A Standardized and Interconnected Approach to Green Infrastructure Development in Virginia and Surrounding States Using Morphological Image Processing

Carroll Courtenay*, Todd Lookingbill
University of Richmond
*carroll.courtenay@richmond.edu

Purpose

To map the core areas (sections of forest or wetland habitat, greater than or equal to 250 acres in area) in Maryland, Washington, D.C., Virginia, West Virginia, and North Carolina to compare the state GI plans and to facilitate the development of an inter-state GI system.

Background

Green infrastructure (GI) consists of planned and managed networks of natural habitat, which strengthens habitat health by helping to maintain ecological processes and diversity. Many states have worked to develop GI networks in order to preserve natural resources and ecological processes. However, these networks plans take considerable time to develop and are unable to respond quickly to landcover changes or conservation priorities. There is also no uniform process for developing GI plans, and some states have no plan at all. **Table 1** briefly describes the GI plan for each state in the study area.

We used morphological spatial pattern analysis (MSPA) as a tool to quickly and uniformly develop GI networks for Virginia and its neighboring states. MSPA uses the structural components of natural landcover to develop a network of core and corridor areas. In previous studies, MSPA-based networks have reasonably approximated the GI networks developed by state programs (Wickham et al., 2010). MSPA are relatively simple to identify, and the approach allows core and corridor areas to be developed between states using consistent methods. Since habitats do not end at state borders, it is important to developed GI plans that are ecologically functional at regional scales.

State GI Plans

Table 1.

State	State GI Networks	Description
Maryland	Maryland's Green Infrastructure Assessment	Large contiguous blocks of natural land and corridors were developed to allow plant and animal movement. The assessment is used to identify and prioritize these areas of greatest statewide ecological importance (Weber et al., 2006).
Washington, D.C.	None	None.
Virginia	Virginia Natural Landscape Assessment (VaNLA)	Core areas of unfragmented natural cover, along with a system of natural landscape corridors, were created to the green infrastructure program. An Ecological Integrity Model was developed to rank these sites based on a number of different ecological attributes (Weber, 2008).
West Virginia	None	None.
North Carolina	One North Carolina Naturally Initiative, Conservation Planning Tool (CPT)	The One North Carolina Naturally Initiative focused conservation planning on connecting already conserved areas. CPT refines the conservation focus, identifying and prioritizing essential natural resources required to maintain ecosystems (Douglass).

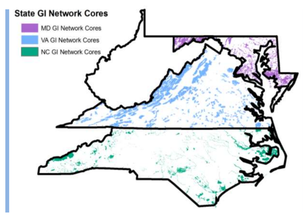

Figure 1. Cores identified in individual state GI plans. West Virginia and Washington, D.C. do not currently have plans. Other plans differ by state as described in Table 1 ** I am going to split this into three maps when I get back to schoo. Fig 1) MD, Fig 2) VA Fig 3) NC**

Methods

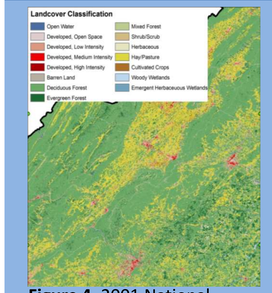

Figure 4. 2001 National Landcover Data (NLCD).

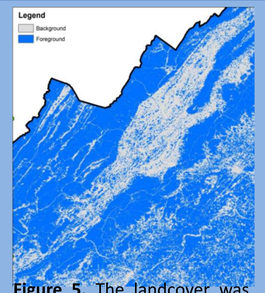

Figure 5. The landcover was reclassified into 'Foreground' (forest and wetland) and 'Background' (other classes)

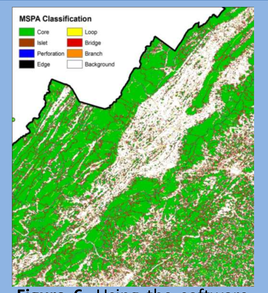

Figure 6. Using the software GUIDOS 1.3, a MSPA was run to reclassify the landcover into 7 structural components.

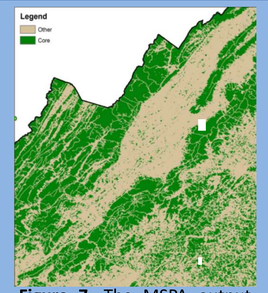

Figure 7. The MSPA output was reclassified into 'Core' and 'Other.'

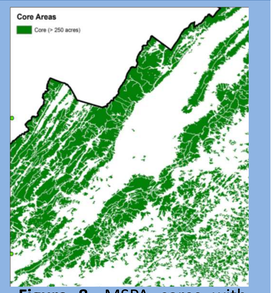

Figure 8. MSPA cores with contiguous areas greater than or equal to 250 acres were extracted.

MSPA Network Cores

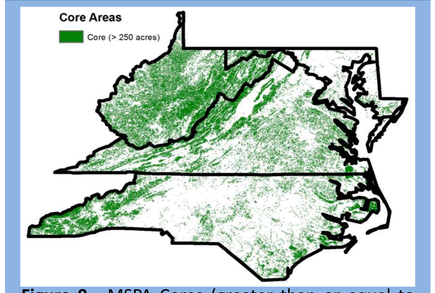

Figure 9. MSPA Cores (greater than or equal to 250 acres). Note the density of cores in West Virginia, a state that does not have a GI plan but has a lot of GI potential.

Results

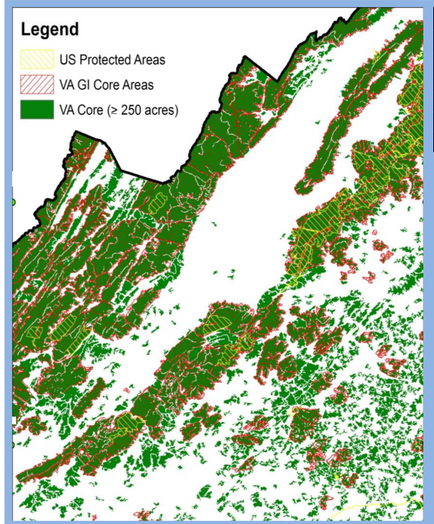

Figure 10. MSPA cores (greater than or equal to 250 acres) overlaid with US Protected Areas (PAs) (IUCN classes I and II only) and VaNLA cores.

	MSPA Cores		State GI Cores		Protected Areas	
	Number	Area (% of State)	Number	Area (% of State)	Number	Area (% of State)
Maryland	741	14.73	650	8.32	38	1.25
Washington, D.C.	1	0.58	NA	NA	0	0
Virginia	4005	30.35	614	22.39	120	1.14
West Virginia	4220	49.99	NA	NA	37	0.86
North Carolina	3806	20.82	519	13.15	98	2.21

Table 2. Summary of three main conservation approaches considered: MSPA core, state GI network core, and US Protected Areas.

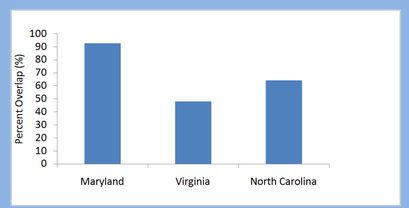

Figure 11. Percentage of State GI Network Core that was identified as MSPA Core Area. The MSPA approach produced a nearly identical GI network to the Maryland state plan. Overlap for the Virginia state plan was around 50%. Washington D.C. and West Virginia do not have state GI networks

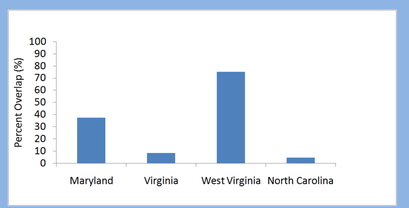

Figure 12. Percentage of Protected Areas that was identified as MSPA Core Area. Less than 10% of the land identified as potential core is already protected in Virginia and North Carolina. Although West Virginia does not have. many PAs, over 70% are MSPA core. Washington D.C. does not have any IUCN Class I or II US Protected Areas

Conclusion

As there is no single, national method for GI development, variations between the plans was expected. However, ecosystems do not end at state borders. In order for GI networks to be successful and function to their full capacity, an effort must be made to connect and standardize the development of these networks to create inter-state systems. MSPA offers relatively simple and uniform methods for constructing GI networks. The cores derived through MSPA overlap relatively well with GI networks for each state (92.8% in Maryland, 64.2% in North Carolina, and 48.0% in Virginia). It's particularly useful in states where the amount of natural landcover is low (e.g., Maryland). In states that are still largely forested (e.g., West Virginia), a more restrictive criteria for defining MSPA Cores (e.g., core area requirements of 500 acres or more) might be a more reasonable goal for GI Plans. MSPA, however, offers a starting point for the process. Functional attributes could be later added to the development of GI networks, creating more complex systems.

Summary of Results

-MSPA methods match state GI plans of MD, VA, and NC fairly well
  -MD: 92.8% of MSPA core in state GI plan
  -VA: 48.0% of MSPA core in state GI plan
-The amount of natural land cover in the state greatly affects the resulting MSPA classification
  -MD has significantly fewer cores (741) and area (14.73%) than VA (4005 cores; 30.35% of state)
  -Methods for defining core structural element could be fine tuned in MSPA to be more restrictive for states like VA.
-No GI plan for WVA.
  -WVA: 75.3% of PAs identified as MSPA core area (only 2.73% of total MSPA cores in WVA)

Bibliography and Acknowledgements

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