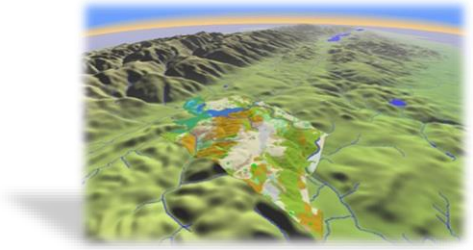


ENVIRON 761:

Landscape Analysis – Part 1:

Fragmentation & Landscape Geometry

Instructor: John Fay

Overview

- From habitat to habitat patches (Demo)
- Patch geometry
  - FRAGSTATS (Demo)
  - ArcMap (Demo)
    - Area, perimeter, thickness, shape index, core area
    - Average nearest neighbors

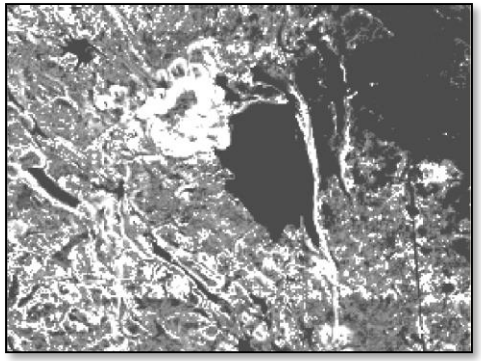
Habitat and *Habitat Patch* maps

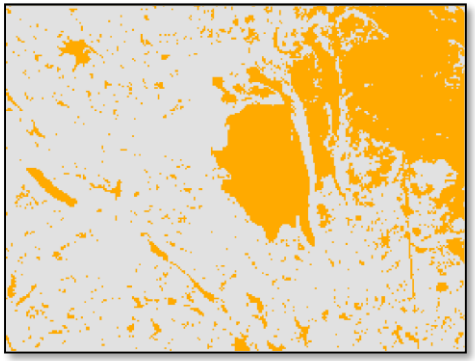
Pronghorn distribution model → Pronghorn habitat map → Pronghorn habitat-patch map

Continuous:
Pronghorn habitat suitability (0.0-1.0)

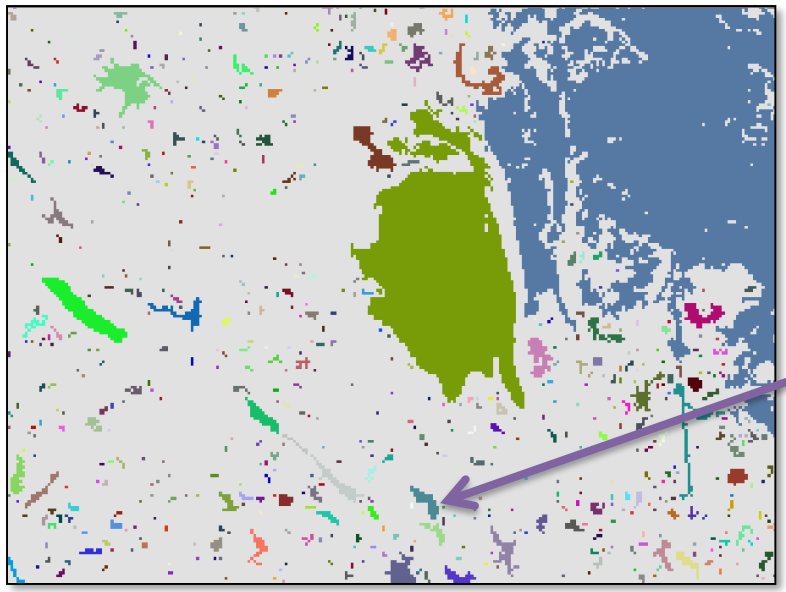
Binary:
Separates pixels into suitable and non-suitable classes

Nominal:
Clusters of connected habitat cells are grouped and given a unique ID





Patch attribution/prioritization



Patch ID	*102010*
Area	450 HA
Cost	$250k
Core-area ratio	0.82
Threat idx.	0.24
Biodiversity idx.	0.03
Betweenness idx.	0.478
Ecosys. svc. idx.	0.850
TOTAL SCORE	**0.227**

Quantitative score used to rank against other patches

Patch Geometry Metrics

- Properties of the size and shape of a habitat patch that may affect its conservation value…
  - Area
  - Perimeter
  - Thickness
  - Shape complexity
  - Percent of area that's core (core-area ratio)
  - Dispersion vs. clumpiness of patches*

* Property of a landscape, not a single patch…

Assignment: *Compute metrics*

- A table of the **summary statistics** (min, max, mean, std. deviation) of:

  - ✓ patch area,
  - ✓ perimeter,
  - ✓ shape index, &
  - ✓ edge-area ratios

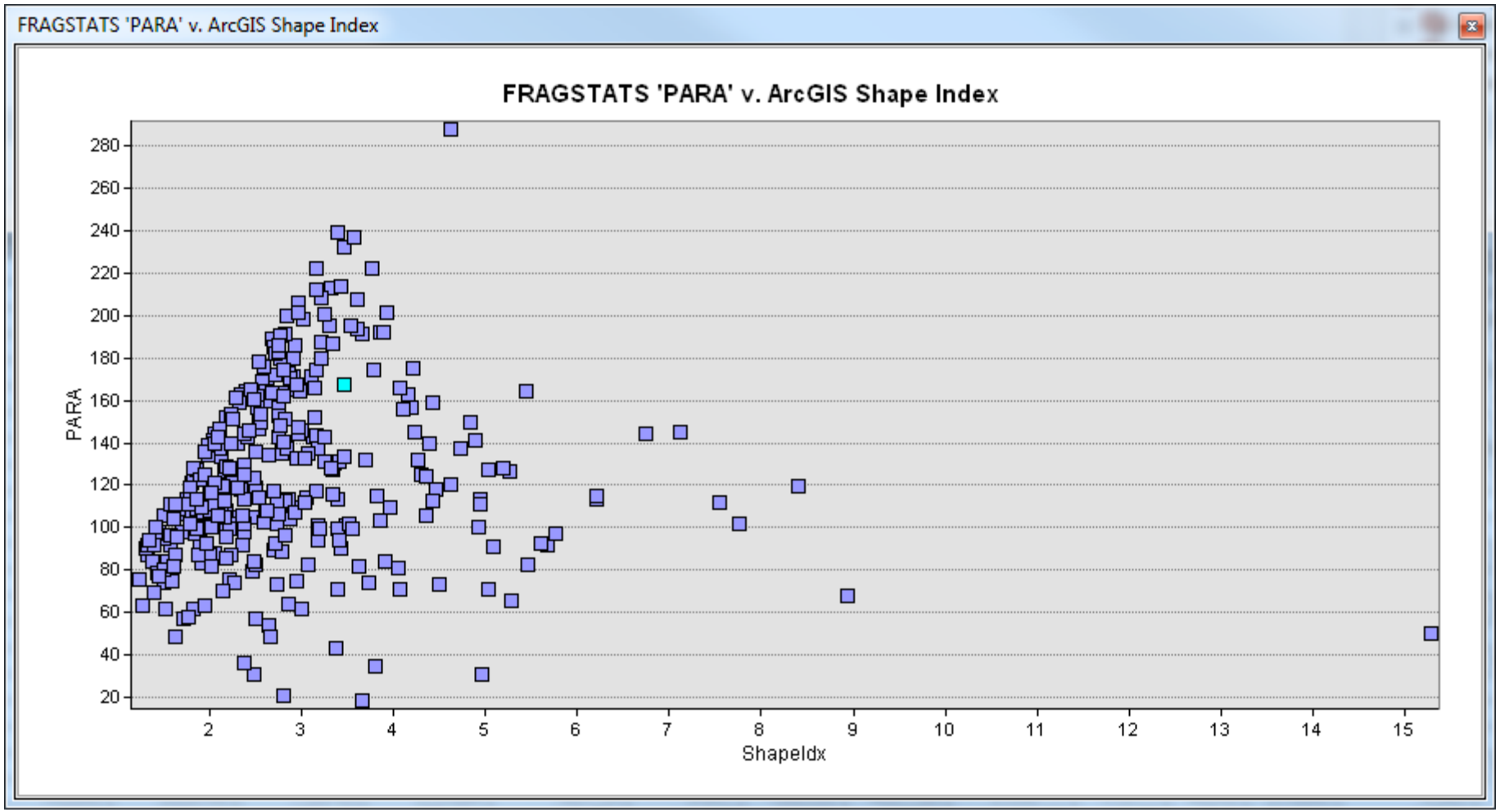
  …for the set of pronghorn habitat patches within the study area.

  Also include columns for the same or similar measures (if they exist) from the FRAGSTATS outputs.

- An X-Y scatterplot of FRAGSTATS computed perimeter –area ratio (PARA) against Shape Index, calculated in ArcGIS.

Assignment: *Compute metrics*

- Shape index vs. Perimeter-Area ratio



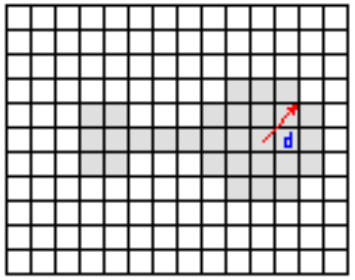
Constructing Habitat/Habitat Patches

- Species Distribution Model → Habitat
  - Which threshold to use?
- Habitat → Habitat Patches
  - 'RegionGroup' tool…
- Removing tiny patches
  - May be "noise"
  - Might not be large enough to be useful

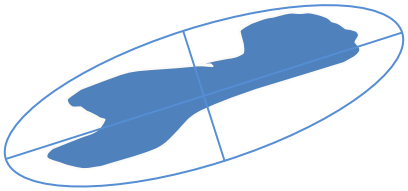
Zonal Geometry (ArcGIS)

- Area
- Perimeter
- Thickness
- Centroid
- Elliptical characteristics

Forest polygon



ZONALTHICKNESS on forest zone



Attributes of Patch_centrd

ObjectID	Value	Count	Majoraxis	Minoraxis	Orientation
0	1	1	551.24157714	205.2805328	152.723114013672
1	2	1	16.925687789	16.92568778	90
2	3	1	92.031661987	74.70791625	135
3	4	1	283.90103149	168.5163879	74.2899703979492
4	5	1	33.851375579	16.92568778	90
5	6	1	391.35882568	157.3823242	167.515258789063
6	7	1	16.925687789	16.92568778	90
7	8	1	61.237712860	23.39072418	95.1524200439453
8	9	1	360.04232788	209.2641448	160.938064575195
9	10	1	53.842014312	42.56584930	45
10	11	1	208.74642944	123.5139770	88.9923095703125
11	12	1	165.79930114	89.84900665	65.9140625
12	13	1	38.582225799	22.27545738	45
13	14	1	165.03775024	74.64105987	70.0033569335938
14	15	1	442.65081787	311.2980957	7.52797937393188

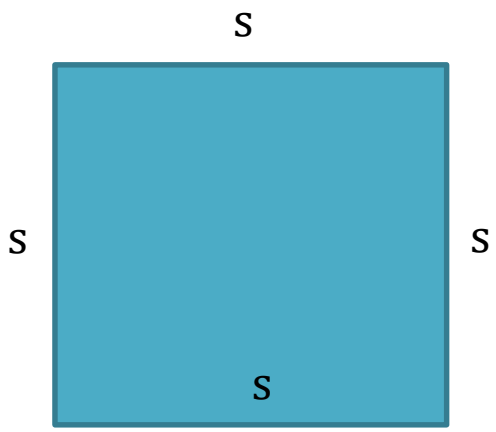
Record: 3 Show: All Selected Records (0 out of 2583 Selected.)

Shape Index

Shape index compares a patch's perimeter to the perimeter of a square with area the same as that patch's.

$$shape\ index = \frac{p_{patch}}{p_{min}}$$

The smallest perimeter occurs when the shape is at its most compact, i.e. a *square.*



p_{min} for a square of area $A = 4\ (\sqrt{A})$, so

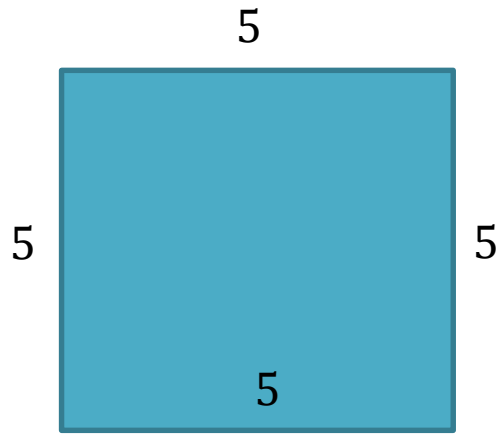
$$shape\ index = \frac{p_{patch}}{4\ (\sqrt{A})}$$

$P = 4*s$

$\underline{A = s^2;\ s = \sqrt{A}}$

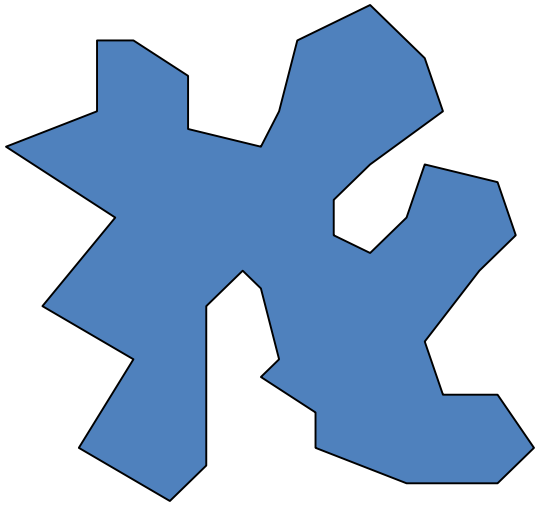
$P = 4(\sqrt{A})$

Shape Index



$$\frac{\text{Perimeter}}{4 * \sqrt{(\text{Area})}}$$

As values get larger, the shape is more complex (less compact)…



Area = **25**
Length of on side = **5**
Perimeter = 4*5 = **20**

Shape index
= 4 (√25) / 20
= 1.00

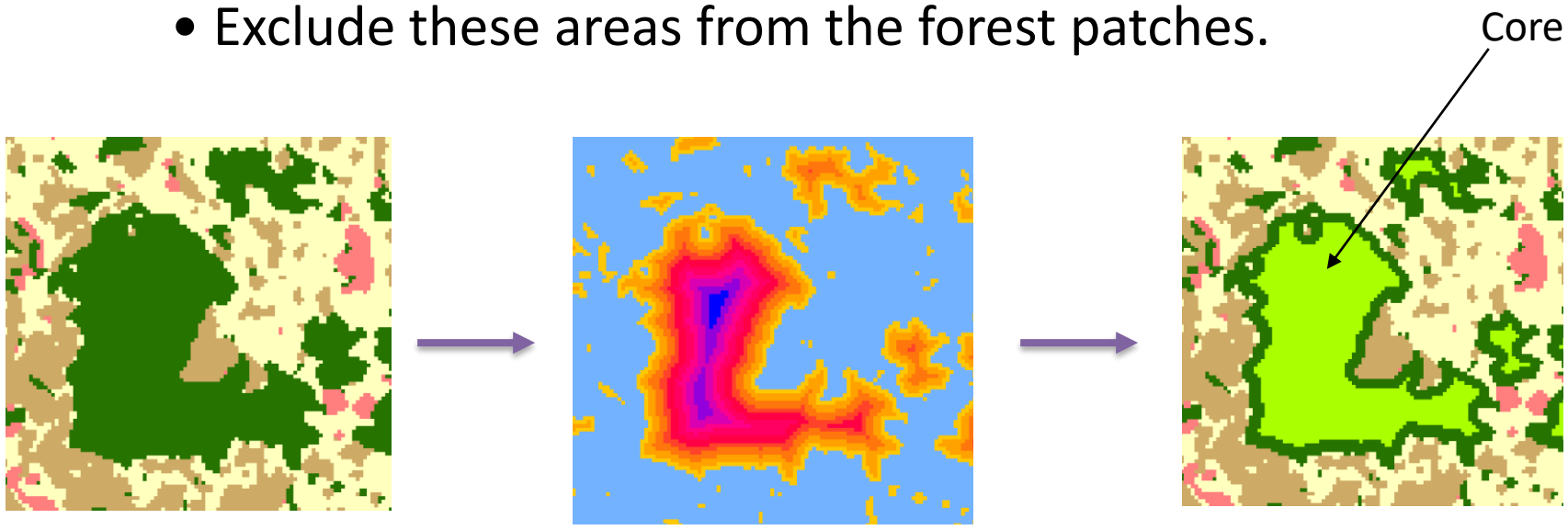
Area = ***25***
Perimeter = ***60***

Shape index
= 60 / 4 (√25)
= 3

Core-Area Ratio

If pronghorn tend to avoid habitat that is within 200 m of an edge, how much of a habitat patch's area is actually available to them.

- Identify cells within 200 m of the edge.
- Exclude these areas from the forest patches.



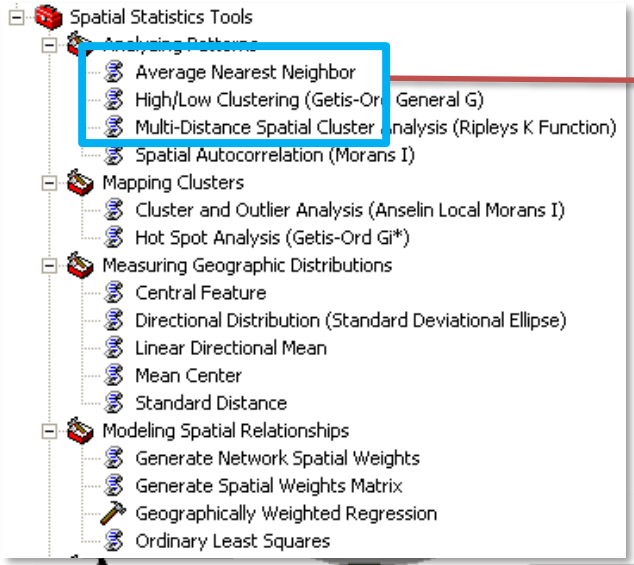
Habitat patch

Distance from edge

Cells > 200m from edge = Core

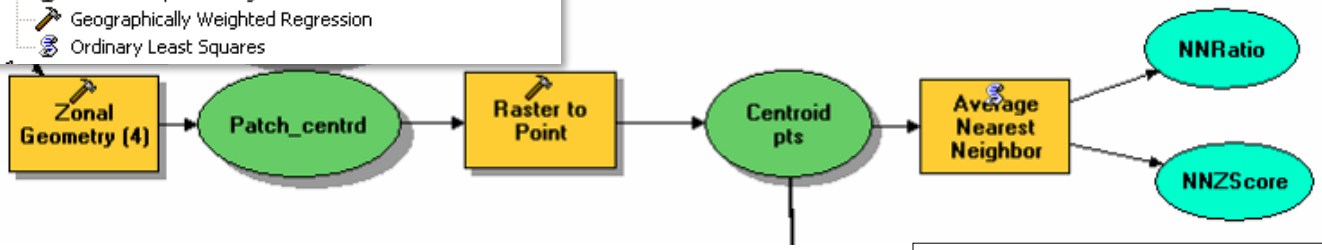
* Use a mask to set non-patch areas to No Data in result…

Spatial distribution



Average Nearest Neighbor

NNRatio: Values < 1 indicate the forest patches are clustered; values > 1indiciates patches are dispersed.



NNZScores: Indicates the statistical significance of the result. At a significance level of 0.05, a z score would have to be greater than 1.96 or less than (–1.96) to be statistically significant.

FRAGSTATS

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FRAGSTATS: Spatial Pattern Analysis Program for Categorical Maps

Home Page

What is FRAGSTATS?

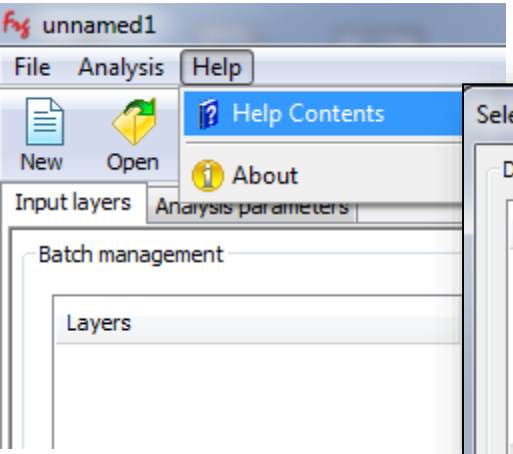
FRAGSTATS is a computer software program designed to compute a wide variety of landscape metrics for categorical map patterns.The original software (version 2) was released in the public domain during 1995 in association with the publication of a USDA Forest Service General Technical Report (McGarigal and Marks 1995).

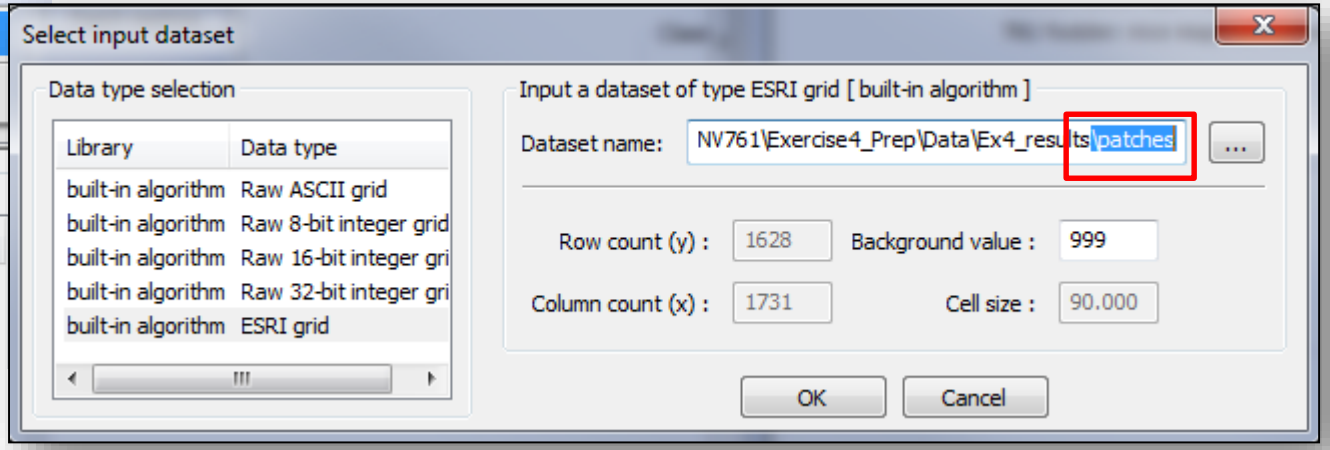
Since then, hundreds of professionals have enjoyed the use of FRAGSTATS. Due to its popularity, the program was completely revamped in 2002 (version 3.3). Recently, the program was upgraded to accommodate ArcGIS10.x. The program is currently undergoing a major revamping, which will result in the release of version 4.0 early in 2012. Version 4.0 has a completely redisigned architecture and is designed to support the addition of cell-level metrics and surface pattern metrics, among other things. Version 4.0 has essentially the same functionality as version 3.x, but with a new user interface that reflects the redesign of the model architecture, and is simply a stop-gap release for individuals that work with ArcGIS10.x. We expect to release additional versions (e.g., 4.1 and so on) shortly thereafter that incorporate new features

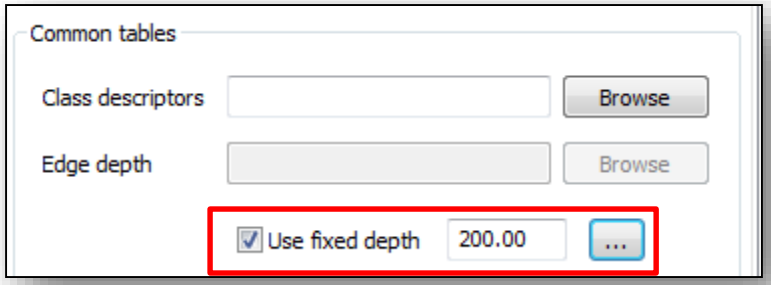
Quicklinks
NALCC
FRAGSTATS
CAPS
HABIT@
RMLands
Vernal pools
Fire
Shortcourses

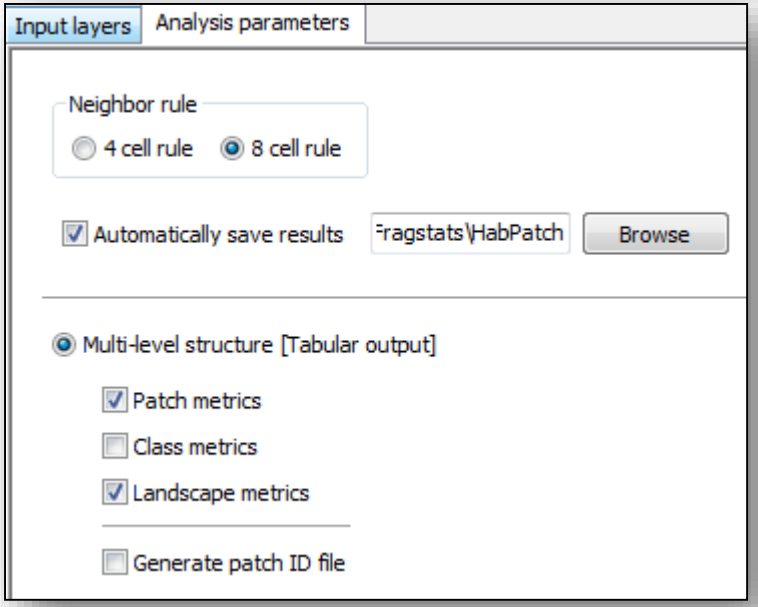
http://www.umass.edu/landeco/research/fragstats/fragstats.html

FRAGSTATS


unnamed1
File
Analysis
Help
New
Open
Help Contents
About
Input layers
Batch management
Layers


Select input dataset
Data type selection
Library
Data type
built-in algorithm Raw ASCII grid
built-in algorithm Raw 8-bit integer grid
built-in algorithm Raw 16-bit integer gri
built-in algorithm Raw 32-bit integer gri
built-in algorithm ESRI grid
Input a dataset of type ESRI grid [built-in algorithm]
Dataset name:
NV761\Exercise4_Prep\Data\Ex4_results\patches
Row count (y) :
1628
Background value :
999
Column count (x) :
1731
Cell size :
90.000
OK
Cancel


Common tables
Class descriptors
Browse
Edge depth
Browse
Use fixed depth
200.00


Input layers
Analysis parameters
Neighbor rule
4 cell rule
8 cell rule
Automatically save results
Fragstats\HabPatch
Browse
Multi-level structure [Tabular output]
Patch metrics
Class metrics
Landscape metrics
Generate patch ID file

FRAGSTATS

Patch Metrics (no class level or landscape level deviations):

- Area - Edge: Patch Area, Patch Perimeter
- Shape: Perimeter-Area Ratio, Shape Index
- Core Area: Core Area, Number of Core Areas, Core Area Index.

Class Metrics

- *None – why??*

Landscape Metrics (no distribution statistics):

- Area - Edge: Total Area, Largest Patch Index, Total Edge, Edge Density
- Core Area: Total Core Area, Number of Disjunct Core Areas

FRAGSTATS

Save and Run scenario…

- ~~Can take several minutes to calculate~~

Patch metrics results:

1. Rename “____.patch” to “_____.csv”
2. Open csv file in Excel (or Notepad ++)
3. Find & Replace “cls_” with empty string

4. Open in ArcMap, Copy Rows to new table

5. Use ‘TYPE’ attribute to link with habitat patch features

Landscape Prioritization

- Patch geometry gives us one approach to prioritizing some habitat patches over others for conservation.
- Other prioritization schemes include:
  - Level of threat/likelihood of persistence
  - Biodiversity co-benefits
  - Patch connectivity
  - Ecosystem services co-benefits

These are what we'll be looking at in the coming weeks…