

Lynx and Climate Change – Recommendations on Experts for SSA Consultation



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Introduction

Climate change related impacts to lynx are likely to include the following:

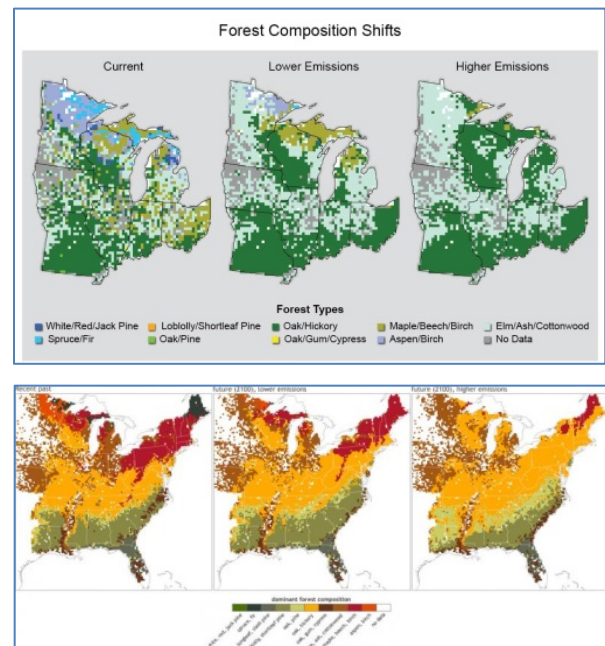
1. Changes to lynx climate envelope

- Increasing temperatures may exceed the temperature tolerance of the species, which is adapted to colder climates
- Healy Hamilton conducted some modeling of lynx climate envelope for the 2050s and 2090s, using the A2 emissions scenario.
 - Dataset represents the predicted distribution for Canada Lynx (*Lynx canadensis*) for the 2050s and 2090s (10-yr period average), based on the agreement (spatial average) of 5 niche modeling techniques (BIOCLIM, Climate Space Model, Envelope Score, Environmental Distance, SMV) and monthly precipitation and average temperature from 12 GCM's from the A2 emission scenario. Localities used to produce the model were resampled from the core area (highest probability) of the predicted distribution based on 48 Worldclim 1.4 climatic variables and BIOCLIM.
 - Results are posted in Data Basin. <http://databasin.org/maps/e82e8422-f33f-4d4e-838c-204b8959dccb>



2. Loss of boreal forest habitat

- Various modeling studies suggest that forest ecosystems and landscapes are likely to change as a result of shifting climate envelopes of key plant species. Much of this work has been done in the NE and Upper Midwest. Boreal forest habitats are likely to be greatly reduced or disappear from these areas (based on modeling results). See figures included here.
- Observational data and modeling projections indicate an increase in disturbance in lynx forest habitats. These include:

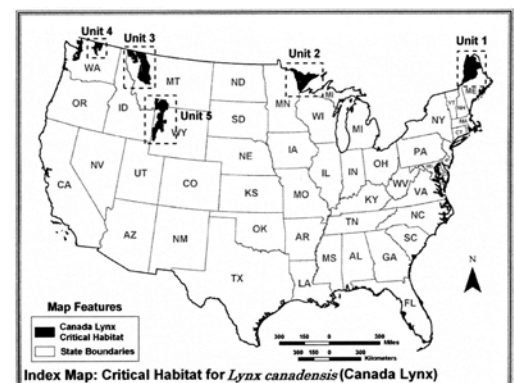


- Fires – Increasing intensity and areal extent burned, if not total number of fires. Especially so in Western United States.
 - Insect pests and diseases -- Increasing incidence of forest destruction due to insects and other pests. For example, conifer beetles in the Western United States and hemlock wooly adelgid in Eastern and NE United States.
 - Combination of disturbances – Insect pests are working in tandem with fire and drought to reshape landscapes in the Western United States, particularly Colorado, Montana, and North Cascades areas.
 - Overlaid on other disturbances (anthropogenic)
3. Changes in snow cover
- Both areal extent and depth of snowpack in lynx habitat has been changing, along with changes to snow quality and texture. These changes affect the ability of lynx to secure their main prey – snowshoe hare – and to stay ahead of other carnivores that are potential competitors (e.g., bobcat)
 - <http://www.gfdl.noaa.gov/news-app/story.79>
4. Changes in prey distribution, abundance, availability
- Climate change will affect the climate envelope and habitat of the lynx's principal prey, the snowshoe hare, thereby affecting predator-prey relationships.
 - In addition, recent research by Mills and colleagues has demonstrated an emerging color mismatch between snowshoe hare and their habitat due to earlier melting snow. This could lead to increased susceptibility to predation, thereby affecting predator-prey relations.
 - <http://www.pnas.org/content/110/18/7360.short>

Identification of Experts to be Considered for Consultation

Identification of lynx experts was based on my personal familiarity with experts and with potentially relevant literature, as well as through multiple internet searches using Google and Google Scholar. Lynx experts were recommended on the basis of their relevant experience in one or more of six lynx “units¹,” including field research and/or management of lynx, their habitats, and/or their prey.

Identification of climate change experts was also based on my personal familiarity with experts and potentially relevant



¹ Six units are: Unit 1—Northern Maine; Unit 2—Upper Midwest; Unit 3—NW Montana; Unit 4—North Cascades and Okanogan; Unit 5—GYE; Unit 6—Colorado.

literature, as well as through multiple internet searches using Google and Google Scholar. Climate change experts were identified on the basis of their demonstrated research and publication record on relevant climate change topics of regional significance (i.e., experience in one or more of six “units”). Two types of climate experts were identified. The first type includes experts on climate change itself – both observed and projected changes – including temperature and precipitation patterns, snowpack, changing hydrology, etc. The second type includes experts on ecological response to climate change, including landscape modelers, climate envelope modelers, etc.

Results are presented by Unit, as follows:

Unit 1 – Northern Maine

- Lynx
 - Jennifer H. Vashon
 - Canada lynx and black bear biologist, Maine Department of Inland Fisheries and Wildlife
 - Conducted much research on lynx in Maine
 - “Spatial Ecology of a Canada Lynx Population in Northern Maine” --
<http://www.maine.gov/ifw/wildlife/pdfs/Lynx%20spatial%20patterns.pdf>
 - “Canada Lynx Assessment” --
<http://www.maine.gov/ifw/wildlife/pdfs/Lynx%20Assessment%202012%201%20Final.pdf>
 - Email: jennifer.vashon@maine.gov
 - Christopher L. Hoving
 - Works for Michigan DNR
 - Worked on lynx in Maine and Michigan
 - “Broad-scale predictions of Canada lynx occurrence in eastern North America” -- <http://www.bioone.org/doi/abs/10.2193/0022-541X%282005%29069%5B0739%3ABPOCLO%5D2.0.CO%3B2?journalCode=wild>
 - “Michigan Species CCVA” (includes lynx) --
https://www.michigan.gov/documents/dnr/3564_Climate_Vulnerability_Division_Report_4.24.13_418644_7.pdf
 - Email: hovingc@michigan.gov

- Daniel J. Harrison
 - Professor of Wildlife Ecology, U. Maine
 - Has conducted lynx research with grad students
 - “Movement paths reveal scale-dependent habitat decisions by Canada lynx” -- <http://www.bioone.org/doi/pdf/10.1644/10-MAMM-A-005.1>
 - “Winter habitat selection by Canada lynx in Maine: prey abundance or accessibility?” -- <http://onlinelibrary.wiley.com/doi/10.2193/2006-288/pdf>
 - Email: harrison@maine.edu
- Climate
 - Art DeGaetano
 - Professor, Earth and Atmospheric Sciences, Cornell University
 - Expert on climate and snowpack in the Northeast
 - “A methodology for statistically downscaling seasonal snow cover characteristics over the Northeastern United States” -- <http://onlinelibrary.wiley.com/doi/10.1002/joc.3626/abstract>
 - Email: atd2@cornell.edu
 - Ivan Fernandez
 - Soil Scientist, University of Maine
 - Lead author on “Maine’s Climate Future: 2015 Update”
 - <http://climatechange.umaine.edu/research/publications/climate-future>
 - Not a climate scientist per se, but he should know a good climate person for the NE and Maine owing to his role in producing this document
 - Email: ivanjf@maine.edu
 - Louis Iverson
 - USFS Northern Research Station
 - Landscape ecologist / impact of climate change on tree distributions
 - “Projected Tree Species Redistribution Under Climate Change: Implications for Ecosystem Vulnerability Across Protected Areas in the Eastern United States” -- http://www.fs.fed.us/nrs/pubs/jrnl/2015/nrs_2015_zolkos_001.pdf
 - Email: liverson@fs.fed.us

Unit 2 – Upper Midwest

- Lynx
 - Christopher L. Hoving
 - Michigan DNR
 - See Maine for details
 - Ron Moen
 - Senior Research Associate, Natural Resources Research Institute, U Minnesota-Duluth
 - Lynx research
 - “Movement and Habitat Use of Canada Lynx During Denning in Minnesota” <http://www.bioone.org/doi/abs/10.2193/2008-072>
 - Email: rmoen@d.umn.edu
- Climate
 - Stephen Handler
 - USFS Northern Research Station
 - Climate change & landscape adaptation specialist / coordinates the Northwoods Climate Change Response Framework
 - “Minnesota forest ecosystem vulnerability assessment and synthesis: a report from the Northwoods Climate Change Response Framework project” <http://www.nrs.fs.fed.us/pubs/45939>
 - Email: sdhandler@fs.fed.us
 - Michael Notaro
 - Associate Director and Senior Scientist, Nelson Institute Center for Climatic Research, University of Wisconsin-Madison
 - “Twenty-First-Century Projections of Snowfall and Winter Severity across Central-Eastern North America” <http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-13-00520.1?journalCode=clim>
 - “Forest ecosystem vulnerability assessment and synthesis for northern Wisconsin and western Upper Michigan: a report from the Northwoods Climate Change Response Framework project” <http://www.nrs.fs.fed.us/pubs/46393>
 - Email: mnotaro@wisc.edu

Unit 3 – NW Montana

- Lynx
 - John R. Squires
 - USFS Research Wildlife Biologist
 - “Combining resource selection and movement behavior to predict corridors for Canada lynx at their southern range periphery” <http://www.treesearch.fs.fed.us/pubs/43874>
 - “Estimating detection probability for Canada lynx *Lynx canadensis* using snow-track surveys in the northern Rocky Mountains, Montana, USA” <http://www.treesearch.fs.fed.us/pubs/44629>
 - Email: jsquires@fs.fed.us
- Climate
 - Dan Fagre
 - Northern Rocky Mountain Science Center, USGS
 - Climate change in the northern Rockies
 - “The Unusual Nature of Recent Snowpack Declines in the North American Cordillera” <http://www.sciencemag.org/content/333/6040/332.abstract>
 - Steven Running
 - Regents Professor of Ecology; Director, Numerical Terradynamics Simulation Group, University of Montana
 - Many climate change related publications
 - Email: swr@ntsg.umt.edu
 - Synte Peacock
 - National Center for Atmospheric Research
 - Climate modeler
 - “Projected 21st century climate change for wolverine habitats within the contiguous United States” -- <http://iopscience.iop.org/1748-9326/6/1/014007>
 - “Projected Twenty-First-Century Changes in Temperature, Precipitation, and Snow Cover over North America in CCSM4” -- <http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-11-00214.1>
 - Email: synte@ucar.edu

- Marketa Elsner
 - Bureau of Reclamation
 - Hydrologic engineer; experience modeling surface water hydrology, with a focus on climate change impacts and decision support
 - “Climate change predicted to shift wolverine distributions, connectivity, and dispersal corridors” --
http://www.fs.fed.us/rm/pubs_other/rmrs_2011_mckelvey_k001.pdf
 - E-mail: melsner@usbr.gov

Unit 4 – North Cascades and Okanogan

- Lynx
 - Gary M. Koehler
 - Washington Department of Fish and Wildlife (retired)
 - Many publications on lynx and large carnivores in Washington
 - Cannot locate current Email address
- Climate
 - Josh Lawler
 - Associate Professor, School of Forest Resources, U. Washington
 - Climate change and wildlife vulnerability and adaptation planning
 - Lawler, J. J., H. D. Safford, and E. H. Girvetz. 2012. Martens and fishers in a changing climate. In: K. B. Aubry, Editors. Biology and Conservation of Martens, Sables, and Fishers: a New Synthesis. Cornell University Press.
 - Email: jlawler@u.washington.edu
 - Marketa Elsner
 - Previously worked with Climate Impacts Group at UW
 - “Implications of 21st Century Climate Change for the Hydrology of Washington State” --
<http://cses.washington.edu/db/pdf/wacciach3hydrology644.pdf>
 - See NW Montana for details
 - Jessica Lundquist
 - University of Washington

- One of the leading experts on snowpack in PNW
 - Research focuses on spatial patterns of snow and weather in the mountains and how those patterns are likely to affect streamflow and water resources in a changing climate.
 - “Lower forest density enhances snow retention in regions with warmer winters: A global framework developed from plot-scale observations and modeling” --
<http://onlinelibrary.wiley.com/doi/10.1002/wrcr.20504/abstract>
 - Email: jdlund@u.washington.edu
- Phil Mote
 - Director, Oregon Climate Change Research Institute, OSU
 - Co-leader of the NOAA-funded Climate Impacts Research Consortium (CIRC) for the Northwest
 - “Detection and Attribution of Observed Changes in Northern Hemisphere Spring Snow Cover” --
<http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-12-00563.1>
 - Email: pmote@coas.oregonstate.edu

Unit 5 – GYE

- Lynx
 - Kerry M. Murphy
 - USFS, formerly Yellowstone National Park
 - Lynx research in GYE
 - “Distribution of Canada Lynx in Yellowstone National Park” --
<http://halfpenny.me/PDFby/YNPLynxDistri.pdf>
 - Email: kmmurphy02@fs.fed.us
- Climate
 - Climate Change summary for
 GYE: <http://www.montana.edu/lccvp/documents/GYEclimatesummary.4.pdf>
 - Monica G. Turner
 - Ecosystem and Landscape Ecology Lab, Department of Zoology, University of Wisconsin-Madison
 - Decades of work in the GYE and northern Rockies on landscape ecology, fire and climate change

- “Ecological Implications of Climate Change in Yellowstone: Moving into Uncharted Territory?” --
http://landscape.zoology.wisc.edu/PublicationsNew/Rommie_Turner2015.pdf
 - “Recent mountain pine beetle outbreaks, wildfire severity, and postfire tree regeneration in the US Northern Rockies” --
http://landscape.zoology.wisc.edu/PublicationsNew/Harvey_etal2014_PNAS.pdf
 - “Continued warming could transform Greater Yellowstone fire regimes by mid-21st century” --
<http://www.pnas.org/content/108/32/13165.full.pdf+html>
 - Email: turnermg@wisc.edu
- Tony Chang
- Graduate Student, Department of Ecology, Montana State University
 - Ecological effects of climate change in GYE
 - “Historic & Projected Climate Change in the Greater Yellowstone Ecosystem” --
http://www.researchgate.net/publication/275345000_Historic_and_Projected_Climate_Change_in_the_Greater_Yellowstone_Ecosystem
 - “Patterns and variability of projected bioclimatic habitat for *Pinus albicaulis* in the Greater Yellowstone Area” --
http://www.montana.edu/hansenlab/documents/downloadables/PO_NE_chang.pdf
 - Email: tony.chang@msu.montana.edu
- Gregory T. Pederson
- USGS, Northern Rocky Mountain Science Center, Bozeman
 - Snowpack research
 - “Regional patterns and proximal causes of the recent snowpack decline in the Rocky Mountains, U.S.” –
<http://onlinelibrary.wiley.com/doi/10.1002/grl.50424/pdf>
 - Email: gpederson@usgs.gov

Unit 6 – Colorado

- Lynx
 - Tanya Shenk
 - Research coordinator for Great Plains CESU (NPS); formerly Colorado Division of Wildlife
 - Studied reintroduced lynx in Colorado
 - “Evaluating the Canada lynx reintroduction programme in Colorado: patterns in mortality” --
<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2664.2010.01805.x/abstract>
 - Email: tanya_shenk@nps.gov
- Climate
 - Joseph Barsugli
 - Research Scientist III, Earth System Research Laboratory, NOAA
 - Climate modeling; connects climate science with managers who are informing planning for water and land management in Colorado region.
 - “Climate Change in Colorado – A synthesis to support water resources management and adaptation, 2nd edition” --
http://www.colorado.edu/climate/co2014report/Climate_Change_CO_Report_2014_FINAL.pdf
 - E-mail: joseph.barsugli@noaa.gov
 - Thomas T. Veblen
 - Professor, Department of Geography, University of Colorado
 - Disturbance effects on forests
 - “Briefing: Climate and Wildfire in Western U.S. Forests” http://www.fs.fed.us/rm/pubs/rmrs_p071/rmrs_p071_081_102.pdf?
 - “Historical, Observed, and Modeled Wildfire Severity in Montane Forests of the Colorado Front Range” --
<http://www.plosone.org/article/Authors/info:doi/10.1371/journal.pone.0106971>
 - Email: thomas.veblen@colorado.edu

General

- Dominique Bachelet
 - Conservation Biology Institute and Oregon State University
 - Vegetation and climate modeler with broad experience and great insight
 - “Climate change and fire effects on a prairie-woodland ecotone: projecting species range shifts with a dynamic global vegetation model” -- <http://consbio.org/products/publications/climate-change-and-fire-effects-prairie-woodland-ecotone-projecting-species-range-shifts-dynamic-global-vegetation-model>
 - “Assessing potential climate change effects on vegetation using a linked model approach” -- <http://consbio.org/products/publications/assessing-potential-climate-change-effects-vegetation-using-linked-model-approach>
 - Email: dominique@consbio.org