Connectivity

Measuring connectivity

- Connectivity is considered a “vital element of landscape structure”
- Difficult to define precisely and quantify
  - Structural connectedness of patch types (or habitat)
  - Functional connectedness” of the landscape as perceived by an organism or ecological process.

Measuring connectivity

- Structural connectedness or physical continuity of a patch type (or a habitat) across the landscape can be evaluated by a combination of metrics
  - Habitat extent (patch size)
  - Subdivision (number of patches and patch size distribution)
  - Contagion

Measuring connectivity

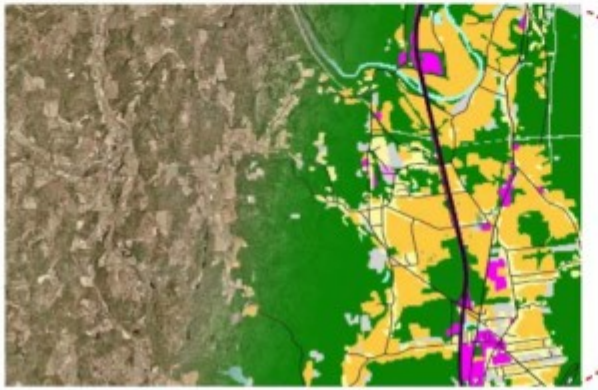
- Functional connectedness depends on the organism or process of interest; patches that are connected for birds might not be connected for squirrels, seeds, fire spread, or hydrologic flow.

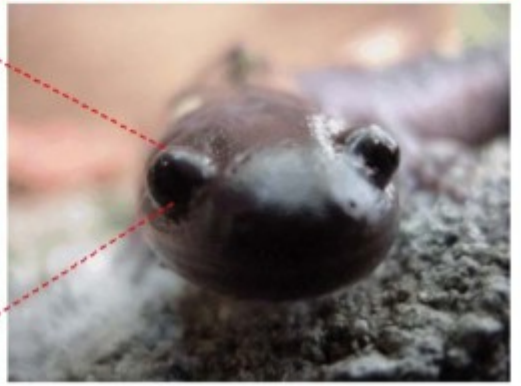
Connectivity vs continuity

Insights on Metrics...*connectivity metrics*

Continuity versus Connectivity

- Landscape continuity refers to the *structural* connectedness of the landscape or its physical continuity.
- Landscape connectivity refers to the *functional* connectedness of the landscape as perceived by a focal organism or process.



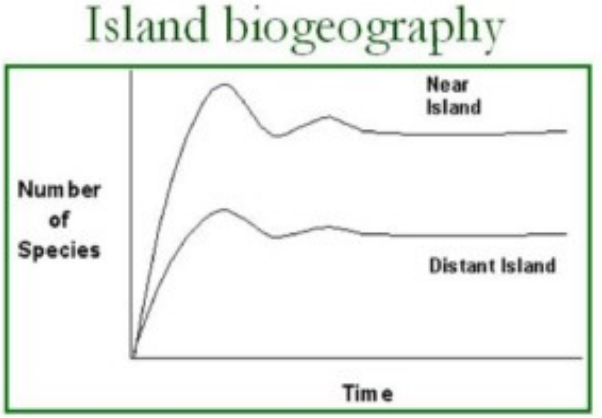


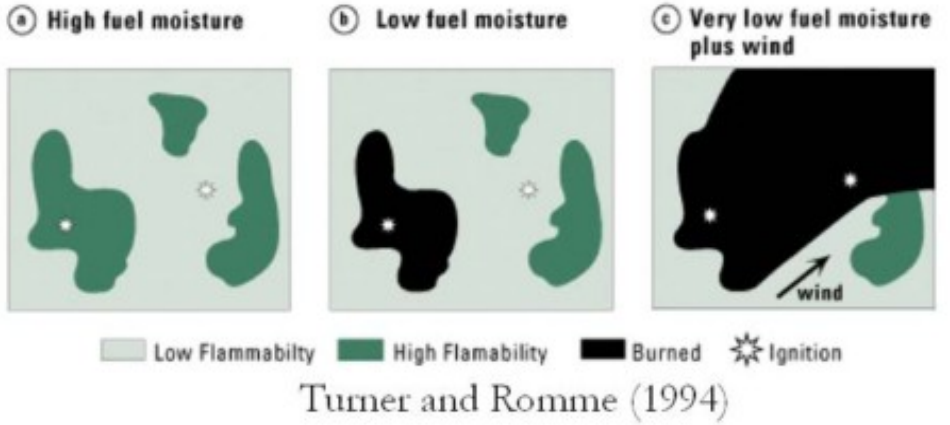
Isolation (inverse of connectivity)

Insights on Metrics...*isolation metrics*

Why does isolation matter?

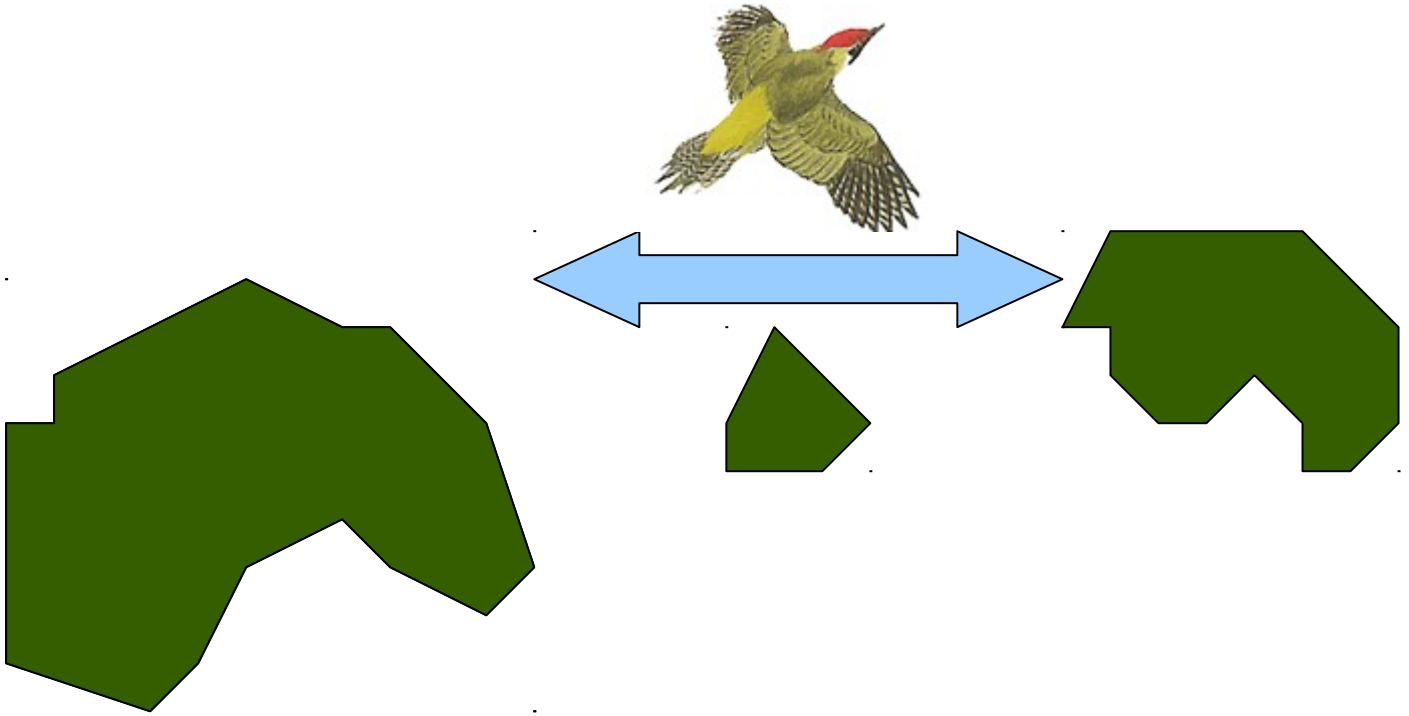
- Population isolation and implications for metapopulation dynamics
- Landscape continuity and implications for spread of disturbances





Turner and Romme (1994)

Functionally connected but not structurally continuous

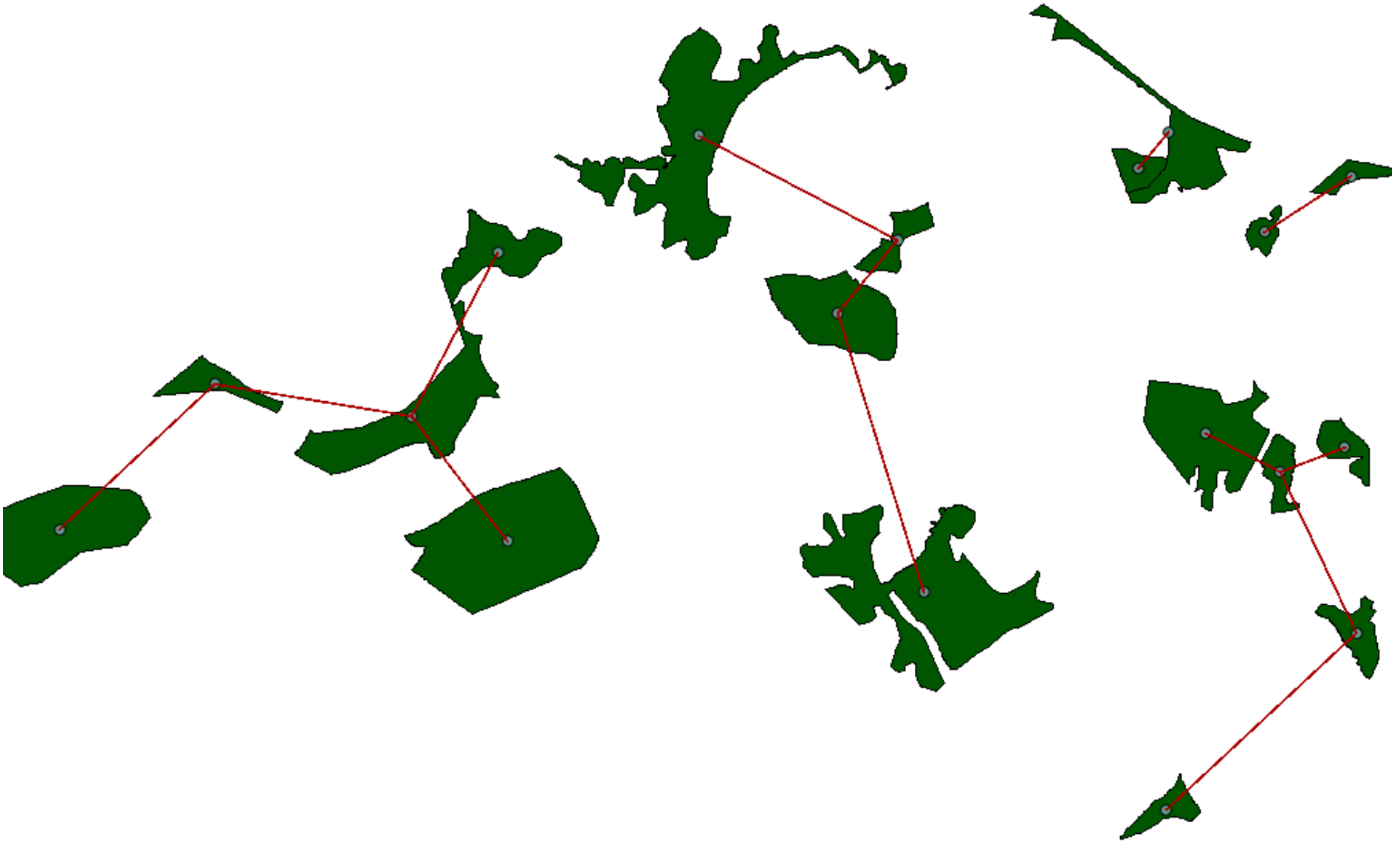


Structurally continuous but not functionally connected

Network analysis

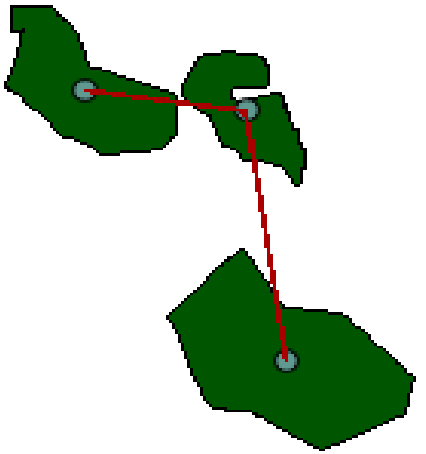
- In some situations network analysis can be useful
- For example we could measure the distance from the centre of each patch to the nearest patch centroid.
- This might define flows across the landscape

Simple nearest neighbour network



Issues

- Distances often measured between polygon centroids in a GIS.
- This is not appropriate for large patches that are close together
- Fragstats does find edge to edge distance.



Issues

- Shortest distance may also not capture connectivity well

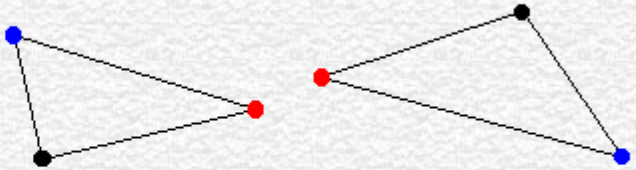


Figure 1 : The shortest distance doesn't consider the whole shape.

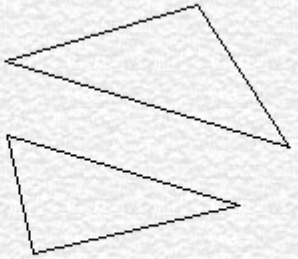


Figure 2 : The shortest distance doesn't account for the position of the objects.

Further issues

- Least cost path (functional connectivity) should take into account properties of the space between patches
- Not all intervening space is equal
- This can be looked at by assigning different weights to each type of habitat
- This is difficult in practice

Using buffers to study connectivity

- Process centred approach (functional connectivity)
- Decide a critical distance between patches (d) that limits movement between patches
- Buffer out to d/2 from each patch
- Count the number of patches within each connected neighbourhood
- Count the number of neighbourhoods
- Fewer neighbourhoods mean greater connectivity

Assignment

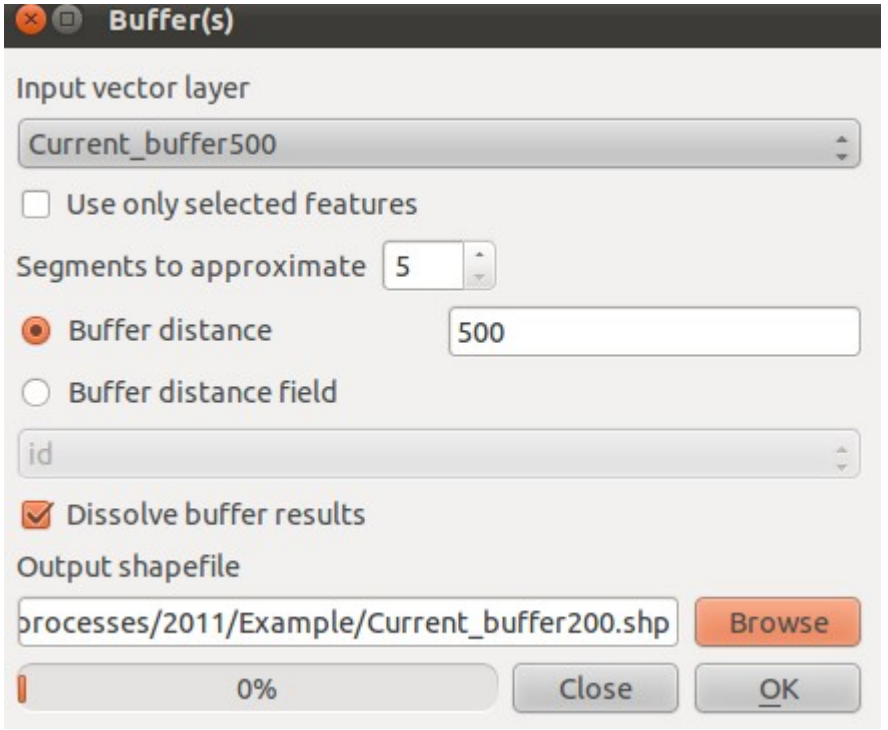
Using buffers in this way requires polygons to be defined for habitat types

Could be used to look at connectivity between reserves

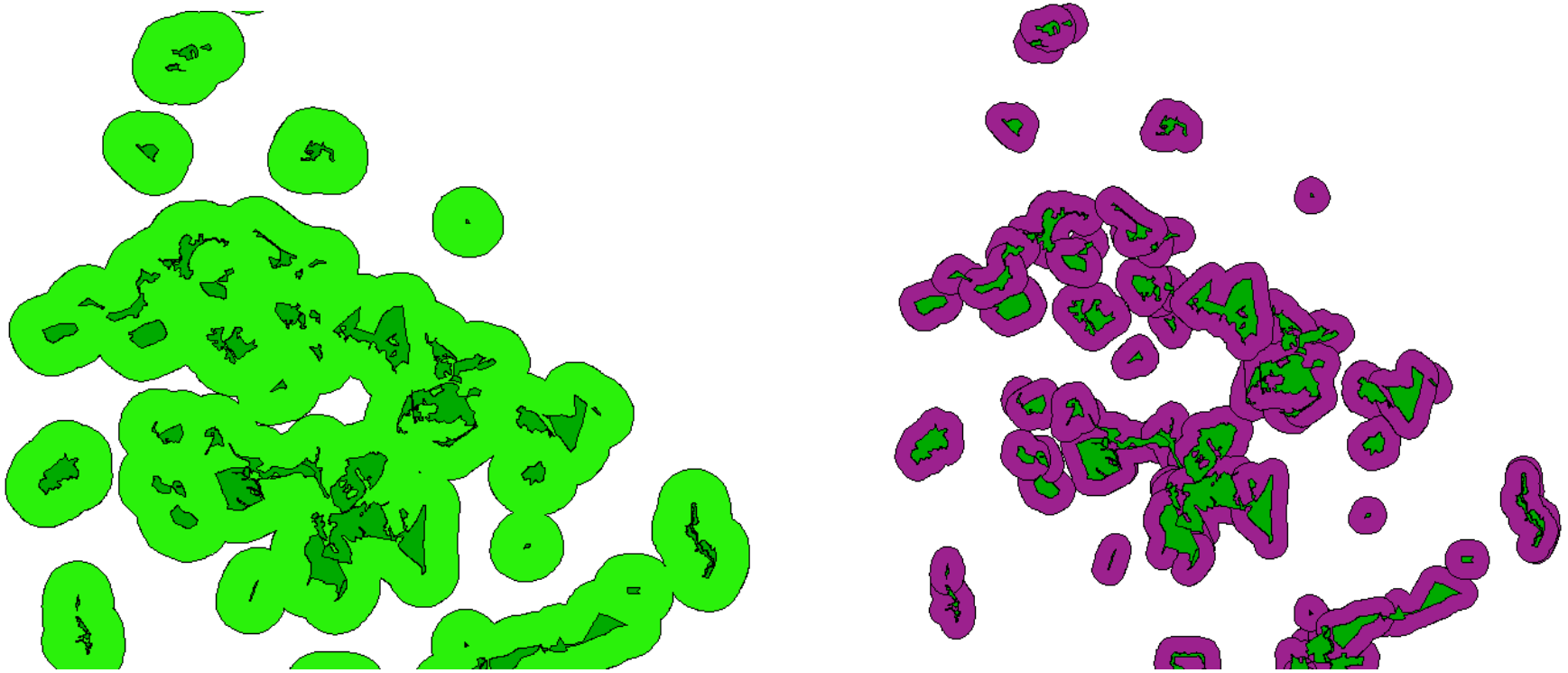
Does not take into account the nature of the matrix

GIS tips

- The buffer distance should be half the critical crossing distance
- Dissolve the buffer results



Dissolved buffer vs undissolved

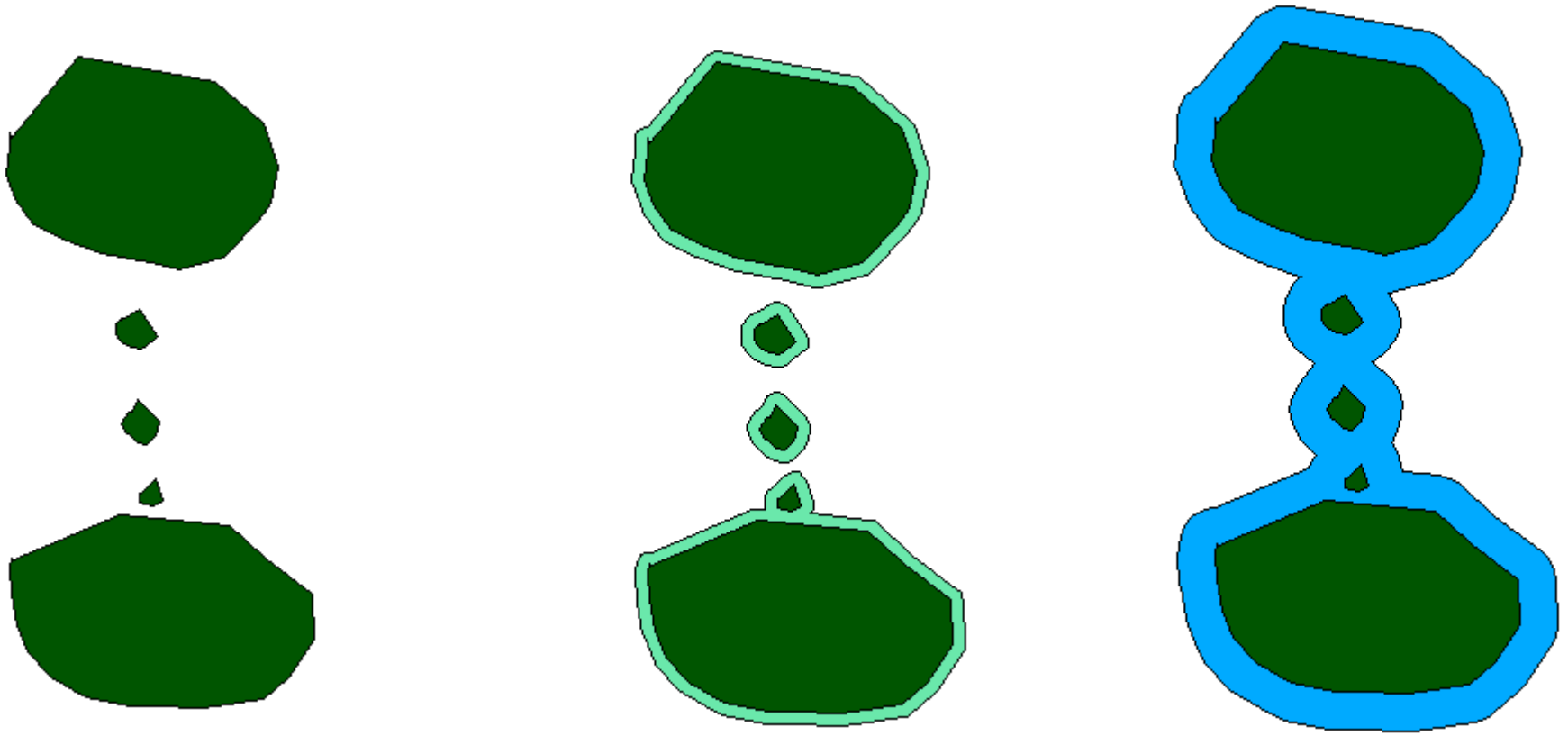


Analysing results

- The results can be analysed “by eye” or grouping can be automated in GIS
- How many patches in each cluster?
- How many clusters?
- Number of patches in largest cluster?
- Mean/median number of patches per cluster
- Mean area of connected patches

Analysing results

- Method can be particularly useful for analysing the effect of “stepping stones”



Summary

Measuring connectivity (and isolation) is complex. There are many additional ways of looking at the issue. However we have seen that simple buffering can produce interpretable results that are used by researchers to communicate complex landscape structure.