Evaluating Connectivity in the Northern Appalachian and Acadian Region to Improve Wildlife Mobility

Photo Credit: https://www.adn.com/multimedia/slideshow/photos-lynx-mama-and-her-litter-kittens-give-photographer-show/2016/03/11/

STUDENT AUTHORS

Renee Albrecht
Masters Candidate, 2020
Bren School of
Environmental Science
& Management
renee_albrecht@bren.ucsb.edu
(708) 856-4413

Sofie McComb
Masters Candidate, 2019
Bren School of
Environmental Science
& Management
sofiemccomb@ucsb.edu
(281) 435-4865

Robert Saldivar
Masters Candidate, 2020
Bren School of
Environmental Science
& Management
rnsaldivar@bren.ucsb.edu
(805) 235-6665

CLIENT AUTHORS

Dirk Bryant
Director of Conservation Programs
The Nature Conservancy
New York, Adirondack Chapter
dbryant@tnc.org
(518) 576-2082

Jessie Levine
Senior Conservation Advisor
Coordinator, Staying Connected Initiative
The Nature Conservancy
jlevine@tnc.org
(518) 302-1216 (office)
(514) 691-7581 (mobile)

OBJECTIVES

The primary goal of this project is to help the client, The Nature Conservancy (TNC), evaluate functional connectivity for a set of target species in the Northern Appalachian/Acadian (NAPA) region. Specific objectives include:

1. Review existing functional connectivity assessments conducted within the NAPA region in order to map well-connected, poorly connected, and data-deficient areas.
2. Provide recommendations for broad-scale and affordable species connectivity monitoring that can be implemented region-wide, comprising both field and spatial methodologies.
3. Develop a modeled approach for calibrating structural connectivity metrics on the basis of functional connectivity measures, with recommendations for improving connectivity of fragmented and low mobility areas.

SIGNIFICANCE

Climate change is expected to alter the specific conditions that define which habitat areas are suitable for a particular species.[2] Generally, organisms adapt to warming climates by moving to higher latitudes and elevations, or to climates that best represent their past habitat.[8] Human-caused habitat loss and fragmentation inhibit the ability of species to migrate into these new ranges. Furthermore, habitat fragmentation can lead to harmful inbreeding because it leaves small populations geographically isolated and limits the dispersal of adaptive genes.[7] Current conservation practices that establish isolated, preserved areas will fail to protect organisms if their entire ranges shift. Conservation managers will need to adopt adaptive management strategies that bolster the connectivity of the landscape to prevent extinctions due to habitat loss and fragmentation.[1,5,7]

The ability of an organism to successfully move through an adaptively connected region depends on both the structural and functional connectivity of the landscape.[6,7] Structural connectivity refers to the physical characteristics of the landscape that impact organism mobility (e.g. forest cover, roads) while functional connectivity refers to how the characteristics of a species enable it to move through the landscape (e.g. dispersal patterns, habitat use).[3] Structurally connected landscapes offer a promising climate resilience strategy yet their capacity to effectively preserve biodiversity is dependent upon whether they are functionally connected.

TNC has developed means to assess structural connectivity throughout the NAPA region using proxy measures of land use and land cover change but lacks meaningful measures of functional connectivity, or species mobility, in the landscape. In the absence of functional connectivity metrics, TNC is unable to determine if their efforts are prioritizing the correct geographic locations and significantly improving species' ability to move through the landscape. As TNC prepares to launch their climate resilience work at a sub-continental scale, they wish to be able to monitor, measure, and continuously enhance the impact of their conservation actions. This is critical not only for increasing landscape resilience and species mobility during climate change, but also for improving the safety of developed areas and roads for wildlife and humans. TNC is the primary client for this proposal but the deliverables will be for all the partners of the Staying Connected Initiative (SCI), and many SCI initiative partners may be involved in the research process and project.

BACKGROUND

Although the NAPA region is the most intact temperate broadleaf forest in the world, the velocity of human-induced climate change will likely require rapid range shifts that the current NAPA landscape would be unable to support.[3] At 80 million acres (325,000 km^2) of forest, NAPA is home to over five million humans and millions more wildlife.[3] The region covers portions of five U.S. states (New York, Massachusetts, New Hampshire, Vermont, and Maine) and three Canadian provinces (Quebec, New Brunswick, and Nova Scotia). Forests in this region provide economic natural resources and ecosystem services such as clean water and air, recreation, and habitat for biodiversity. The NAPA landscape supports far-roaming mammals such as the American black bear (*Ursus americanus*), American marten (*Martes americana*), bobcat (*Lynx rufus*), and Canadian lynx (*Lynx canadensis*). As wide-ranging animals, these mammals are good proxies for overall landscape connectivity and serve as SCI target species.[4] The NAPA region is comprised of large core intact forest blocks, with forested corridors connecting them. Further connecting these core habitat areas is essential for safeguarding organisms from climate change impacts while also supporting human values and activities dependent on the forest ecosystem. As human development and road access increase in the area, natural pathways between core forest areas must be maintained for wide-ranging mammals and future climate-driven species migrations.

The Nature Conservancy Appalachian Chapters and their 57 partner organizations have invested significant resources into the Staying Connected Initiative (SCI). SCI is an international and multi-organization partnership formed in 2009 working to create a healthy and connected landscape across the Northern Appalachian/Acadian region of the eastern United States and Canada for the benefit of both people and nature. SCI aims to enhance connectivity by focusing on nine priority linkage areas that help to connect the core forest blocks within the NAPA region. SCI defines a linkage area as "*a broad region of comparatively greater or more concentrated connectivity important to facilitate the landscape or regional-scale movement of multiple species and to maintain ecological processes between core areas, and where structural connectivity is at risk*".[3] Each linkage focuses on protecting and restoring priority parcels that would increase overall regional connectivity. In 2013, SCI published the first iteration of its structural measures framework. Currently, SCI is interested in updating and adding structural and functional connectivity metrics to assess current conservation work across partners.

AVAILABLE DATA

The Nature Conservancy has access to a range of structural connectivity datasets covering the NAPA region that students can use for this project. These include the following spatial datasets:

- SCI identified linkage areas and human footprint on the landscape
- Structural connectivity models in many of the SCI linkage areas
- Habitat composition, generalized land cover classes, and protected lands designations
- Landscape resistance and connectivity layers based on landscape composition
- Regional Flow model based on Circuitscape analysis
- Nature's Network "Connectors" data (United States only)

Data that would be gathered from TNC, SCI partners, government affiliates, academic institutions, and publicly available datasets include:

- Road miles, culverts, traffic volume classes, and annual average daily traffic data (for select roads in the Unites States)

- Camera and tracking data along key roads from TNC and SCI partners
- Existing functional connectivity studies publicly available
- Data on roadkill and high wildlife collision areas from various state and provincial departments of transportation in the NAPA region
- Species presence for the SCI target species (American black bear, American marten, bobcat, and Canadian lynx) from research studies, such as Farrell et al., 2018

POSSIBLE APPROACHES

The general approach will synthesize information on structural and functional connectivity throughout the NAPA landscape into a technical guidance document that will inform the management strategy in the region. The approach will include tasks such as:

- A review and spatial analysis of existing structural and functional connectivity assessments conducted within the NAPA region
- An economic analysis comparing the feasibility and cost of various methods to assess functional connectivity at scale. Examples include:
  - Use of hair samples for genetic measures of mobility and isolation of core populations submitted by hunters and trappers to fish and wildlife departments
  - Determining least-cost telemetry practices to collect and identify large-scale remote audible monitoring data
  - Utilize spatial data on road kill and high wildlife collision areas from state transportation departments as measures of species presence
  - Examining species distribution models for the four target mammals to compare likely species migration with habitat-based structural connectivity areas.
- GIS and modeling work to update structural connectivity methodology metrics for NAPA with information from functional connectivity assessments

DELIVERABLES

For deliverables, the project would include the following components:

1. **Interactive map** displaying areas covered by existing functional connectivity assessments throughout the NAPA region from literature and unpublished data.
2. **Guidance document** recommending methods to validate structural connectivity at a broad scale using affordable and cutting-edge functional connectivity metrics.
3. **Recommendations** for a modeled approach to update and calibrate structural connectivity metrics for improving connectivity of poorly connected areas.

INTERNSHIP

The Nature Conservancy can provide an internship with a $2,000 stipend to enable one student to further the objectives of the project over the summer of 2019. The internship will be based in TNC's Adirondacks office with other Northeast TNC offices (Concord, NH; Boston, MA; etc.) or remote work negotiable.

BUDGET

The budget for this project is not projected to exceed the $1,300 provided by the Bren School of Environmental Science & Management. Costs will include printing expenses and conference calls.

CITATIONS

[1] Anderson, M., Clark, M. & Sheldon, A. O. Resilient Sites for Species Conservation in the Northeast and Mid-Atlantic Region. 126

[2] Chen, I.-C., Hill, J. K., Ohlemüller, R., Roy, D. B. & Thomas, C. D. Rapid Range Shifts of Species Associated with High Levels of Climate Warming. *Science* **333**, 1024–1026 (2011).

[3] Coker, D. & Reining, C. A Measures Framework for Staying Connected in the Northern Appalachians. (2013).

[4] Farrell, L. E. *et al.* Landscape connectivity for bobcat (Lynx rufus) and lynx (Lynx canadensis) in the Northeastern United States. *PLOS ONE* **13**, e0194243 (2018).

[5] Goetz, S. J., Jantz, P. & Jantz, C. A. Connectivity of core habitat in the Northeastern United States: Parks and protected areas in a landscape context. *Remote Sens. Environ.* **113**, 1421–1429 (2009).

[6] Hopkins, A., McKellar, R., Worboys, G. & Good, R. Climate change and protected areas, in G. L. Worboys, M. Lockwood, A. Kothari, S. Feary and I. Pulsford (eds) Protected Area Governance and Management, pp. 495–530, ANU Press, Canberra. (2015).

[7] Rudnick, D. A. *et al.* The role of landscape connectivity in planning and implementing conservation and restoration priorities. 21 (2012).

[8] Parmesan, C. Ecological and Evolutionary Responses to Recent Climate Change. *Annu. Rev. Ecol. Evol. Syst.* **37**, 637–669 (2006).

The Nature Conservancy
Adirondacks

Barnett Center for Conservation
PO Box 65 | 8 Nature Way
Keene Valley, NY 12943

518-576-2082
nature.org/newyork
adirondacks@tnc.org

Group Project Committee
Bren School of Environmental Science and Management
Bren Hall, 2400 University of California, Santa Barbara, CA 93117

January 23, 2019

Dear Committee members:

Please accept this letter of support for the project titled: *Evaluating Connectivity in the Northern Appalachian and Acadian Region to Improve Wildlife Mobility,* prepared by Renee Albrecht, Sofie McComb and Robert Saldivar. The Nature Conservancy (TNC) would be delighted to work with Bren School students on the body of work described in their proposal, which would be an important contribution to our efforts to secure and enhance wildlife connectivity in the Northern Appalachians region and beyond.

TNC is now organizing our land conservation work in North America around securing a network of resilient and connected lands, which will allow species to shift their ranges in the face of climate change. Within the Northern Appalachians, we have been collaborating with 60 NGO, government agency and academic partners in five states and three Canadian provinces, to enhance connectivity within nine regionally important linkages (a public-private partnership called the Staying Connected Initiative (SCI)). TNC sees this initiative as a potential model for scaling up connectivity work at a subcontinental scale, contributing to our 'resilient and connected' conservation goals.

The Bren Project would help us both in measuring conservation impact within the SCI geography, and to more effectively determine where to invest in additional potential linkages as we scale the work regionally. To date, SCI partners have relied on structural connectivity metrics to determine where to work (e.g. FunConn, Least Cost Path and other models to predict species movement). We've developed a framework to assess changes in structural connectivity over time, as a proxy for functional connectivity. The proposed project will help us calibrate both the models and the metrics using existing (smaller scale) analysis of functional connectivity---which is really what we want to be measuring. In addition, we are looking for guidance on how to begin incorporating functional connectivity monitoring within our linkages. The technology has advanced considerably in recent years (e.g. DNA analysis) to make this more affordable.

There are policy implications as well. The New England Governors and Eastern Premiers recently adopted a resolution around ecological connectivity as a strategy to promote climate change adaptation, and they are working on an implementation plan to roll this out. SCI has been playing a supporting role here, so through our engagement we see opportunities for the

Bren Project to inform planning and monitoring best practices within a wide suite of government agencies.

I anticipate that TNC could provide $2,000 in help offset the costs of an internship, housed at one of our offices in the region (most likely in Massachusetts or in the Adirondacks at this point). Several TNC staff including myself could help guide the work and support the students with their research. TNC datasets referenced in the proposal can be readily shared with the students on this project. And as noted above, we can tap our SCI network of 60 partners to identify relevant functional connectivity studies to incorporate in project analysis, access data and provide input on calibrating structural connectivity metrics.

Thank you for considering the 'Evaluating Connectivity' proposal. We are excited about the possibility of engaging with your students on this effort, which fills a key gap in our SCI work and has the potential to significantly advance connectivity conservation by TNC and other partners across the region. Please do not hesitate to contact me (phone: 518/576-2082, e-mail: dbryant@tnc.org) if you have any questions or would like to discuss this further.

Sincerely yours,

Dirk Bryant
Director of Conservation Programs, Adirondack Chapter
Staying Connected Initiative, Executive Committee Chair