics
Landscape and Fragmentation Analysis Software

- Fragstats 3.3
  - GUI interface
  - Works with many input formats including ArcGIS Grids (rasters)
  - Landscape, Class and Patch analyses
  - Allows the user to select output metrics
  - Moving window analysis
  - Batch processing

http://www.umass.edu/landeco/research/fragstats/fragstats.htm
Landscape Metrics

- Mean Shape Index
- Nearest neighbor
- Core Area Density
- Evenness
- Shannon’s Diversity Index
- Edge Density
- Contagion
- Proximity Index
- Patch Size
- Interspersion
- Standard Deviation
- Juxtaposition
- Patch Richness
Patch Size

MPS = 8.5 ha  
MedPS = 4.0 ha 
PSSD = 13.1 ha

MPS = 30.3 ha  
MedPS = 4.0 ha 
PSSD = 74.7 ha
Edge Density

TE = 104 km
ED = 0.019 m/m²

TE = 56 km
ED = 0.010 m/m²
Patch Richness

PR = 12

PR = 5
Patch Shape

Mean Shape Index is 1 when all patches are circular and increases as the patches become more irregular.
<table>
<thead>
<tr>
<th>MSI</th>
<th>MPAR m/ha</th>
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<tr>
<td>1.22</td>
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<tr>
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<td>627</td>
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<td>1.44</td>
<td>361</td>
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<td>1.40</td>
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</table>
Diversity varies with Patch Richness while Evenness is independent of Patch Richness.
Patch Diversity and Evenness

SDI = 2.33
SEI = 0.94
PR = 12

SDI = 2.00
SEI = 0.81
PR = 12

Shannon’s Diversity and Evenness Index both reflect the relative distribution in area between patch types. Spatial distribution is not accounted for.
Patch Isolation / Fragmentation

Mean Nearest Neighbor Index is the average of the shortest distances between patches of the same type within the landscape.

MNN = 96.3
MPI = 86.0

MNN = 71.4
MPI = 49.5
Interspersion Juxtaposition Index

$IJI = 75.5$

$IJI = 69.1$

$IJI$ measures patch adjacency. $IJI$ approaches 100 when all patch types are equally adjacent to each other.
Landscape Levels

**Landscape** – metrics are computed for the entire landscape.

**Class** – metrics are computed by landscape class (e.g. cover types or habitat types)

**Patch** – metrics are computed for each patch. A limited number of metrics are available.
Fragstats User Interface
Connectivity Rules

4-cell rule

8-cell rule
Moving Window Analysis

5x5 Neighborhood

Cells included for processing

processing cell

4x4 Neighborhood
Moving Window Analysis

A circular or square moving window moves across the input grid and selected metrics are calculated for the center cell of the window.
Shrub cover

Sage brush types
- Not sagebrush
- Low sage or < 8% cover of big sagebrush
- > 8% big sagebrush cover

Miles
Landscape scale habitat characteristics

Do animals use areas of high or low shrub cover?

Does the amount of ‘edge’ between low and high cover areas affect habitat selection?

Are areas within home ranges homogeneous or heterogeneous with respect to shrub cover?

Does patch size matter?

eetc…………………………
Comparison of areas with medium/high sagebrush cover within 100 m (top) and 1 km (bottom)

- **EE_95_fixedkernel**
- **Medium and High Big Sage**
- **% per hectare**
  - High: 100
  - Low: 0.265252

- **EE_85_fixedkernel**
- **Sagebrush cover %**
- **Medium and High Big Sage**
  - 0-10
  - 10-20
  - 20-30
  - 30-50
  - 50-100
Total edge within a 100 m radius circular moving window
Comparison of total edge between areas of low and medium/high sagebrush cover

EB_85_fixedkemen
Total edge 500m
meters per hectare
High : 80622
Low : 0

EB_85_fixedkemen
Total edge 200m
meters per hectare
High : 3726
Low : 0
**Batch File.**—If Batch mode is selected, then FRAGSTATS will run the batch file specified in the Input File text box and produce output for all of the landscapes designated in the batch file. See Step 4 on Working with Batch Files for details on building a suitable batch file. If Batch mode is selected, then the Input Data Type (see below) and Grid Attributes (see below) will become inactive (grayed out in the interface) because these parameters will be specified uniquely for each input landscape in the batch file.
Further reading....


