Application of connectivity modelling to fragmented landscapes at local scales

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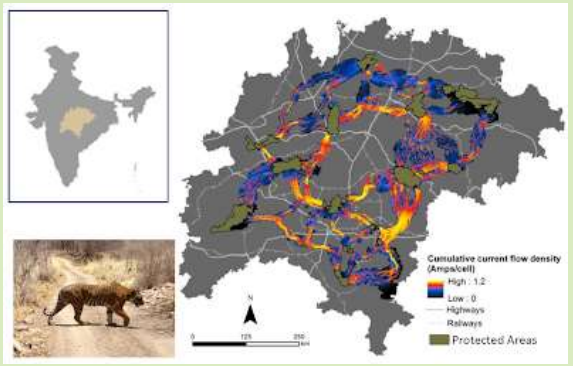
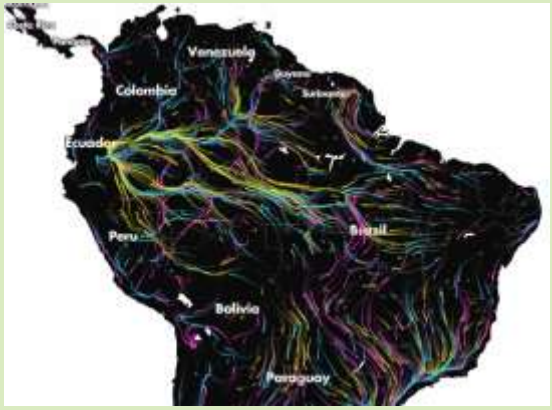
Multispecies connectivity modelling for conservation planning

- Understanding habitat connectivity an essential requirement for effective conservation of wildlife populations
- Used by planners and wildlife managers to address complex questions relating to the movement of wildlife
- “What is the most effective design of a wildlife connectivity network for a particular species or suite of species”?
- Important consideration in the management of road networks to avoid barriers between wildlife populations and reduce collisions
- Estimating ecological connectivity at landscape scales is a complex task aided by the application of ecological models
- Relatively underutilised in Australia, however, commonly used internationally in both planning and academia

Connectivity Modelling and GAP CLoSR

- Connectivity modelling has advanced rapidly in the last decade with improved computing power and more mainstream take-up of modelling tools in planning
- Suite of modelling tools available to answer different questions (Circuitscape, Graphab, Linkage Mapper)
- Recently integrated into a single decision-framework and software interface called GAP-CloSR[1]
- Models fine-scale connectivity critical in highly fragmented rural and urban landscapes
- The model is a balance between ecological complexity, robustness and simplicity.
- Application in several landscapes across south-east Australia in collaboration with land managers (Tasmanian Midlands, Lower Hunter, and Hunter Valley)





[1] Lechner AM & Lefroy EC (2014) General Approach to Planning Connectivity from Local Scales to Regional (GAP CLoSR): combining multi-criteria analysis and connectivity science to enhance conservation outcomes at regional scale – Lower Hunter, University of Tasmania, Hobart, Tasmania

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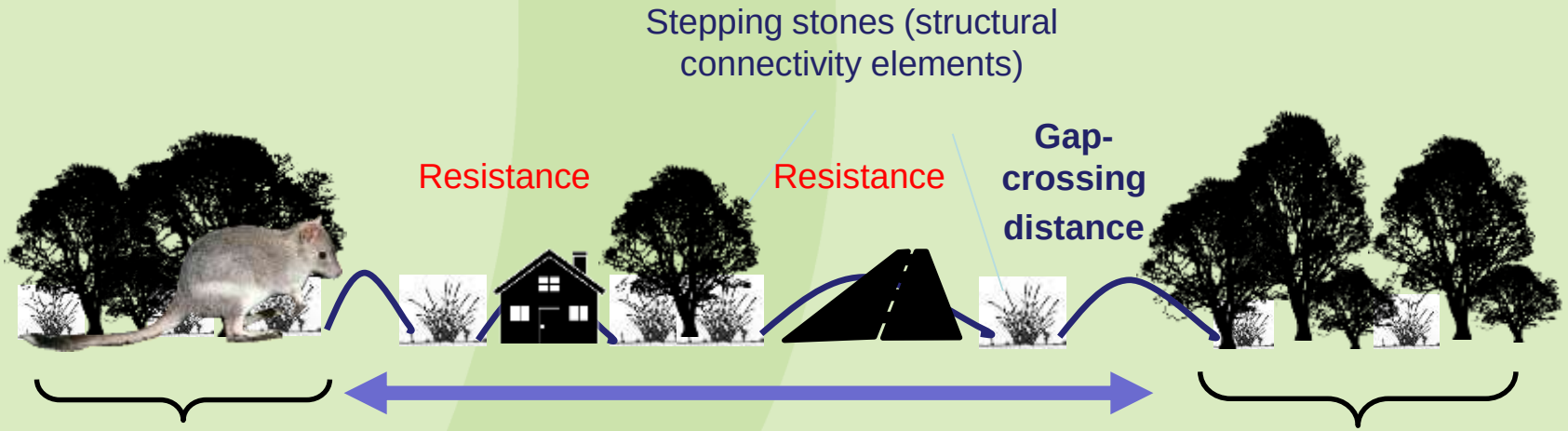
Conceptual model and parameterisation

- Mechanistic model
- Framework suitable for species which exhibit threshold dynamics such as a foray search strategy

Tasmanian Bettong

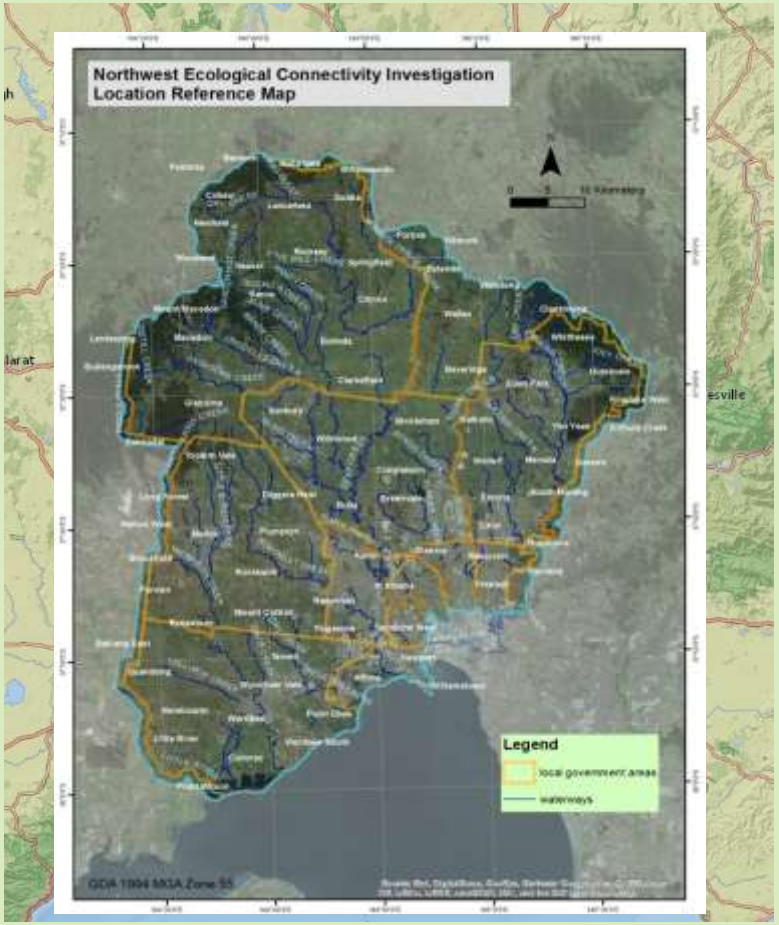
Minimum patch size: 90 ha

Gap-crossing threshold: 200 m



Northwest Ecological Connectivity Investigation

- Hume and Brimbank City Councils
- North and west of Melbourne
- Many land-managers involved
- Questions:
    1. Where habitat is connected or isolated and for what groups?
    2. Where are optimal linkages?
    3. Where do we prioritise connectivity conservation works and community grants?
    4. Where are movement barriers?



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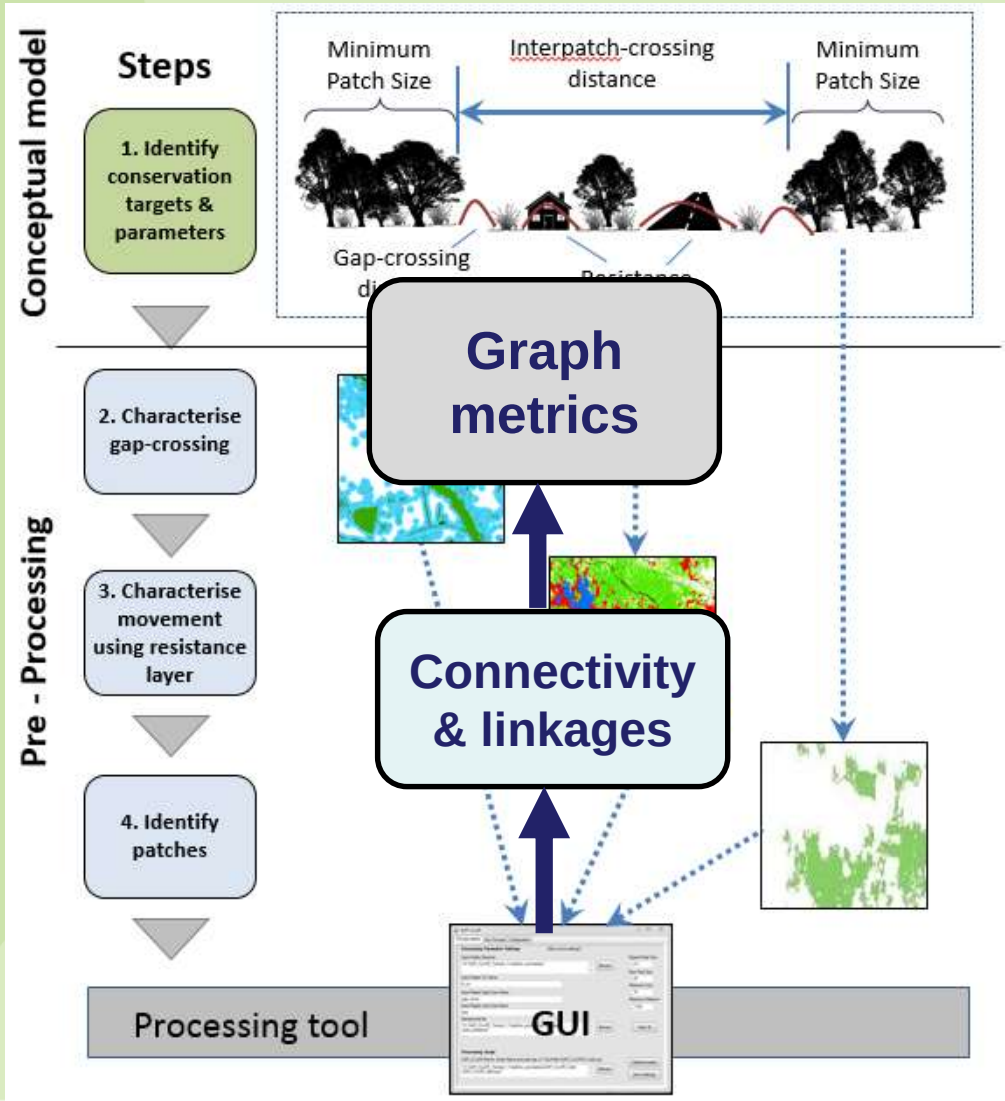
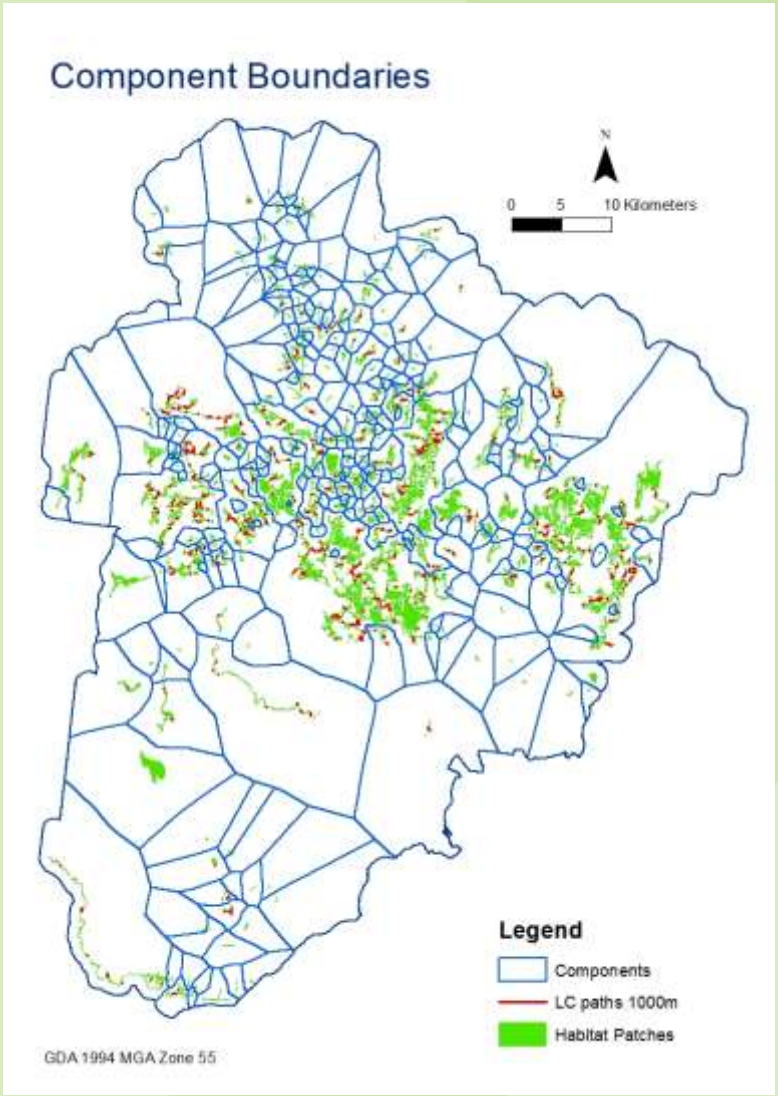
NECI - Process

- Select dispersal guilds and focal species – 11 species (long and short disperser x habitat)
- Expert opinion on species parameters
- Apply to GIS layers (habitat, stepping stones, resistance)
- Model connectivity and linkages/least-cost pathways
- Graph-metric analysis – importance of patches and linkages



NECI – Component Boundaries



- Model identifies which patches are connected and which are not
- Component boundaries (blue lines) - connected patches isolated from all other habitat
- Stepping stones
- Linkages/least-cost paths (red lines)
- Brown Treecreeper example across NECI study area

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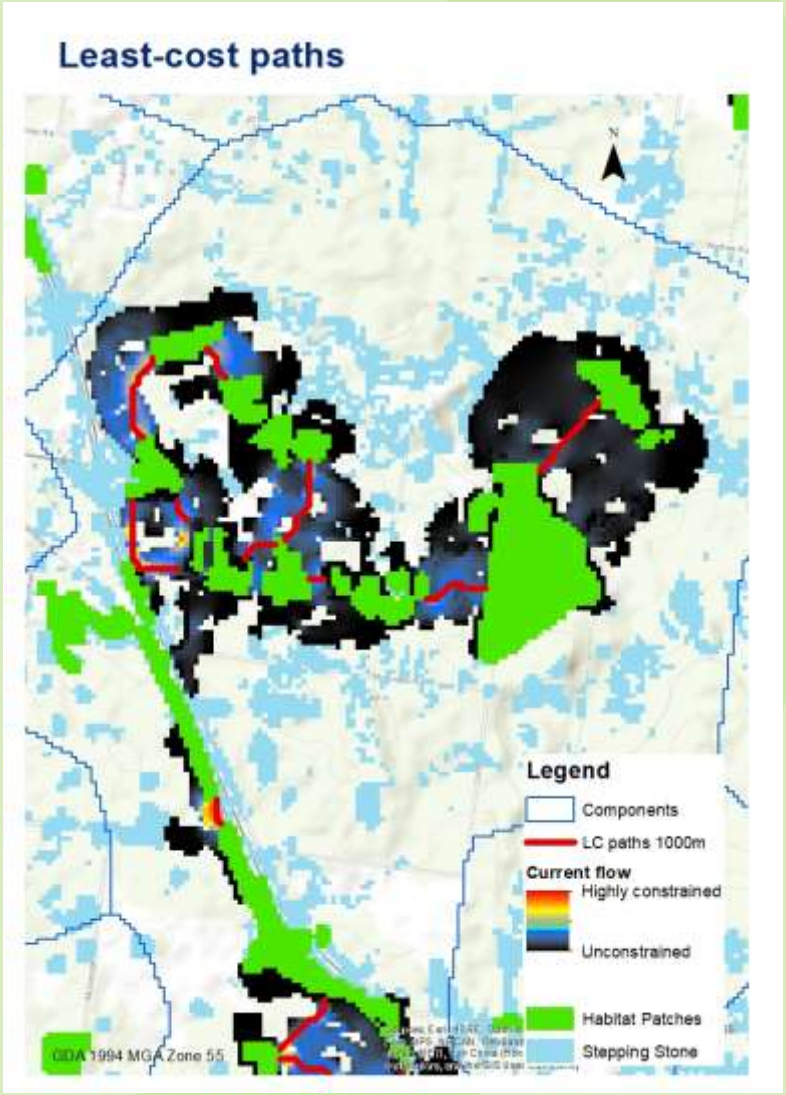
NECI – Least-cost paths (linkages)



- Represent least-cost pathways for animal movement (optimal pathways)
- Shortest pathway between two patches as a function of land cover resistance, limited by stepping stones and movement thresholds of species
- Corridor protection & enhancement
- Movement flow (Circuitscape)

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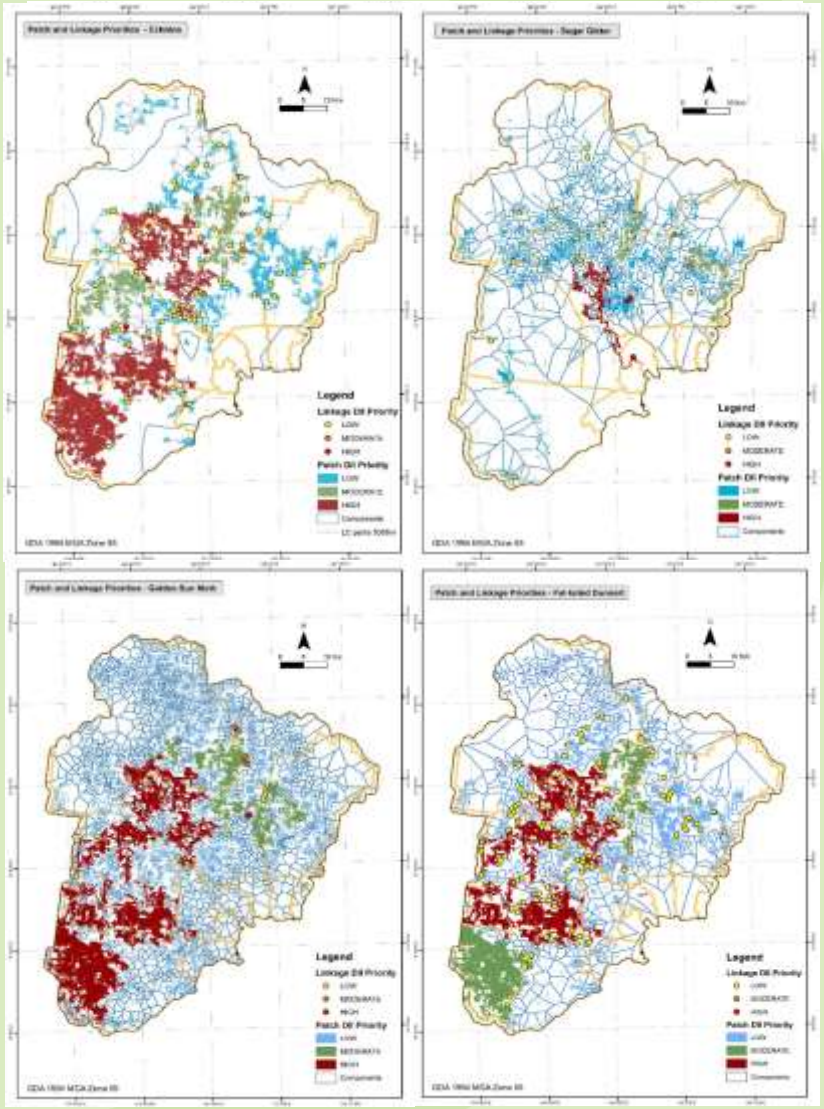
NECI – Graphic Metric Analysis: Integral Index of Connectivity (IIC)



- IIC characterises the **landscape** importance of patches and linkages
- Ranked contribution to overall landscape connectivity
- Differences among focal species
- Echidna, Sugar Glider, Golden Sun Moth, Fat-tailed Dunnart
- Configuration of habitat and stepping stones

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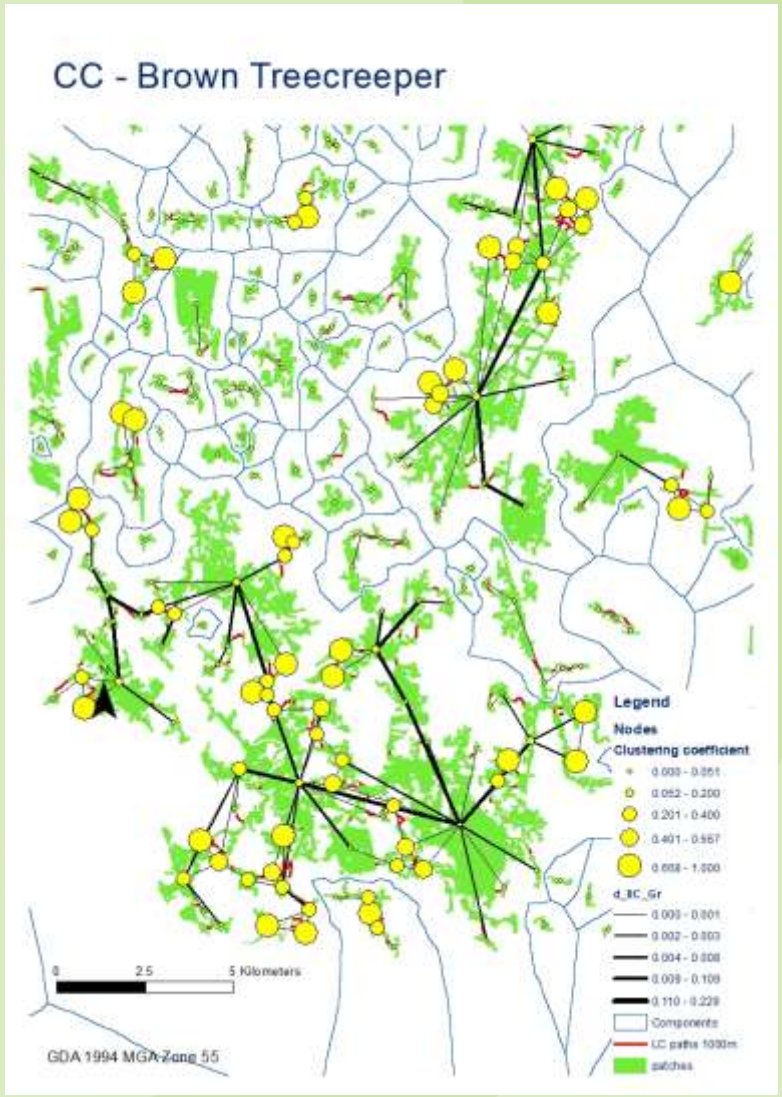
NECI – Graphic Metric Analysis: Clustering Coefficient (CC)



- CC measures the **local neighbourhood** importance of patches
- Indicates sensitivity to fragmentation and redundancy
- Local scale planning

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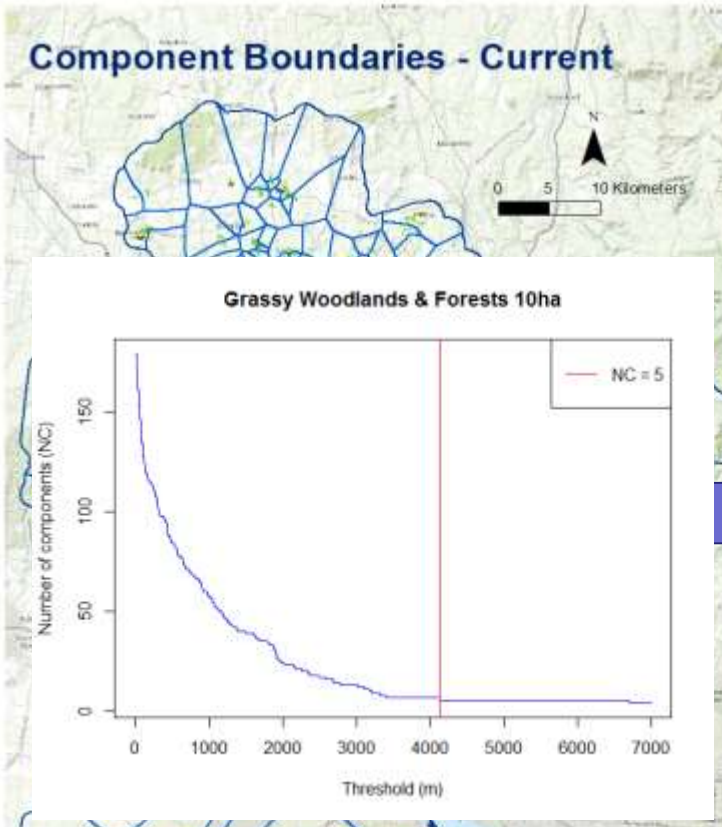
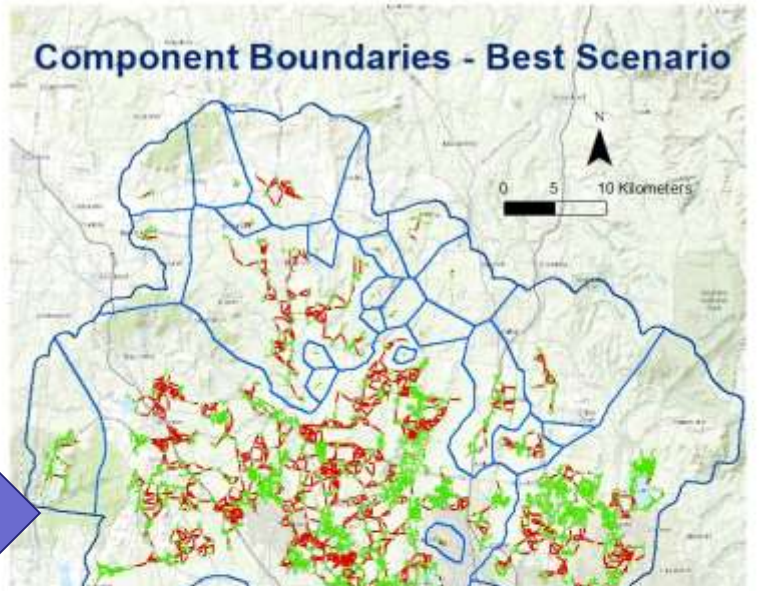
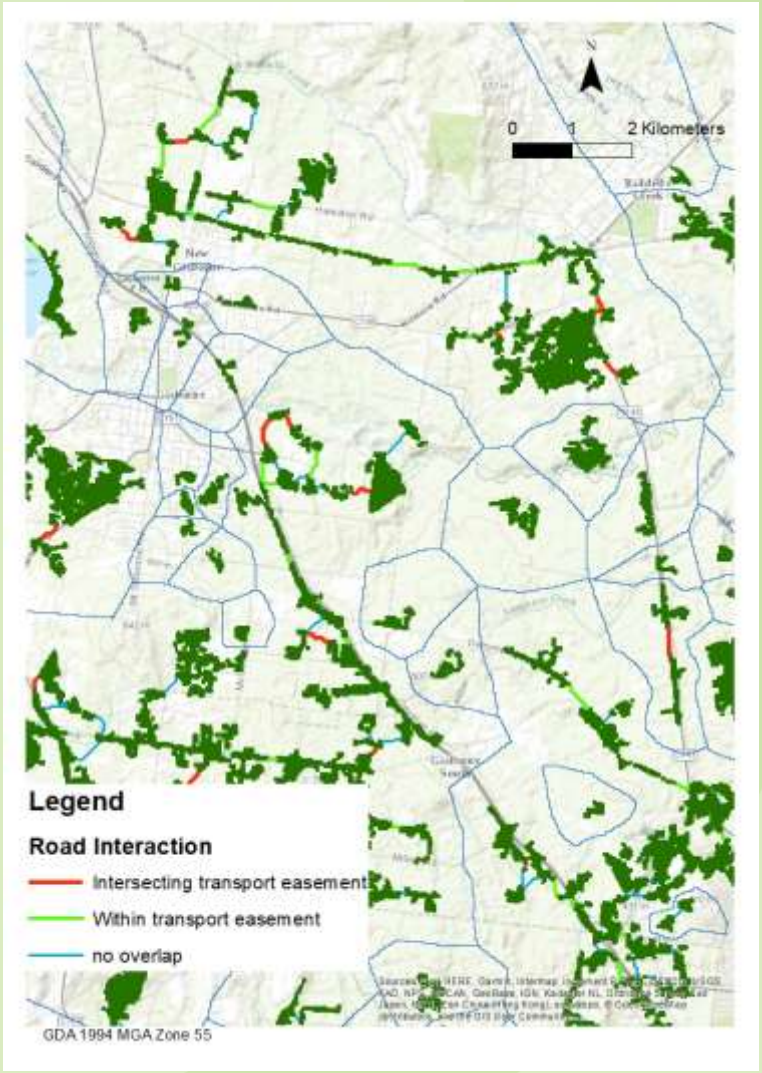
NECI – Scenario (best-case)



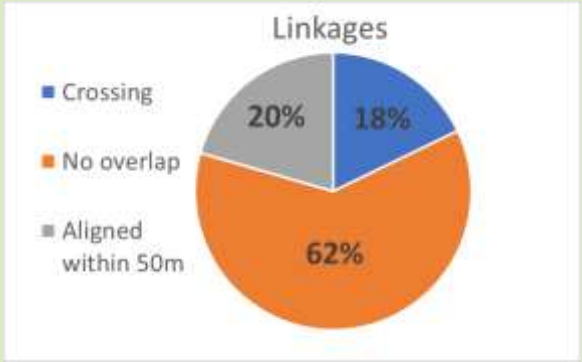


- BTC-Big improvement
- Conservation investment
- Isolation and barriers
- Habitat limits

NECI – Roads



- Influence of roads as barriers and corridors
- Where to prioritise fauna crossing structures, barriers, and roadside vegetation conservation
- Many LCP linkages cross or aligned with roads (roadside vegetation)
- Road management and planning important



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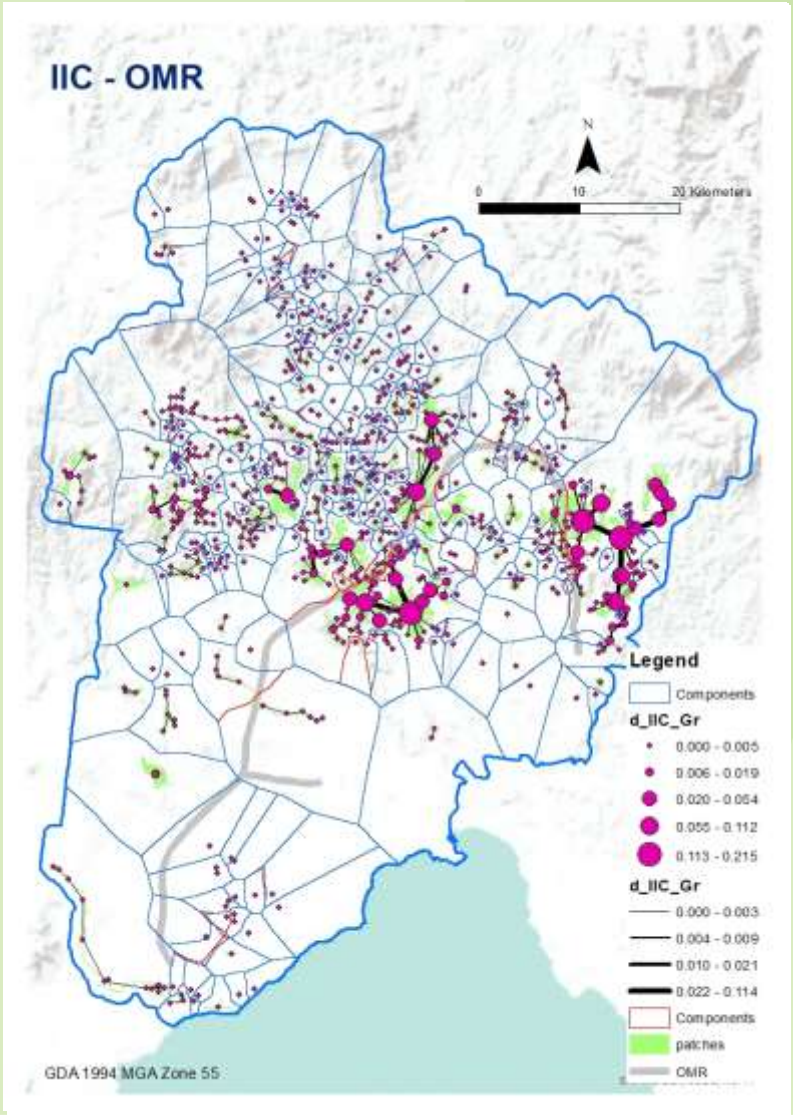
NECI – Infrastructure Planning: Outer Metropolitan Ring Road



- Impact assessment tool
- Specific development scenarios
- Future planning and avoidance
- Estimate magnitude and location of impact
- Outer Metropolitan Ring Road
- Brown Tree Creeper –fragmentation of two major components
- Minor change in IIC
- Circuitscape “current flow” analysis could be used to identify optimal crossing locations

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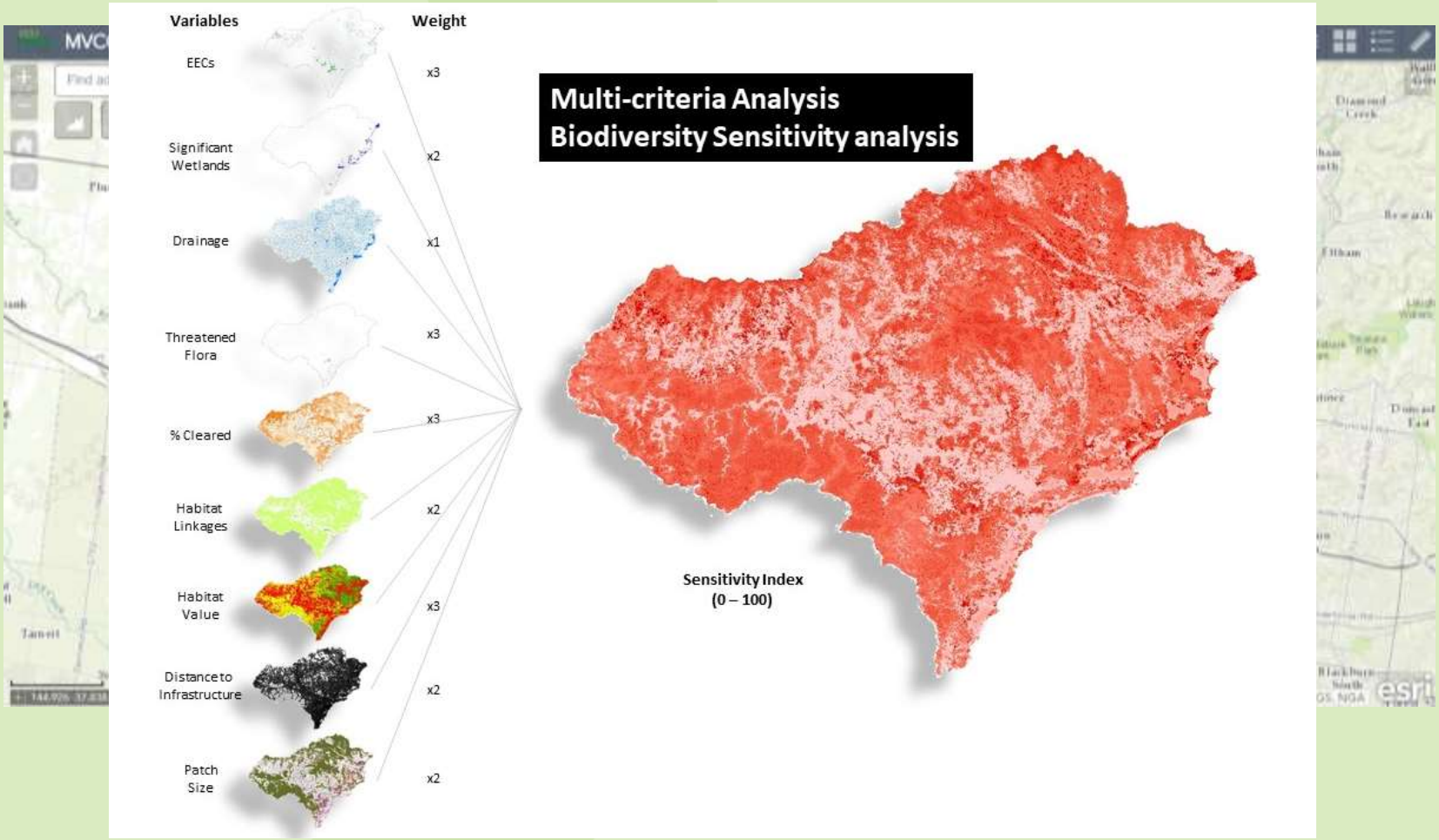
Uses and advances



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