WILDLANDS NETWORK
RECONNECTING NATURE IN NORTH AMERICA

High Priority Science Needs Proposal for South Atlantic LCC

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4) Project Title: **Identifying and Prioritizing Key Habitat Connectivity Areas for the South Atlantic Region**

5) Focal Issue addressed: Integrative projects that meet all aspects of the SALCC niche

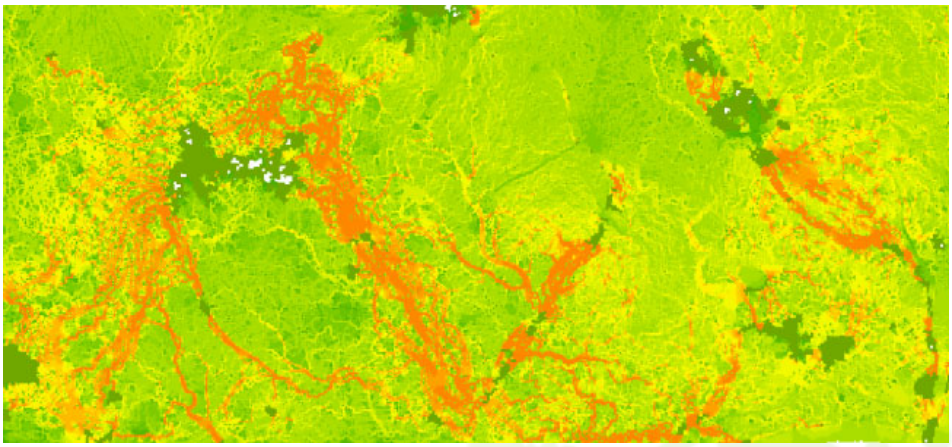
6) Project Duration: two years (2012-2013)

7) Project Objectives or a Project Abstract:

1. To map out current and future levels of habitat connectivity in the South Atlantic region, from the standpoint of multiple groups of terrestrial wildlife species;

2. To prioritize key corridors and linkage areas based on their relative importance and centrality within the overall habitat network and their relative influence on the viability of target wildlife populations;

3. To publish data layers representing the outcomes from the first two objectives, in such a way as to significantly improve conservation decision-making across the South Atlantic LCC region



An example output (NC-SC border) from the Circuitscape software for connectivity analysis

Identifying and Prioritizing Key Habitat Connectivity Areas for the South Atlantic Region

I. Objectives

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II. Project Narrative: Background

Habitat loss has long been recognized as one of the most urgent threats to the incredibly rich biodiversity found in the Southeastern United States. Despite impressive gains in the amount of protected areas across the region, and despite the current economic downturn, rapid human population growth and urbanization continue to drive the loss and degradation of remaining fragments of natural habitats that once supported diverse natural communities. In recent years, climate change and its various indirect impacts, such as sea level rise, have also been identified as posing critical challenges to the persistence of native plants and animals.

Although various conservation groups have begun promoting myriad techniques for helping species adapt to climate change, the most logical, straightforward, and time-tested solution for preventing climate-induced extinctions is simply to provide organisms with room to migrate to keep up with their preferred environmental conditions. Indeed, migration is precisely the mechanism that has allowed most species to quickly adapt to constantly fluctuating climate and sea level conditions over past millennia. Restoring and protecting robust connections between existing fragments of natural habitat will not only allow species to move across environmental gradients and adapt to climate change, it will also create networks of habitat that are large and interconnected enough that species will be able to maintain viable populations, overcoming the current and future negative consequences of outright habitat loss.

From the standpoint of the South Atlantic Landscape Conservation Cooperative (SALCC), identifying regional-scale priorities for preserving and enhancing habitat connectivity must therefore be considered one of the core applied science missions of the partnership. Providing imperiled species with sufficient room to roam is an exercise that must cross geographic, political, and bureaucratic boundaries. The design of habitat networks must consider future conditions, and it must be an adaptive process capable of responding to changes in data availability and landscape change. Furthermore, climate change and habitat loss are factors that affect all species, and efforts to improve habitat connectivity in the Southeast must consider the dispersal requirements and movement capabilities of multiple types of organisms.

The one group of animals that clearly would benefit from additional habitat connectivity at the scale of the entire SALCC is the top mammalian carnivores, such as black bear, red wolves, and Florida panther. These animals once ranged across the entire region, with little respect for state or project boundaries, and scientists estimate they need quite large networks of usable habitat to maintain viable populations. Top predators play essential ecological roles in regulating the trophic structure of ecosystems, and their absence over much of the nation has led to profound alterations in the health of our natural resources, as lamented by Aldo Leopold and other well-known ecologists. Restoring these animals to large blocks of habitat where they are now absent, and buffering the existing populations where they still occur or have been reintroduced, will require conservationists to pay close attention to habitat connectivity levels at the broad scale of the SALCC.

Of course, the large mammalian carnivores are highly mobile animals with fairly generalized habitat requirements. A connectivity plan that focuses on bear, wolves, and panther may therefore fail to meet the needs of less mobile, more specialized wildlife species. Reptiles, amphibians, and certain small mammals and birds fit this description, as vertebrate species whose connectivity needs may not be well met by a system of core reserves and corridors sufficient to maintain the top predators, and which may not be able to cross even low-traffic roads and other barriers that do not pose major obstacles for the larger mammals.

In this proposal, in response to the request by the LCC for "integrative projects that meet all aspects of the SALCC niche", we are asking for $91,145 to map and prioritize key areas for terrestrial habitat connectivity across the South Atlantic region, from the perspective of both the wide-ranging top carnivores and a group of traffic-sensitive and habitat-specific reptiles. The resulting geospatial data layers, which will consider both current and future landscape and climate conditions, will provide essential guidelines for improving conservation decision-making throughout the region for years to come. Our results will update and improve upon those of the only comparable attempt at connectivity analysis at such a large scale in the Southeast, which was the US EPA-funded Southeastern Ecological Framework (SEF). The SEF was completed in 2001 using 1990-era land cover data, and emphasized primarily riparian corridors identified using basic least cost path analysis (Carr et al. 2002; all citations and links available on request).

Methods:

We will first use a variety of connectivity analysis techniques to identify possible corridors and linkage areas around the region. These include new tools such Circuitscape (McRae et al. 2008), Connectivity Analysis Toolkit (Carlos Carroll unpublished), and Wild Lifelines (David Theobald unpublished), as well as more basic methods like Least Cost Path determination. As a group, these tools start with the creation of a resistance layer, a geospatial representation of how difficult it is for target organisms to disperse across a given unit of the landscape. High resistance values are typically associated with barriers such as high-traffic roads and high-density urban areas, whereas low-resistance values correspond with appropriate types of natural habitats. We will use all available geospatial data sets (such as land cover, roads, and vehicle traffic levels) to create the resistance layers under current conditions. We will then recalculate resistance values based on future conditions, using land cover, vegetation, and climate projections for the next 100 years generated by USGS's Southeast Regional Assessment Project (SERAP).

To simplify the analysis, and in light of the fact that the wolves, bear, and panther are known to use a wide range of habitat types, we will create one resistance layer that will serve in the analysis for all three species. We will also create one or more resistance layers representing the dispersal capacities and habitat preferences of several species of the larger snakes (indigo, pine snake, timber rattlesnake, eastern diamondback rattlesnake) and the box turtle, all of which are known to suffer high levels of traffic mortality on roads. This combination of large mammalian carnivores and less-mobile terrestrial reptiles will capture much of the needed terrestrial habitat connectivity in the region, and will nicely complement the current focus of SERAP and previous SALCC-funded investigations on birds and aquatic species.

The connectivity tools use various algorithms to visualize and quantify the flow of dispersal possibilities across the landscape, based on the resistance layer that is fed into the model. Taken as a group, the model results will highlight which potential corridor paths (linear features) and linkage areas (broad zones of suitable habitat that connect core reserves) are most central to the overall network of habitat in the region, under current and future conditions.

These connectivity zones will be further prioritized by examining their relative influence on the estimated population viability of the two target groups across the region. By sequentially running a series of spatially explicit population viability analyses on the landscape, each time either removing an existing potential corridor, or restoring a potential corridor that has already been severed (by roads or habitat loss), we will be able to rank the connectivity areas by how critical they are to the long-term survival of the target wildlife groups. When demographic data are available, the population viability analyses will be conducted separately for different species, highlighting the differential need for corridors between such species as bear and wolves. Otherwise we will pool demographic rates for each group and conduct the prioritization comparisons on the groups as a whole.

Why Wildlands Network?

Since its origination in 1992, Wildlands Network has established itself as the leading organization that specializes in truly large-scale conservation planning and habitat connectivity analysis, with a special focus on meeting the habitat requirements for wide-ranging species. With leadership from Board members such as Michael Soulé and John Terborgh, our emphasis on the scientific evidence for the need for large-scale conservation projects has inspired numerous other groups to move away from the site-based "postage stamp" approach to biodiversity protection in recent years.

With our partners, we have conducted Wildlands Network Designs (which prioritize new core and linkage areas) for a number of key regions in the western United States up and down the spine of the Rocky Mountains. Most recently, under the leadership of our Eastern Director Conrad Reining, we finished a modeling-intensive conservation plan for the Northern Appalachians, which included both identification of priority connectivity areas and population viability analyses for a group of three mammalian carnivores. With the addition to our staff of Dr. Ron Sutherland in 2009, we now have the scientific capacity to focus on additional target species such as reptiles, and also critical Southeastern ecosystems such as longleaf pine forests. Dr. Robert Baldwin, a scientist at Clemson University who previously participated in our Northern Appalachians Wildlands Network Design, will provide additional expertise in conservation GIS and connectivity analysis. We will collaborate with a wide range of additional scientific colleagues and partner organizations to complete the proposed work, including Dr. Carlos Carroll (an expert on connectivity and population viability analyses) and Dr. Tom Hoctor (an expert in conservation corridor planning in Florida and across the Southeast). Due to Ron's strategic office location in Durham, NC, we will also have easy access to conservation scientists, wildlife ecologists, GIS experts, and student interns at Duke, NCSU, and UNC.

III. Relationship to LCC niche

- ***Landscape-scale: How much of the LCC does the project cover?***

Our project will cover the entire SALCC region. Alternatively, as discussed with Rua Mordecai, we could expand the project to cover the entire Southeastern US, matching the boundaries of the SERAP project.

- ***Cross-taxa: How well does the project support or integrate the needs of multiple natural and cultural resources?***

Our dual focus on top carnivores and slower moving reptiles should delineate connectivity areas sufficient for a broad range of other species. The carnivores need large expanses of habitat to maintain viable populations, and should act as umbrella species for numerous smaller animals and plants. The inclusion of the reptiles should capture smaller-scale connections that might otherwise be left out.

- ***Forward looking: Does the project predict future conditions or incorporate prediction of future conditions?***

We will use SERAP and NOAA's new layers on future conditions for vegetation, urbanization, climate, and sea level rise (next 100 years) to model connectivity levels now and far into the future.

- ***Decision focused: Does this project provide information vital to resource managers, policy makers, and conservation planners?***

We will prioritize key habitat linkage areas across the SALCC, filling an important niche in the development of the Optimized Conservation Strategy being developed by the cooperative. Our layers will guide decisions about which lands to either purchase for conservation, or to avoid when planning future roads and urban development. Our results will also assist with prioritizing the location of road mitigation structures such as underpasses.

- ***Adaptive: Does the proposal provide information on how the product can be updated based on new data and information?***

Our methods will consist of a transparent and fully documented modeling effort using the best currently available data and scientific techniques. As such, it will be easy for us and other interested parties to update the connectivity models with new data that becomes available on land cover, roads, urban development, and conservation purchases. We will provide clear instructions in our final reports detailing how the models can be updated with new types of information, and also indicate what types of new data would be most useful for improving and refining our results.

- ***Making connections and filling gaps: How well does this project leverage and integrate existing efforts underway by various organizations?***

Our project takes explicit advantage of the future projections now emerging from the USGS SERAP project at NC State University. We will also work with Tom Hoctor to compare and contrast our results with the US EPA's Southeastern Ecological Framework, a generalized green infrastructure plan that was completed in 2001 without the incorporation of the new connectivity and population viability analysis tools. Our results will allow conservation organizations and agencies (such as The Nature Conservancy, local land trusts, state natural heritage programs, US FWS, the National Park Service, and the US Forest Service) to visualize important connections between their existing landscape-scale project areas, and plan new conservation interventions accordingly.

IV. Project Schedule:

January-June 2012: Pull together geospatial data sets and demographic details about target species, and refine modeling techniques;

July 2012 - June 2013: Run and interpret connectivity models, population viability analyses;

July 2013 - December 2013: Write and submit reports for publication, disseminate results to partner groups across the region, and publish GIS layers and model protocols on the internet (maintain on internet for at least the next two years)

V. Project Deliverables:

1. Accumulated base data layers and demographic parameters that may be useful for similar analyses within the SALCC;
2. Landscape resistance map layers for mammals, reptiles - now and in future;
3. Connectivity maps for mammals, reptiles – now and in future;
4. Population viability analysis results for mammals, reptiles;
5. Map of prioritized key corridors and linkages for mammals, reptiles – based on current and expected future conditions;
6. Interim reports at quarterly intervals;
7. Final report, in publishable format with full methodological details, plus complete model results included as appendices

make one trip from Vermont to Durham, NC in 2012, and Dr.'s Sutherland and Baldwin would meet up a minimum of twice per year at one or the other of their respective locations.

Computer Workstation: Modern software for connectivity analysis (Circuitscape and Connectivity Analysis Toolkit) and spatially-explicit population viability analysis (ALEX, VORTEX, etc) are memory and CPU-intensive. To perform the proposed methodology at the scale of the South Atlantic region and in a timely fashion such that the analysis can be completed and interpreted within a two-year time span, a relatively powerful desktop workstation will be required (16 GB RAM, Intel i7 processor, 2 TB Hard Drive, 64-bit Operating System).

Printing and Misc. Materials: The project will incur expenses for ink cartridges, printers, paper, and other small miscellaneous items during the first and second years. In the second year, we will also print multiple copies of the final report, and distribute the final report along with a data DVD to numerous partners around the South Atlantic region.

Journal Publication: The proposed methodology for strategically combining connectivity and population viability analysis will be a good candidate for publication in a scientific journal, and normal page charges (e.g. $150/page for Conservation Biology) would apply. Publishing the methods would increase the likelihood that similar analysis methods are completed in other LCC regions, providing a boost to cross-region compatibility.

Web Publication of data, reports: At the completion of the project, we will also publish all of our methods, GIS data, and results on the internet for free access by conservation professionals in this and other LCC regions. The expense shown ($4000) is an estimate for securing a contract for two years of web publishing (and associated downloads) for a large amount of data (1 TB) via Amazon's cloud service.

Wildlands Network Contribution: At a minimum, Wildlands Network will use donations and general grants from other sources to pay the remaining 50% of the salary and benefits for Ron Sutherland, including part of the time (25%) that Ron will spend on this proposed project. Other sources of matching funds may be leveraged if an SALCC grant is offered. **Overhead:** Wildlands Network customarily charges 15% administrative overhead on grant proposals and is absorbing as part of the match for this proposal.

Other Funds Applied for: We will be applying for the Doris Duke/WCS Climate Adaptation grant in 2011, and although these grants are primarily intended for on-the-ground interventions, we would dedicate at least some of the funds towards local connectivity analysis that would fit within the scope of our proposal for the SALCC. We also plan to apply for a Z. Smith Reynolds Foundation grant in August 2011, to pay for some of our conservation planning work in North Carolina. Other appropriate foundations and donors will be solicited as they are identified.

Expansion to include the entire Southeastern USA: As discussed with Rua Mordecai, it should be feasible to expand the scope of this project, if funds are available, to include the entire Southeast region and not just the South Atlantic LCC. We estimate this expanded analysis would cost roughly $200,000, of which Wildlands Network could support $60,000. This would leave a balance of $140,000 for which we would need support. A proposal and budget for this expanded scope can be provided upon request.