Dear Dr. Holland,

We welcome the Northeast Climate Science Center as a partner in our effort to provide science-based strategic recommendations for the management of Canada lynx populations exposed to the adverse impacts of global climate change. We submit for your consideration summary details of a research proposal titled *“A landscape genetic approach to inform conservation strategies for Canada lynx in Maine.”* The research team will include Drs. Lisa Komoroske, John Organ, Stephen DeStefano, Warren Johnson, and UMass doctoral candidate Tanya Lama.

**Stakeholders:** This project is an extension of ongoing research supported by our primary stakeholder, the Maine Department of Inland Fisheries and Wildlife and partner agencies US Fish and Wildlife Service Region 5 Endangered Species Program and Association of Fish and Wildlife Agency’s Science and Research Committee.

**Stakeholder Need:** Establishing priorities for habitat preservation that will support resiliency in species of management concern in the face global climate change is a major need for state and federal agencies charged with this task. However, especially with limited resources, managers need to strategically focus their efforts on identifying and managing a configuration of high quality habitat most likely to promote connectivity and adaptive potential under future environmental conditions. Effective plans to accomplish these goals require robust understanding of the key landscape and population drivers underlying species viability - without which, efforts may ultimately fail, especially for species that have already suffered negative impacts from other stressors. Such is the case for the Canada lynx *(Lynx canadensis)*, a habitat and prey specialist that exists at low densities in boreal forests capable of supporting its primary prey source, the snowshoe hare *(Lepus americanus)*. An outbreak of spruce budworm in the 1970s prompted a landscape-scale clear-cut of Maine’s North Woods, producing large contiguous swaths of regenerating spruce fir forest ideal for snowshoe hare and lynx. However, tighter restrictions on forestry practices and climate-mediated impacts are expected to drastically reduce availability of boreal forest habitat that supports lynx in Maine. These stressors, resulting in a loss of ~60% of suitable habitat will likely result in small, fragmented, and increasingly isolated populations of lynx vulnerable to local extinction via stochastic demographic and environmental events. Due to a relatively long generation time and small population size, lynx will not be able to adapt quickly enough to keep pace with future changes. Partnerships with private landowners are the principal conservation strategy for habitat protection in northern Maine, where ~90% of critical lynx habitat is privately owned. However, managers are currently missing key information about where to prioritize these efforts for Canada lynx. Therefore, we propose a landscape genetic approach to evaluate the importance of connectivity and range shift potential for lynx to track future climatic suitability and adapt evolutionarily through the spread of adaptive genetic variation among well-connected populations.

**Method:** We will assess 1) sensitivity to future change based on adaptive and neutral genetic variation; and 2) factors influencing connectivity and range shift potential on the landscape under projected future conditions. To assess sensitivity, we will combine outlier tests with genotype–environment association analysis to identify potential climate-adaptive markers throughout the Canada lynx genome and differences in the frequency of adaptive and neutral variation between populations. To assess connectivity and range shift potential we will develop, parameterize, and implement a biologically justified multivariate resistance surface representative of predicted future conditions that constrain or facilitate movement (and thus gene flow) across the landscape.

**Result:** Our work will predict the Maine lynx population’s response to future change and identify key factors that need to be incorporated into habitat preservation and other management strategies. Furthermore, our multivariate resistance surface will allow us to identify patches of habitat critical to maintaining range shift potential, connectivity with neighboring populations, and gene flow ensuring the spread climate-driven adaptive variation. The framework and methods employed in this proposal fill an identified need for our key stakeholder and place a public trust resource management agency in the vanguard for application of climate-science in resource management. We will work directly with our agency stakeholders to integrate this knowledge into Canada lynx management plans.

**Communications strategy:** We will initiate this project coordinating a half-day workshop in Maine to identify priorities and products directly with our stakeholders. Continued engagement will be fulfilled by quarterly conference calls organized and led by Dr. Komoroske and Ms. Lama to update on project progress and discuss shifts in priorities or emerging needs from the stakeholders. A critical deficit in conservation science is the translation of results into recommendations for management and policy. Thus, importantly, we will translate our results into management recommendations and present them to resource managers and agency personnel in Augusta, Maine (May 2019), followed by a forum to discuss optimal ways to integrate our findings with their management prioritization planning for Canada lynx conservation. Findings and management implications will be more broadly distributed via press release, publication, and local conference presentations.

**Contribution by NE CSC Fellows**: NECSC graduate fellow, Alexej Siren, will advise our team on lynx habitat suitability and provide support with data synthesis.

**Total Requested Budget: ($37,149)**

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| Graduate student support **($14,128)** | |
| 20 h research assistantship at $25.23/h | $14,128 |
| Genetic analyses **($14,745)** | |
| Supplies, DNA extraction, library preparation | $6,495 |
| Sequencing, data storage, computing costs, | $8,250 |
| Travel, stakeholder engagement, science communication **($8,276)** | |
| Initial stakeholder workshop and travel to Augusta, Maine | $1,888 |
| Results and management recommendations forum and travel to Augusta, Maine | $1,888 |
| Conference travel | $2,500 |
| Publication costs | $2,000 |

Thanks for your consideration of this proposal, please let us know if there is any other information we can provide to assist in the review process.

Sincerely,

Dr. Lisa M. Komoroske

Assistant Professor of Conservation Genomics

Department of Environmental Conservation

University of Massachusetts Amherst