Assessment of Current and Future Conditions of Canada Lynx in the Contiguous U.S. Using Species Distribution and Climate Models

NORTH CENTRAL
Climate Adaptation
Science Center

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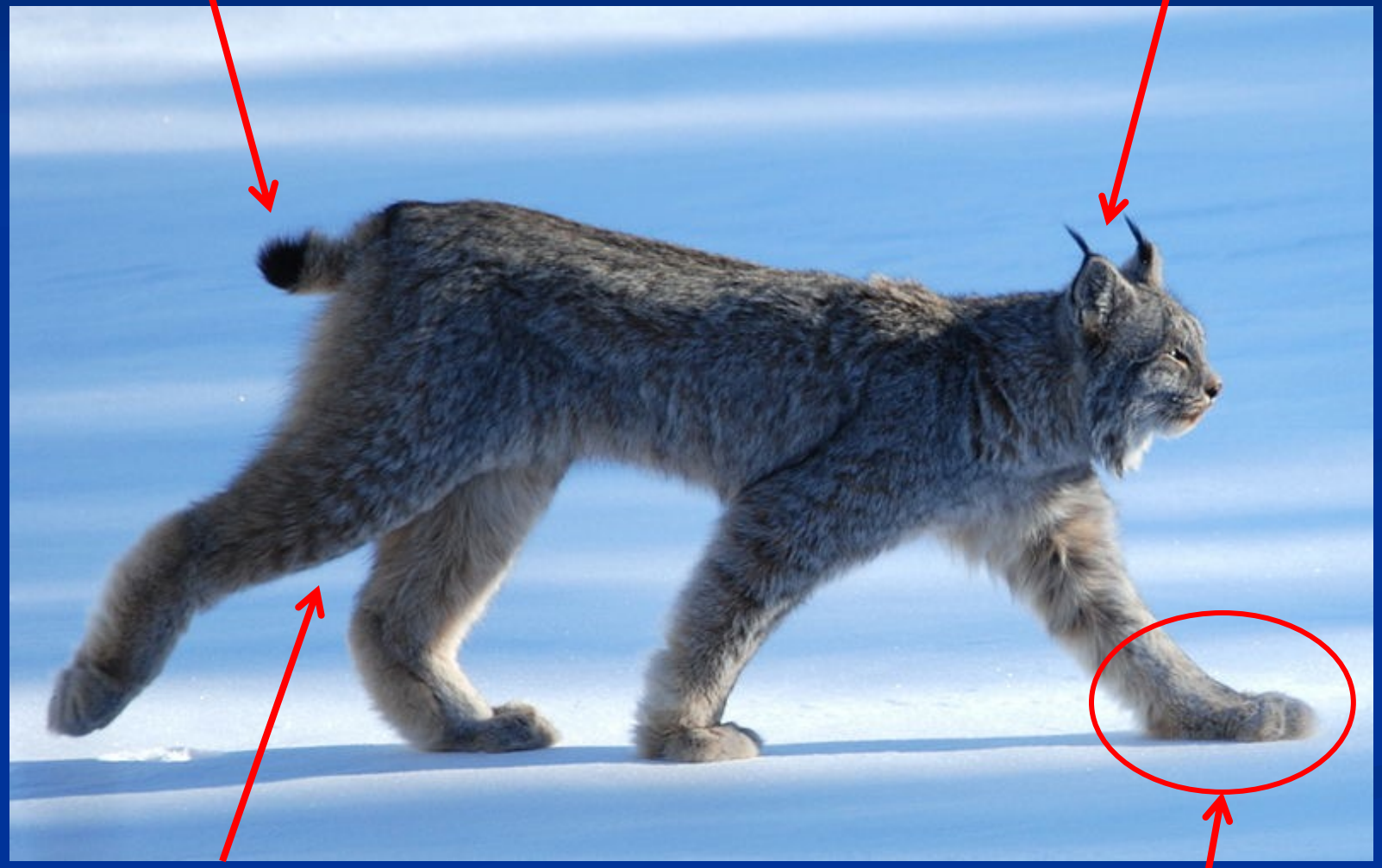
Objectives

- Review Canada lynx distribution, ecology, population dynamics
- Endangered Species Act listing: Threats then vs. now
- Species Status Assessment (SSA) and SSA Addendum
- Species distribution models and climate models and scenarios
- Climate Vulnerability Assessment for the lynx DPS
- Recovery planning and the future of lynx in the Lower-48

Canada Lynx Distribution

Maine Department of Inland Fisheries and Wildlife 2016. Lynx canadensis. The IUCN Red List of Threatened Species. Version 2024-2

Lynx Diagnostic Features (versus bobcat)

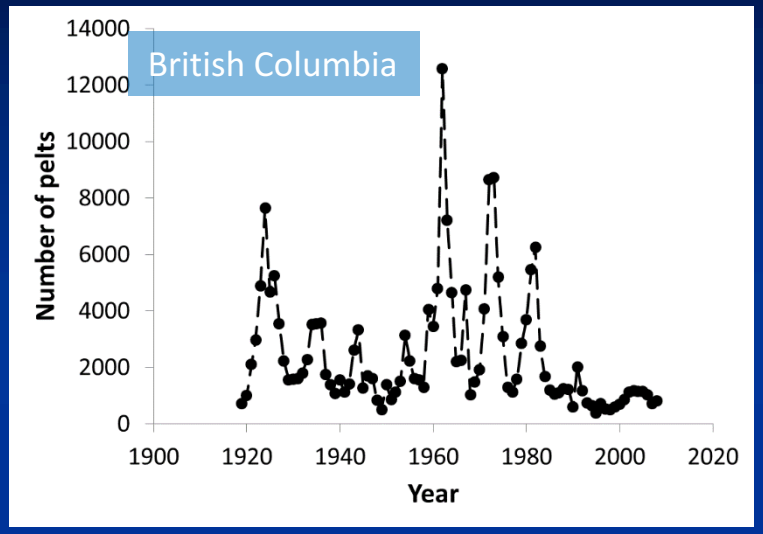


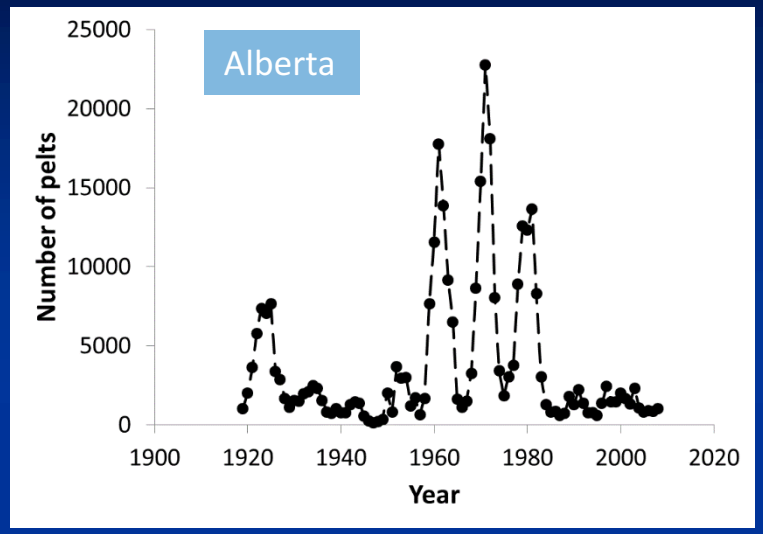
Lynx Need Hares!

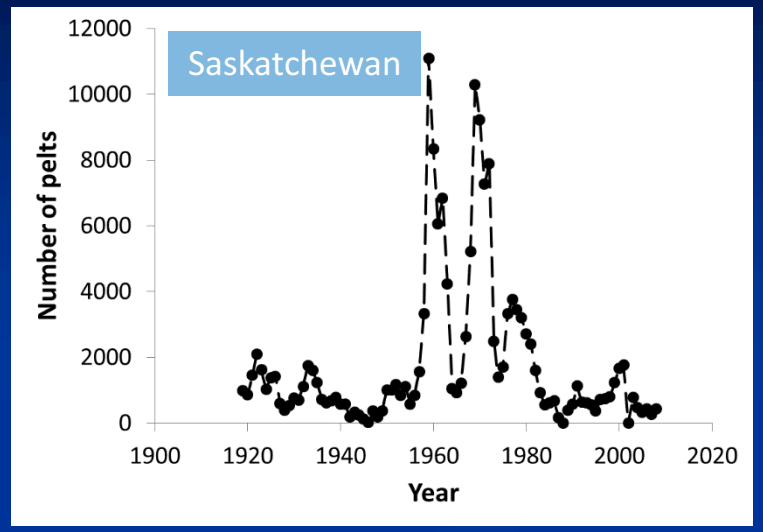
Hares need dense conifer cover at ground/snow level

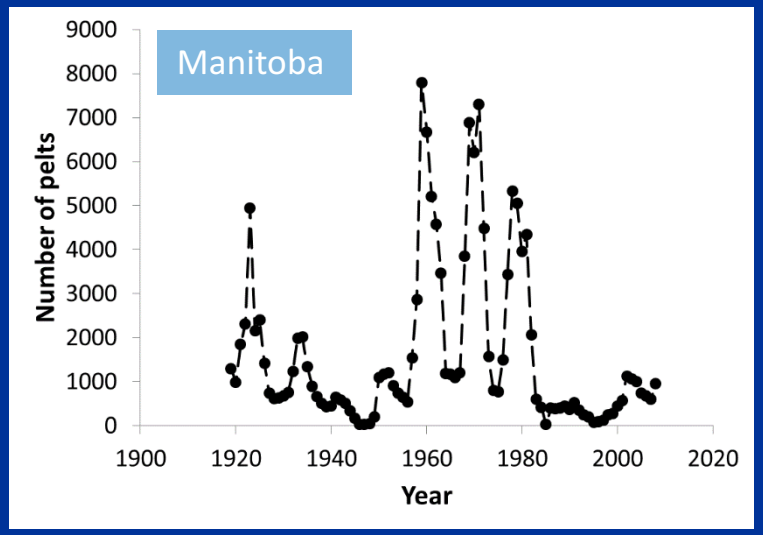
Disturbance (fire, insects, wind, timber harvest) creates HQHH

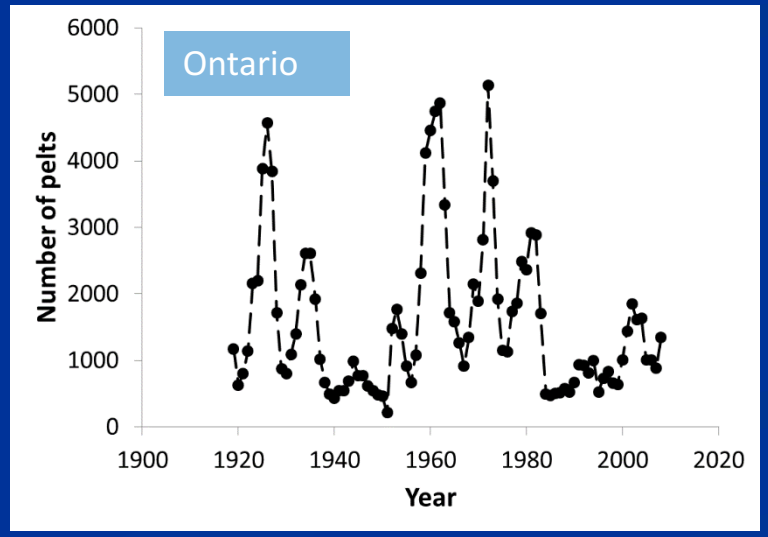
Hare/Lynx Cycles

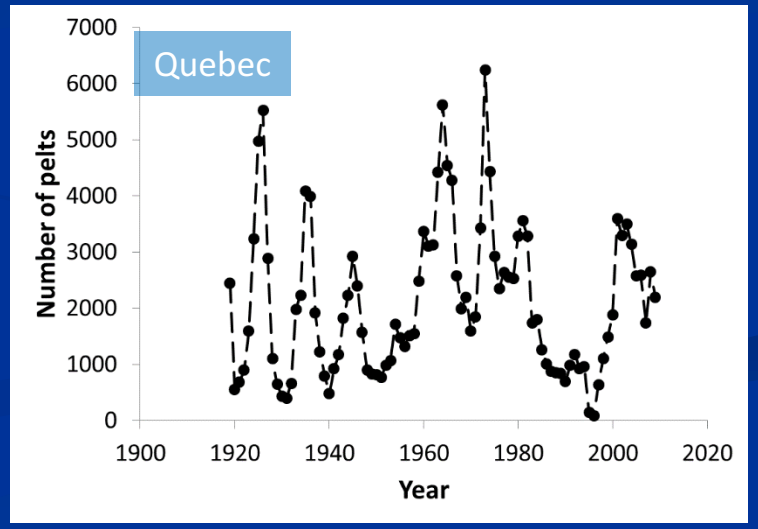












Slides courtesy of Dr. Jeff Bowman, Ontario Ministry of Natural Resources and Forestry, University of Trent, Ontario

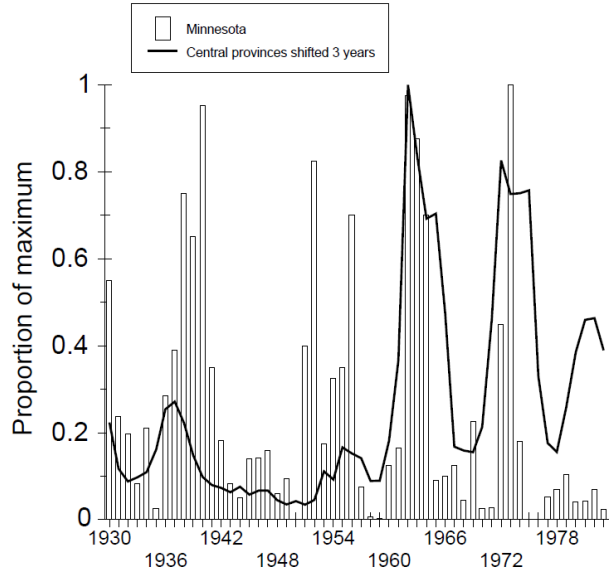


Figure 8.10—Lynx trapping data from Minnesota (Fig. 8.4) overlaid on lynx trapping data from Ontario, Manitoba, and Saskatchewan combined (Fig. 8.3). The strongest correlation between these data sets was with a three-year lag between Minnesota and south-central Canada.

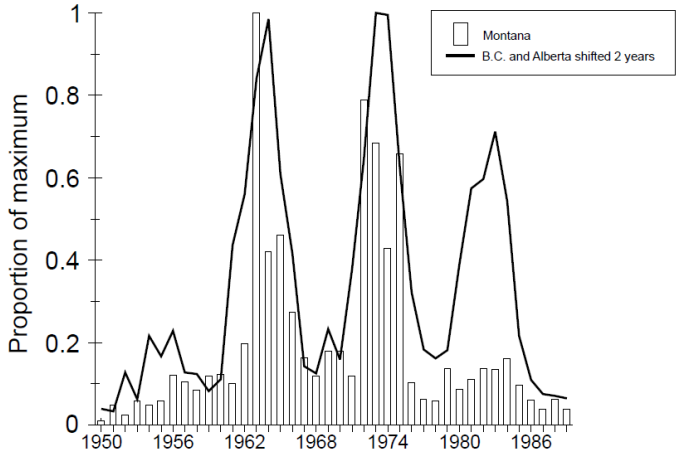
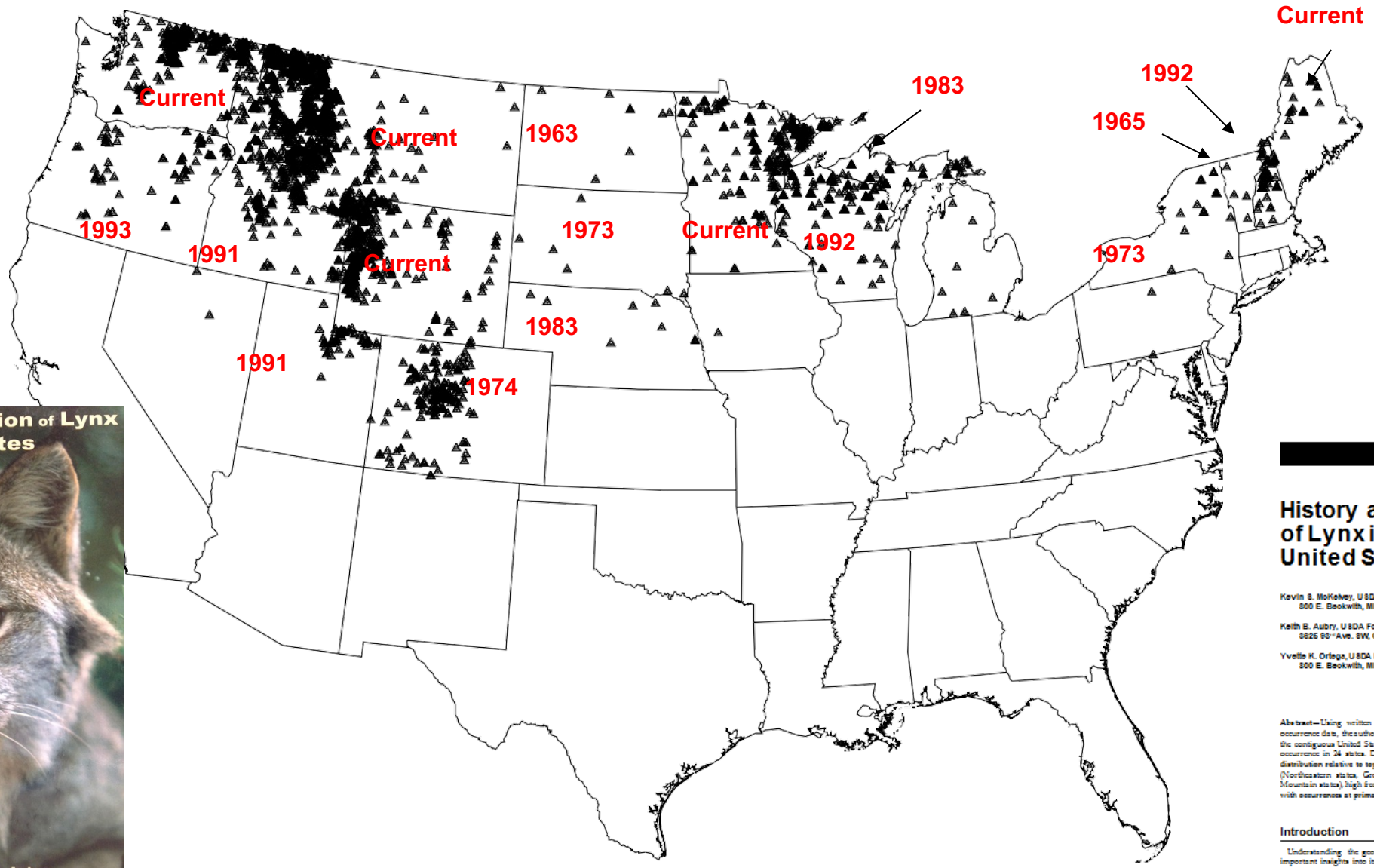
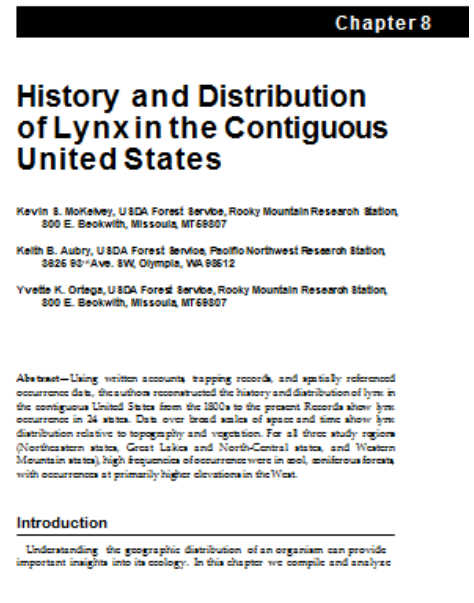


Figure 8.11—Lynx trapping data from Montana (Fig. 8.5) overlaid on lynx trapping data from Alberta and British Columbia combined (Fig. 8.6). The strongest correlation between these data sets was with a two-year lag between Montana and southwestern Canada.

Lynx periodically move south from Canada after irruptions

Figures from McKelvey et al. (2000)




Chapter 8

History and Distribution of Lynx in the Contiguous United States

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Abstract—Using written accounts, trapping records, and spatially referenced occurrence data, the authors reconstructed the history and distribution of lynx in the contiguous United States from the 1800s to the present. Records show lynx occurrence in 24 states. Data over broad scales of space and time show lynx distribution relative to topography and vegetation. For all three study regions (Northeastern states, Great Lakes and North-Central states, and Western Mountain states), high frequencies of occurrence were in cool, coniferous forests with occurrences at primarily higher elevations in the West.

Introduction

Understanding the geographic distribution of an organism can provide important insights into its ecology. In this chapter we compile and analyze

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Figure 8.17—Spatial distribution of lynx occurrence data from 1842 to 1998 (Table 8.1).

Lynx Listing/Litigation History

- 2000 – Final rule listing DPS as threatened (Factor D only)
- 2003 – Remanded determination (clarification of findings)
- 2005 – Recovery Outline
- 2006 – Critical Habitat (only in National Parks)
- 2007 – SPR/5-Yr Review Initiated/2006 CH Rescinded
- 2009 – Revised CH
- 2014 – Court-ordered CH revision/Recovery Plan Lawsuit
- 2017 – SSA V1/5-year Review – recommend delisting/4(f)(1) Memo
- 2020 – CH and Recovery Plan Lawsuits
- 2021/2022 – Settlement Agreements

Endangered Species Act Listing – 2000/2003

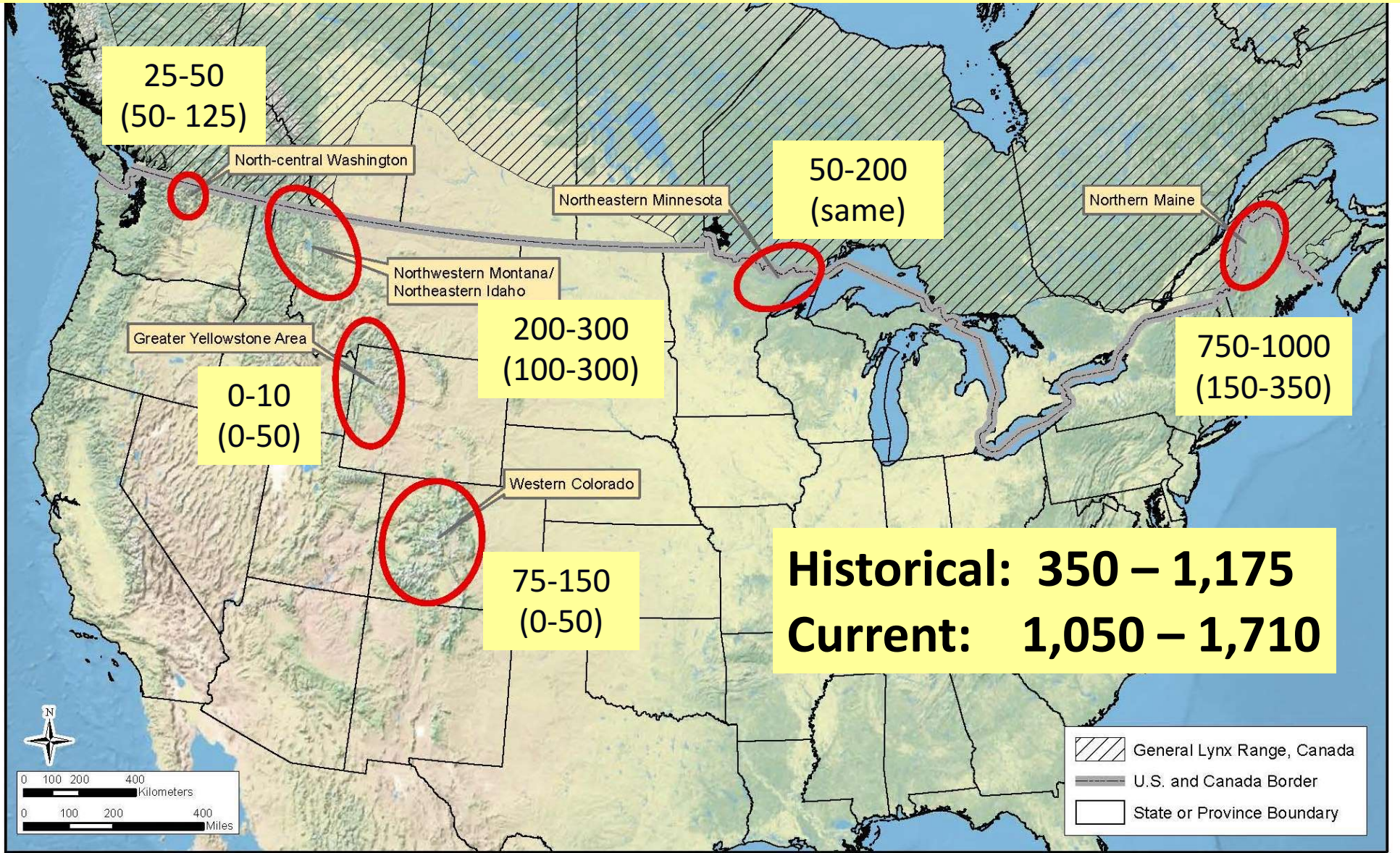
- Canada lynx in contiguous U.S. are a single distinct population segment (DPS) – discrete and significant to the taxon
- Singular threat: ESA Factor D – Inadequacy of existing regulatory mechanisms
- "We conclude ***the single factor threatening the contiguous U.S. DPS of lynx is the inadequacy of existing regulatory mechanisms***, specifically the lack of guidance for conservation of lynx in National Forest Land and Resource Plans and BLM Land Use Plans..."

Endangered Species Act Listing – 2000/2003

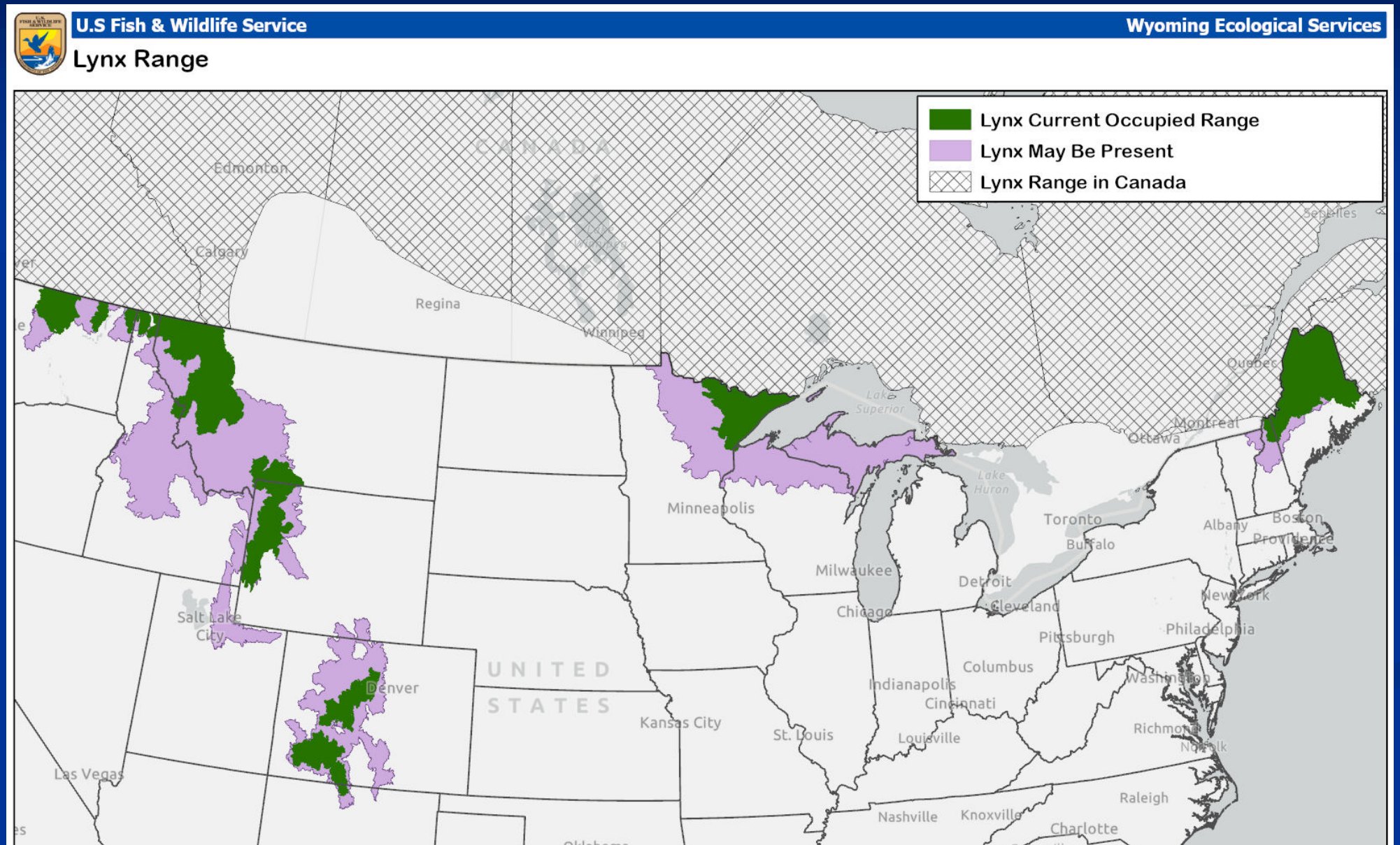
- "…in the contiguous United States, ***lynx populations occur at naturally low densities; the rarity of lynx at the southern portion of the range compared to more northern populations is normal***. The rarity of lynx is based largely on limited availability of primary prey, snowshoe hares. At southern latitudes, low snowshoe hare densities are likely a result of the naturally patchy, transitional boreal habitat."

- "The best scientific information suggests that ***historically only a few areas in the contiguous United States had lynx habitat of high enough quality and quantity to support resident populations and these are areas where resident populations currently continue to persist***—northern Maine, northeastern Minnesota, western Montana, and north-central and northeastern Washington. Evidence of the continuing high-quality habitat of these areas is indicated by the fact that currently there are many more lynx in these areas where resident populations exist (particularly in Maine and northeastern Minnesota) than we knew at the time we listed the species in 2000."

Expert Guesses at Current Lynx Population Sizes (My Guesses at Likely Historical Population Sizes)



Canada Lynx Distribution in the Contiguous U.S.



Threats

- When Listed: Inadequate Regulatory Mechanisms (Factor D)
  - Forest Service and BLM Land/Resource Management Plans
  - LCAS (2000, 2013), NRLMD (2007), SRLA (2008), WLBT Spatial Framework (2022)

- Now: Projected Climate Warming
  - Loss of temps/snow, competitive advantage/exclusion
  - Habitat contraction (north and upslope)
  - Hare declines, changes in northern cycles
  - Increase in fire and insect outbreak size, intensity/severity, frequency

Summary of Lynx SSA (2017) – Expert Opinion

Geographic Unit	Year					
	2025		2050		2100	
	Probability of Persistence (%)[2]	Range (%)[3]	Probability of Persistence (%)	Range (%)	Probability of Persistence (%)	Range (%)
1	96	80-100	80	65-95	50	40-80
2	96	88-100	80	60-90	35	10-60
3	98	95-100	90	70-100	78	50-90
4	80	60-95	70	30-80	38	5-50
5	52	10-70	35	15-60	15	5-50
6	90	60-100	80	50-85	50	20-70

Statutory and Legal Commitments 2022-2025

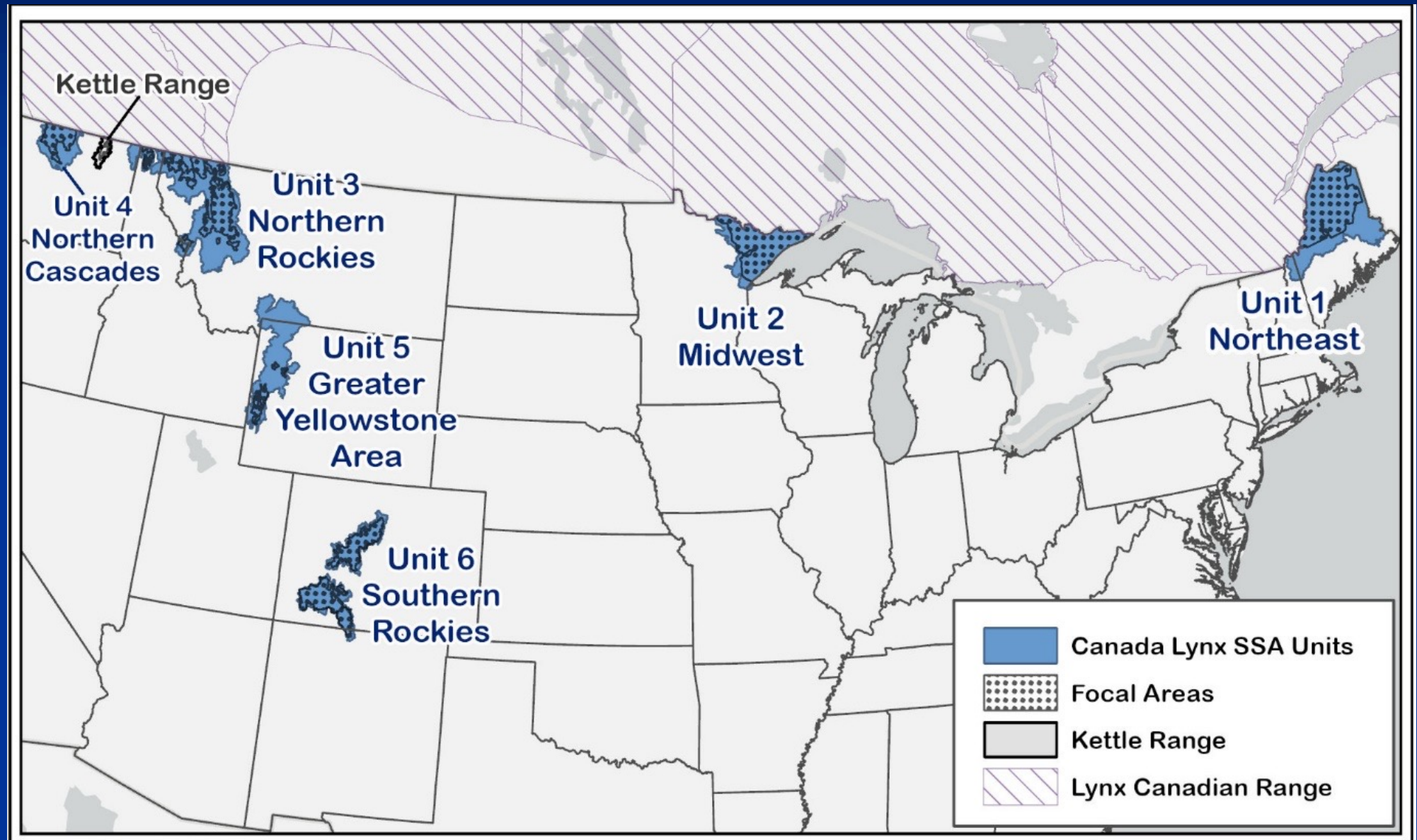
October 2021 and April 2022 – Settlement Agreements

- December 1, 2023 – Draft Recovery Plan
- December 1, 2024 – Final Recovery Plan

- November 24, 2024 – Revised CH Proposed Rule + 4(d)
- November 24, 2025 – Revised CH Final Rule + 4(d)

- SSA Addendum (2023) needed to inform RP and CH

Canada Lynx SSA Units and "Focal Areas"



Lynx CH Remand – New Habitat Modeling

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ORIGINAL RESEARCH

Ecology and Evolution Open Access WILEY

Improved prediction of Canada lynx distribution through regional model transferability and data efficiency

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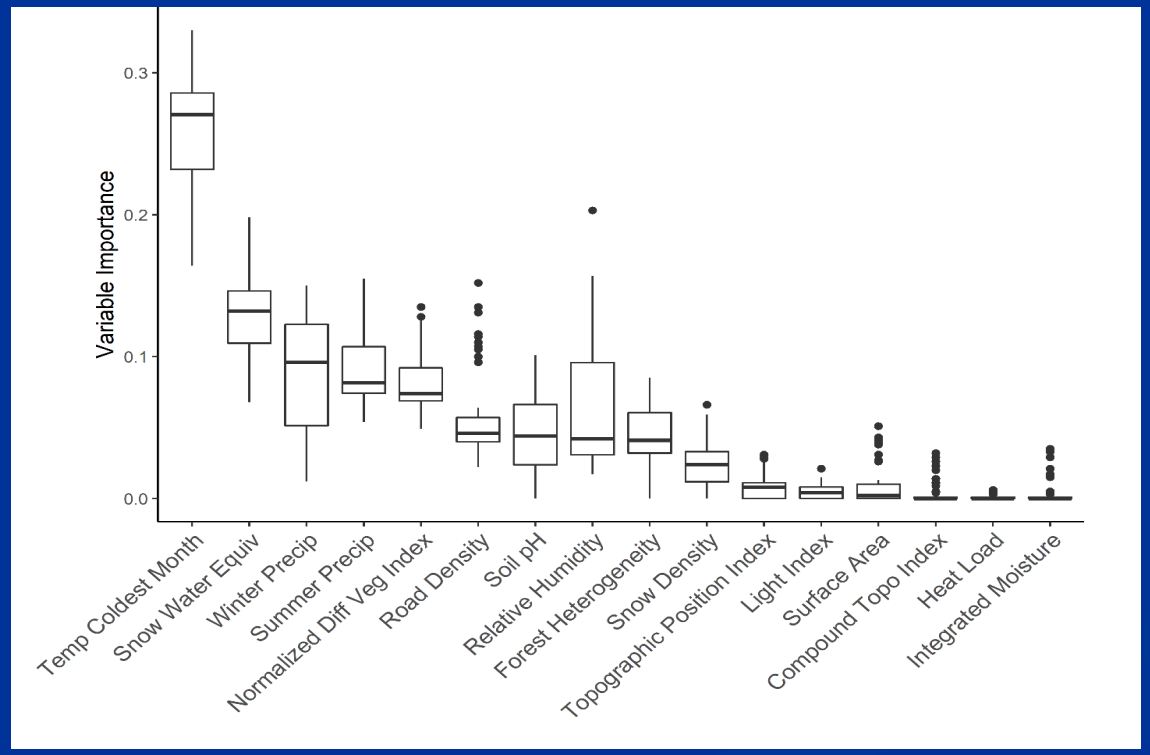
Abstract

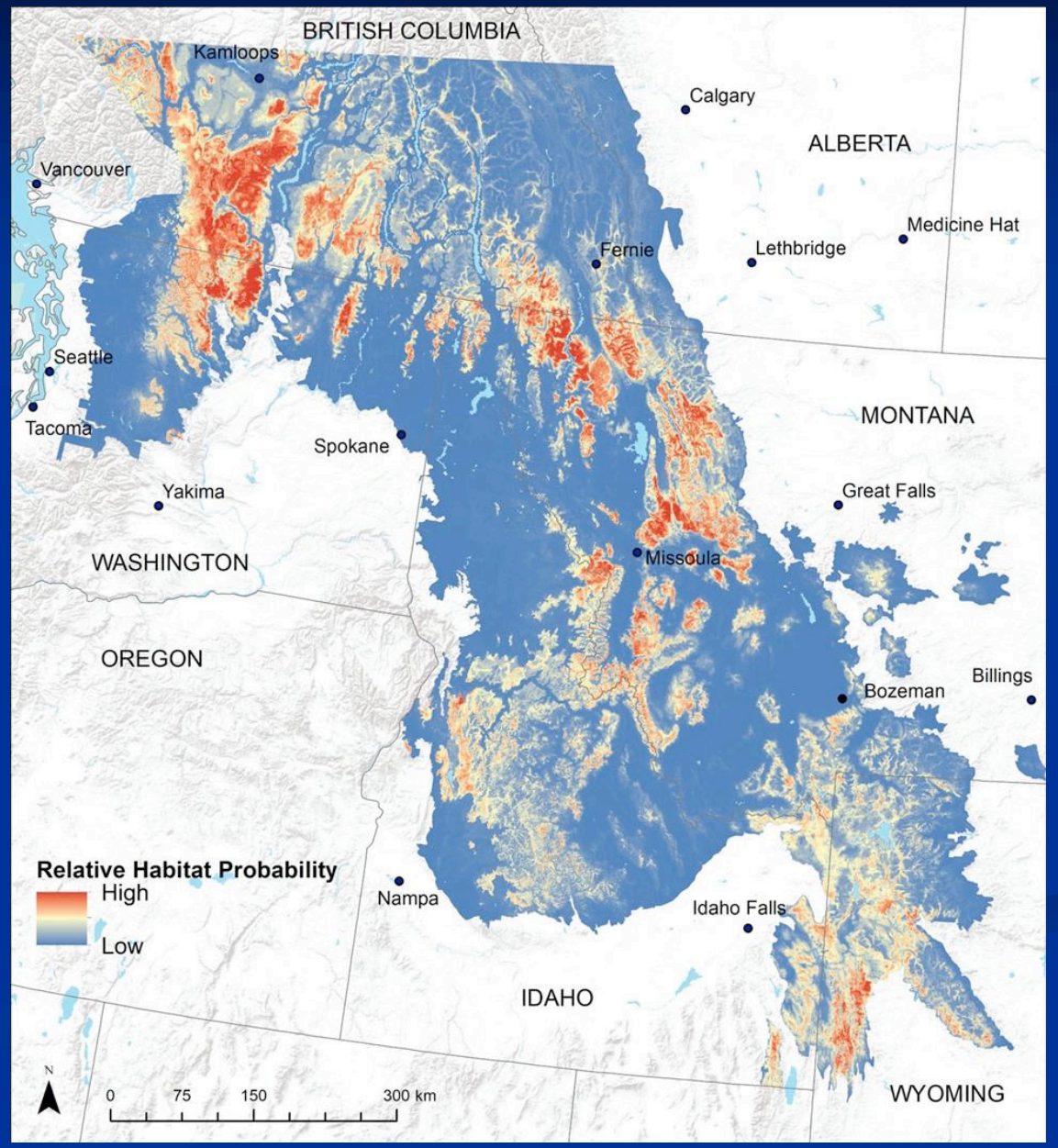
The application of species distribution models (SDMs) to areas outside of where a model was created allows informed decisions across large spatial scales, yet transferability remains a challenge in ecological modeling. We examined how regional variation in animal-environment relationships influenced model transferability for Canada lynx (*Lynx canadensis*), with an additional conservation aim of modeling lynx habitat across the northwestern United States. Simultaneously, we explored the effect of sample size from GPS data on SDM model performance and transferability. We used data from three geographically distinct Canada lynx populations in Washington ($n = 17$ individuals), Montana ($n = 66$), and Wyoming ($n = 10$) from 1996 to 2015. We

Lynx CH Remand – New Habitat Modeling

Olson *et al*. 2021. Improved prediction of Canada lynx distribution through regional model transferability and data efficiency. Ecology and Evolution 11:1667–1690.

Similar modeling – Squires *et al*. in press – for Colorado/Southern Rockies





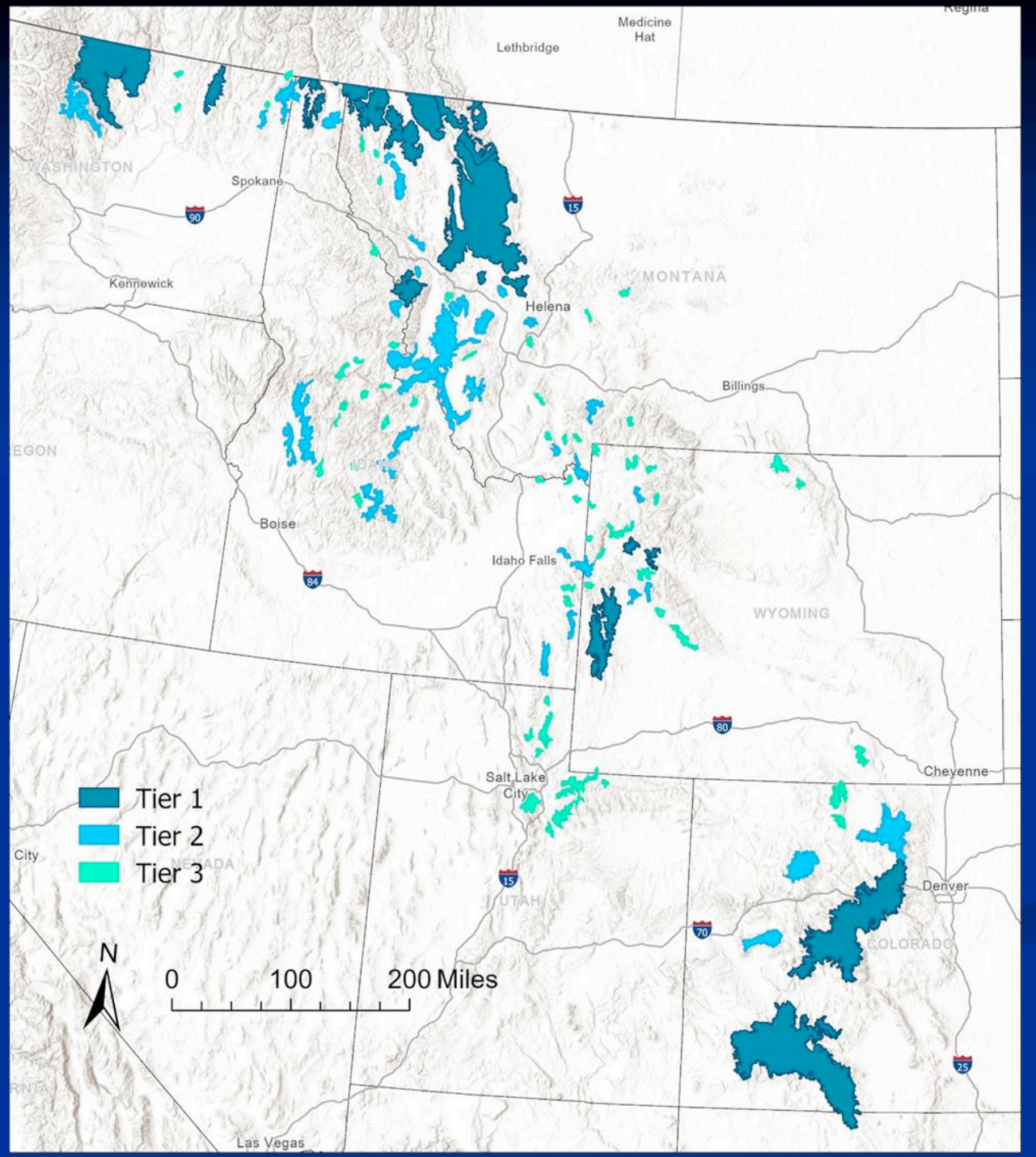
Distribution of Lynx Habitat in the West

Spatial Framework for the Conservation of Canada Lynx Habitat in the Western U.S. and Associated Management Tiers

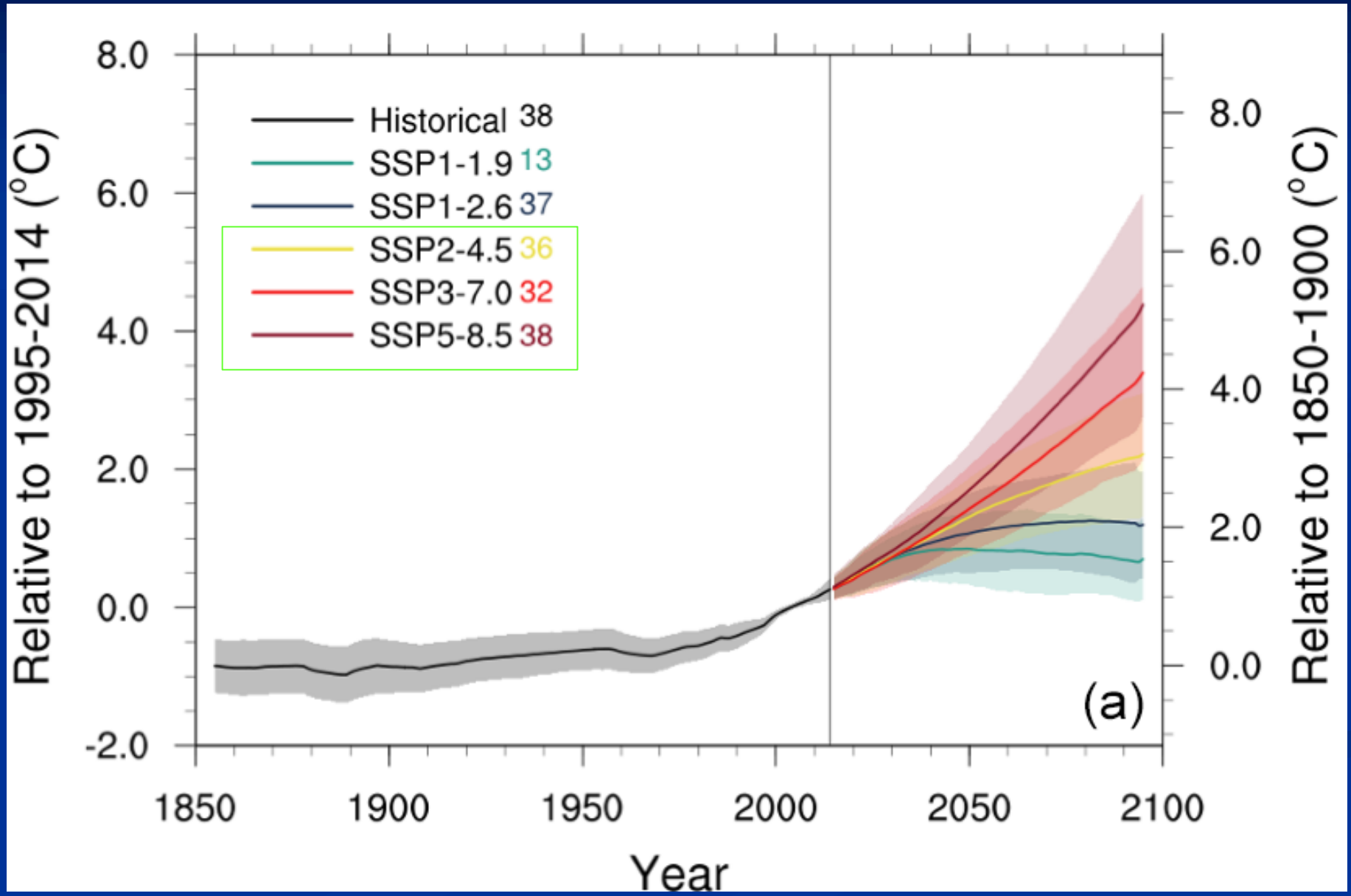
Interagency Western Lynx Biology Team - *December 31, 2022*

Tiers derived from:

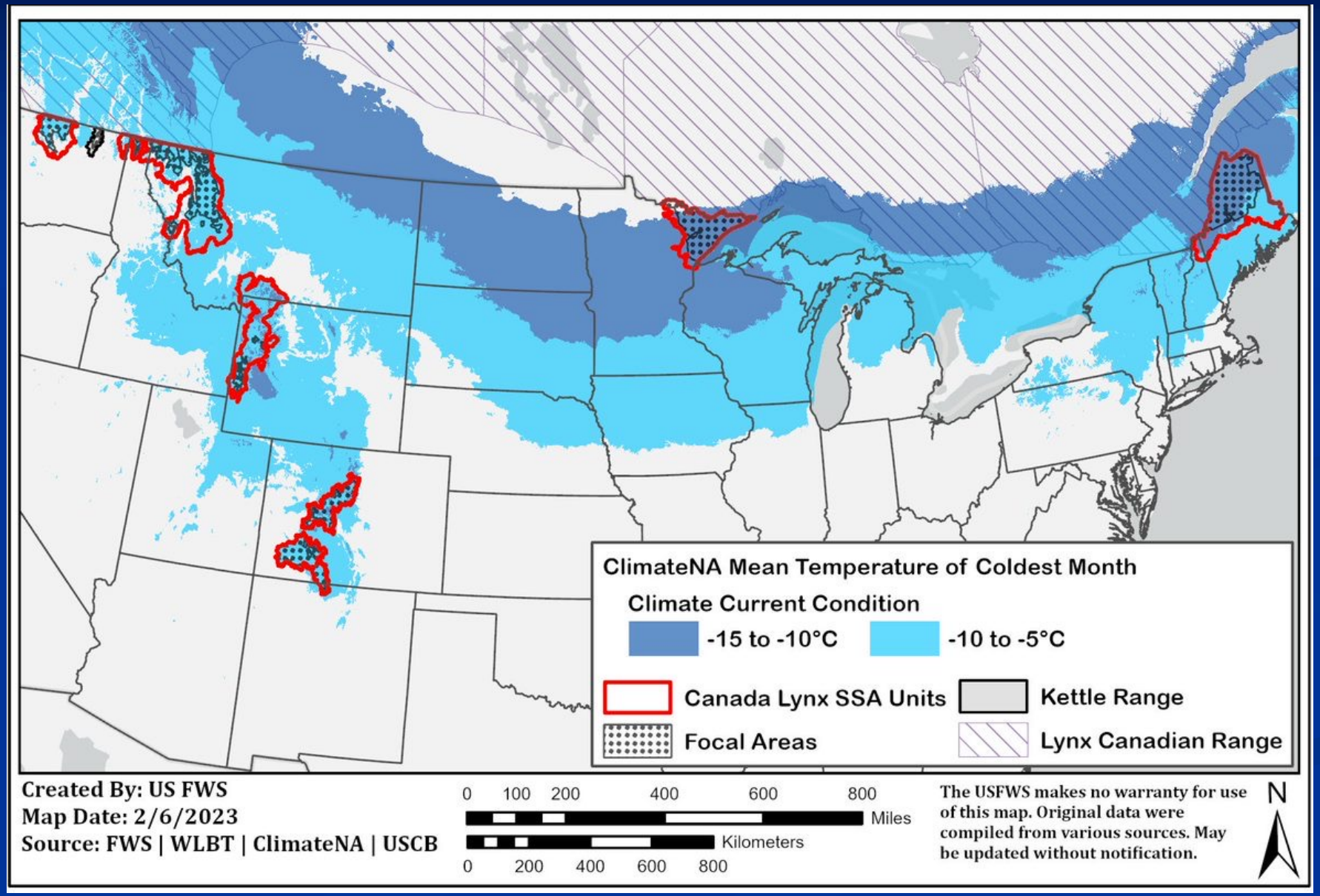
Olson, L.E., N. Bjornlie, G. Hanvey, J.D. Holbrook, J.S. Ivan, S. Jackson, B. Kertson, T. King, M. Lucid, D. Murray, R. Naney, J. Rohrer, A. Scully, D. Thornton, Z. Walker, and J.R. Squires. 2021. Improved prediction of Canada lynx distribution through regional model transferability and data efficiency. Ecology and Evolution 11:1667–1690.



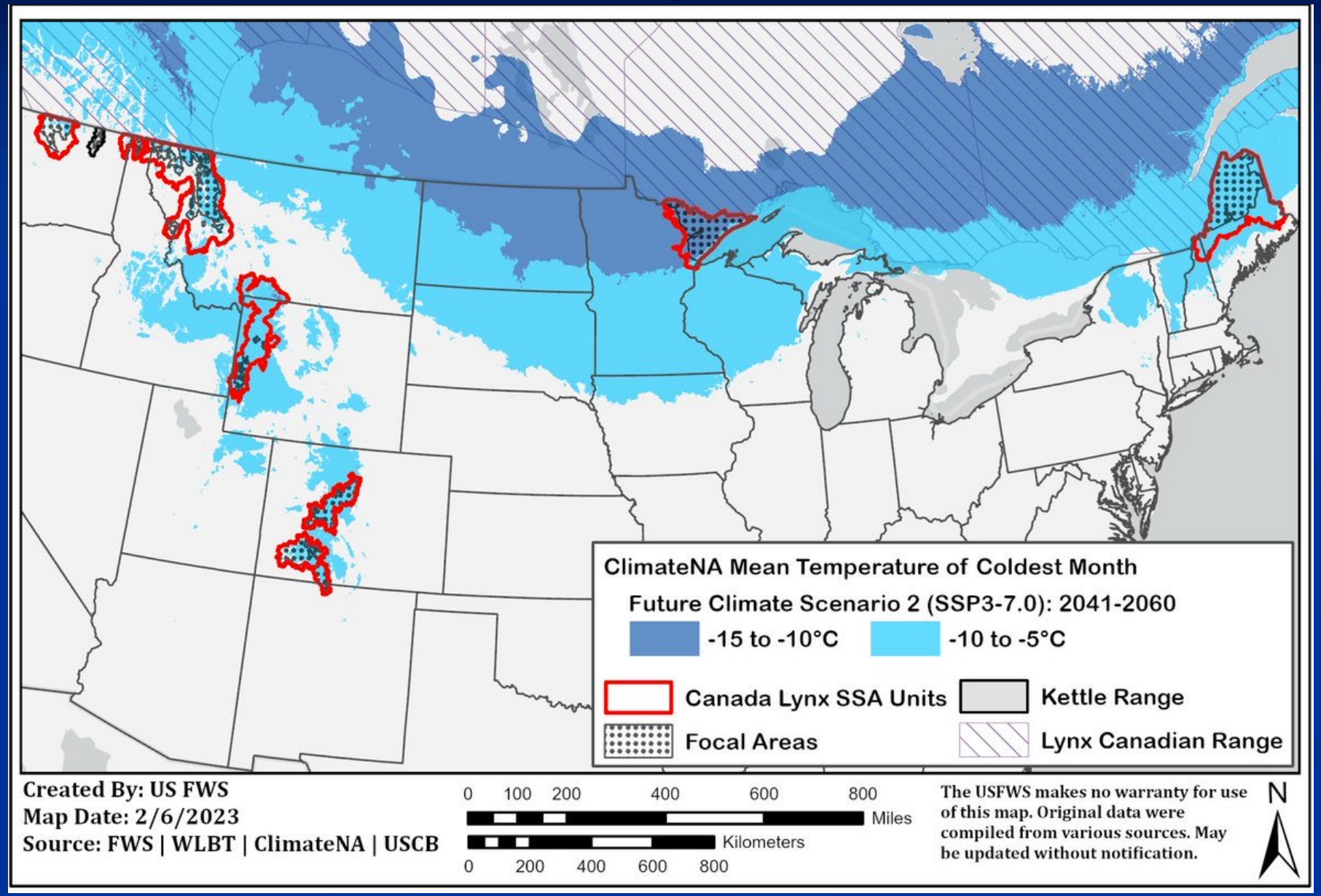
Climate Vulnerability Assessment



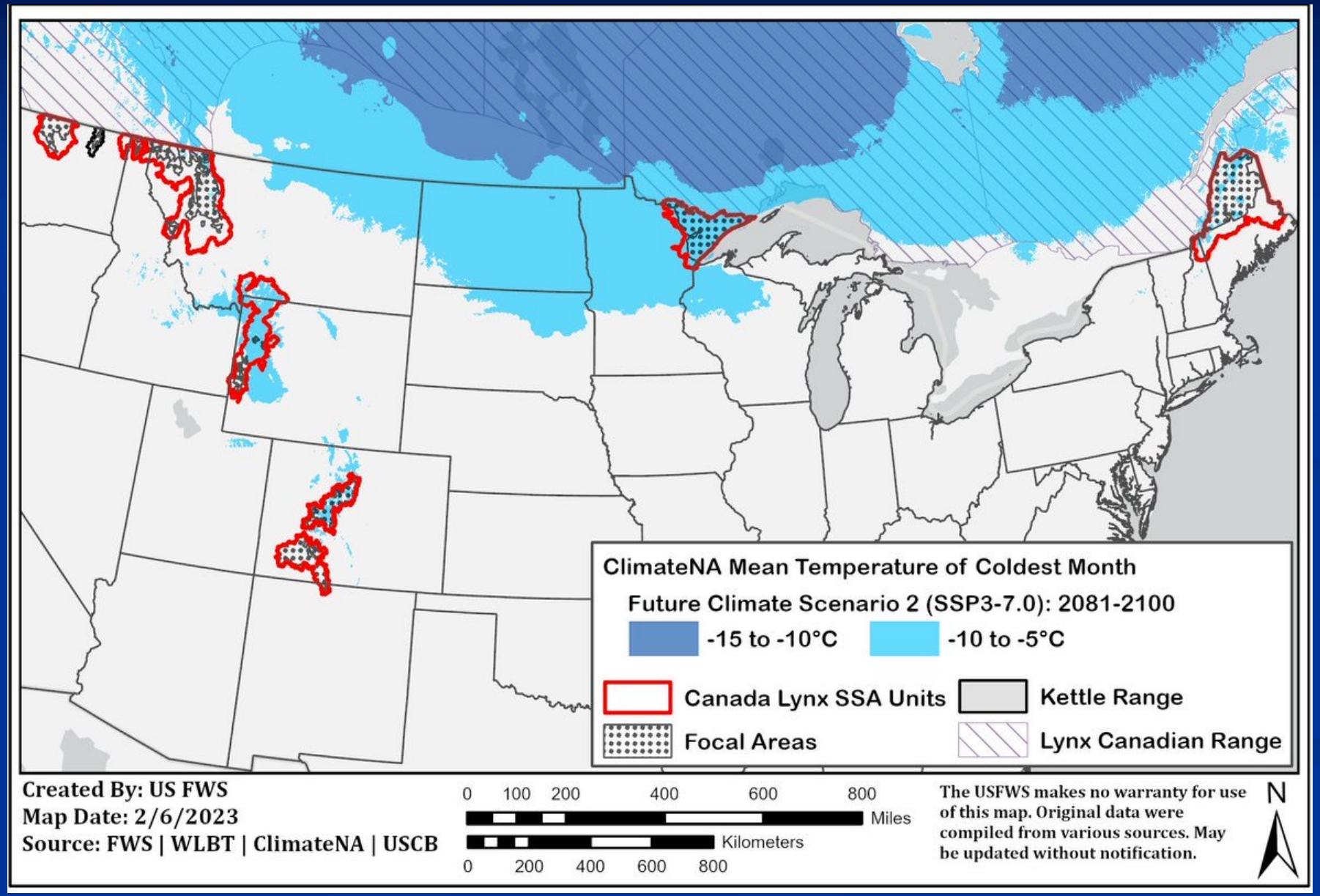
Climate Vulnerability Assessment - Current



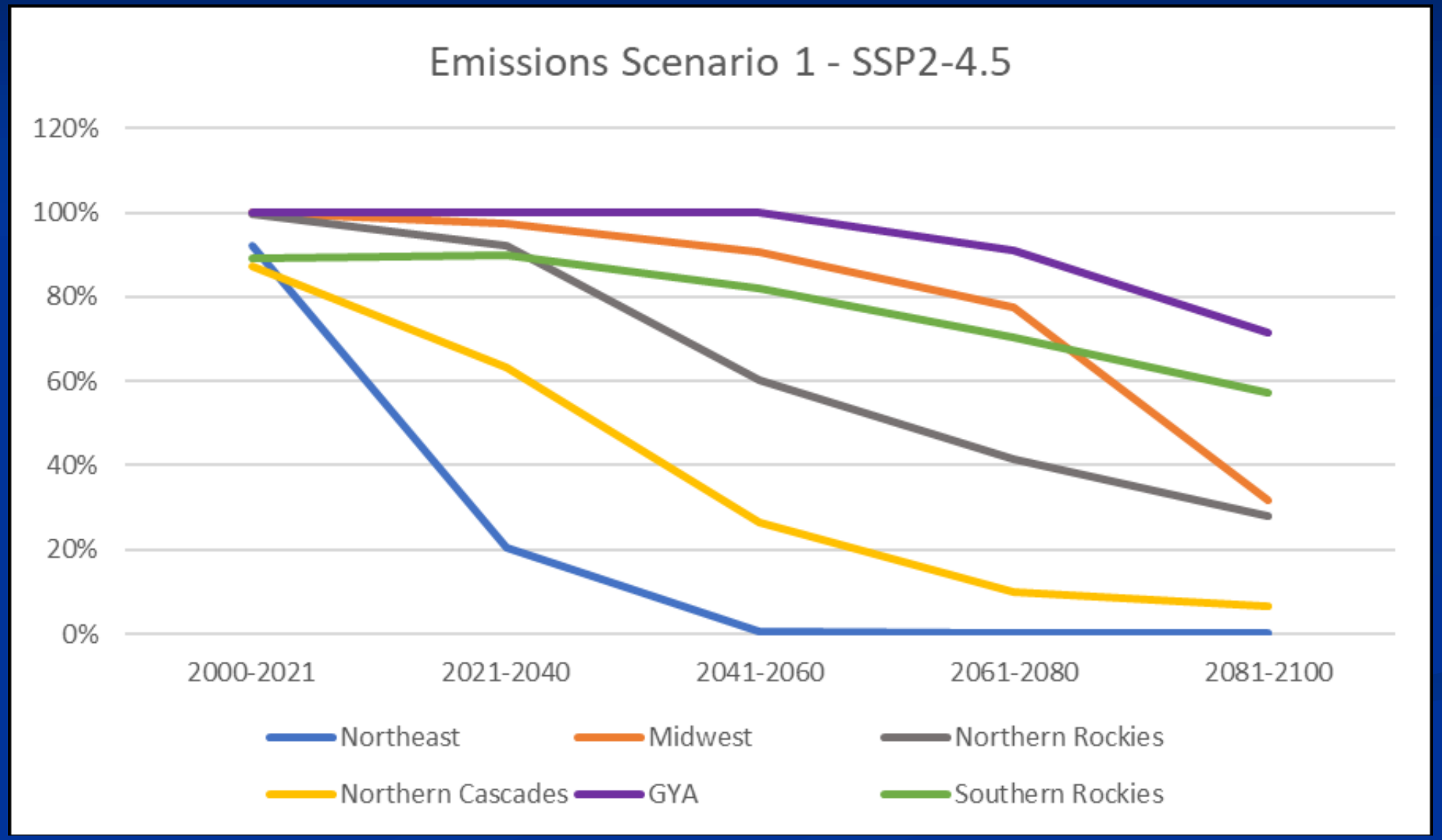
Climate Vulnerability Assessment - 2050

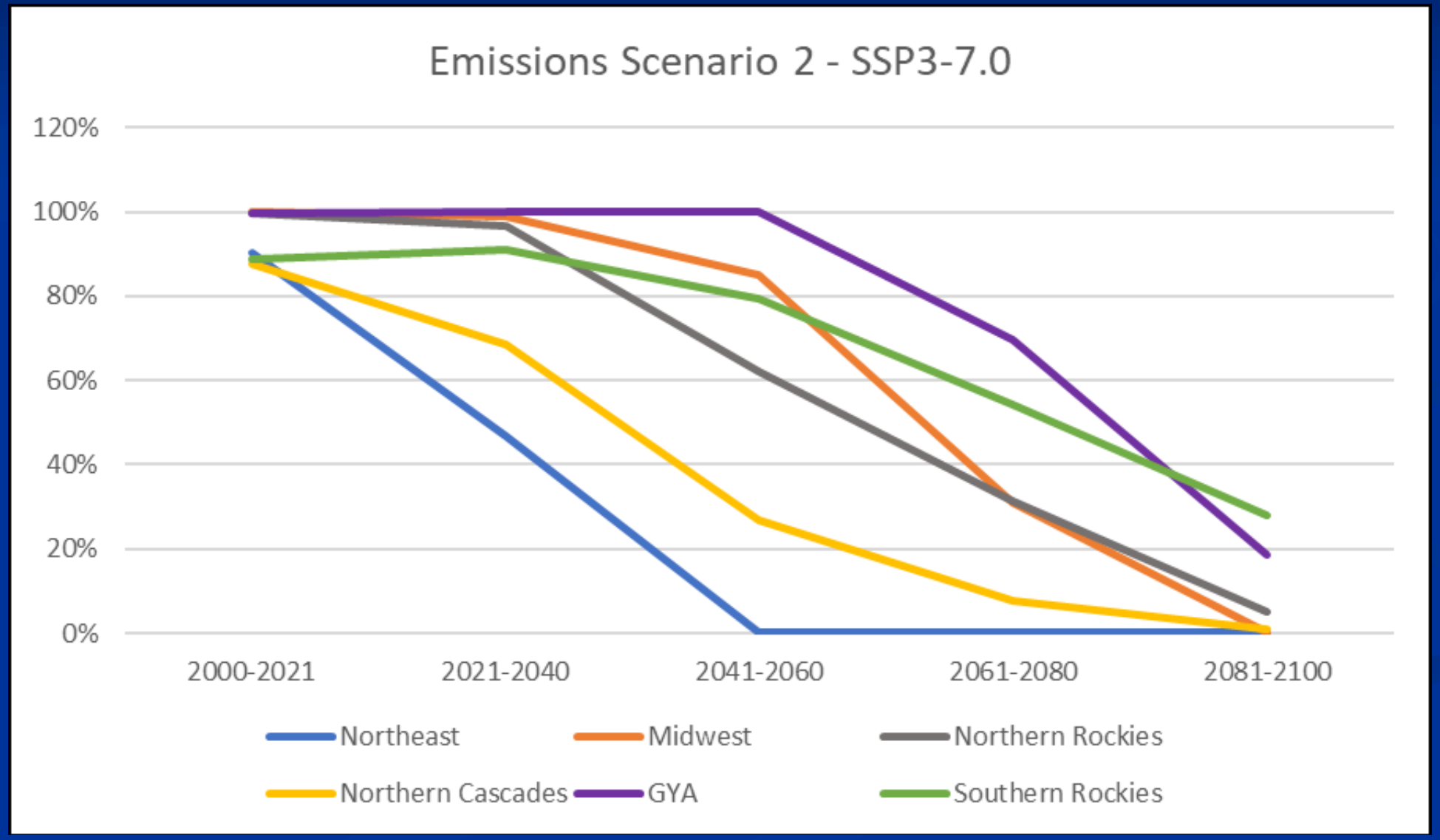


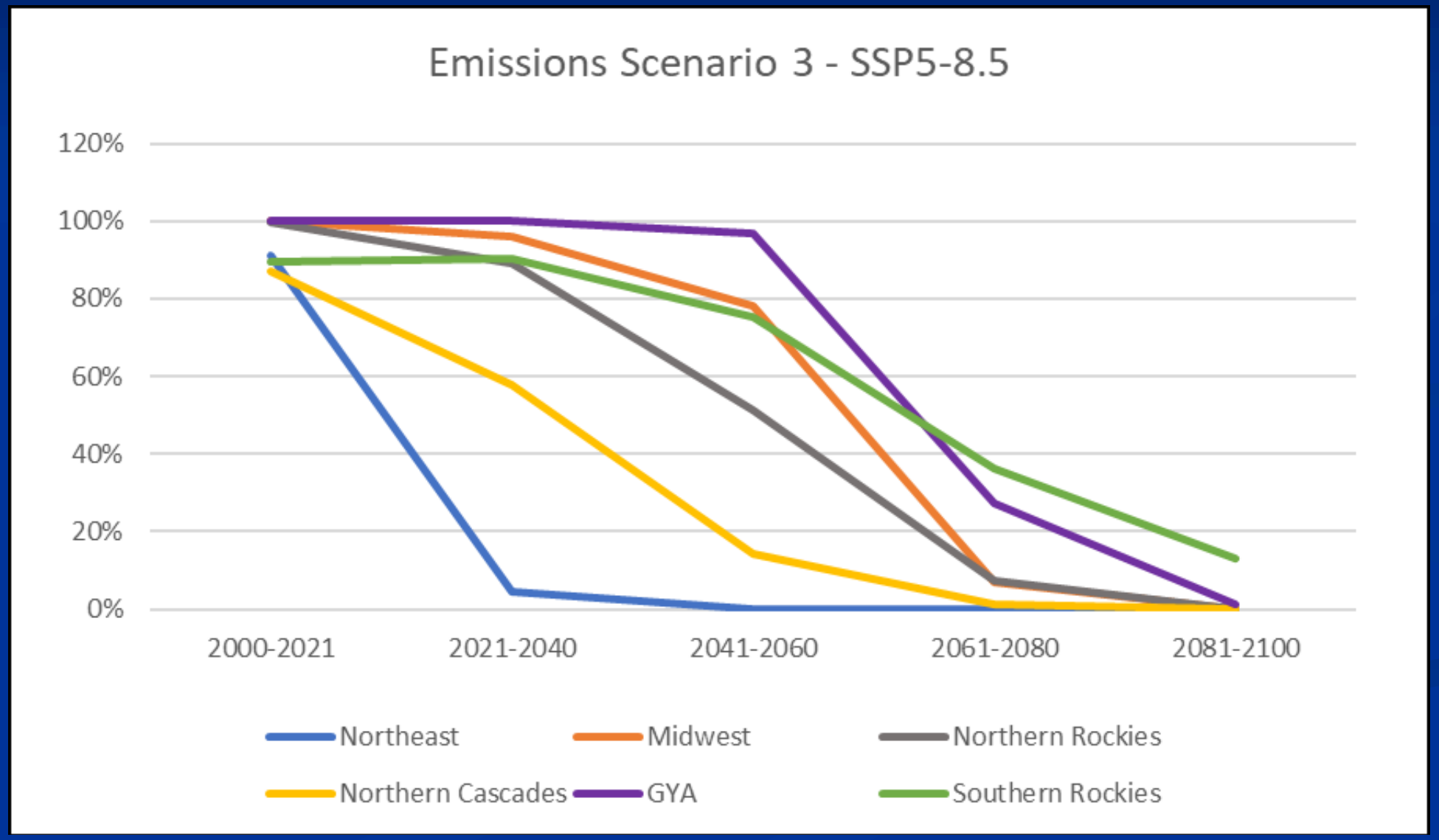
Climate Vulnerability Assessment - 2090



The following graphs show the projected timing and magnitude of loss of favorable conditions in SSA unit focal areas over time with projected warming under each climate scenario. As expected, the speed and magnitude of losses increase with increasing projected greenhouse gas emissions.




Emissions Scenario 2 - SSP3-7.0
120%
100%
80%
60%
40%
20%
0%
2000-2021
2021-2040
2041-2060
2061-2080
2081-2100
Northeast
Midwest
Northern Rockies
Northern Cascades
GYA
Southern Rockies


Emissions Scenario 3 - SSP5-8.5
120%
100%
80%
60%
40%
20%
0%
2000-2021
2021-2040
2041-2060
2061-2080
2081-2100
Northeast
Midwest
Northern Rockies
Northern Cascades
GYA
Southern Rockies

Resiliency Analysis – All Scenarios

Current and plausible future resiliency of Canada lynx populations in six SSA units in the contiguous United States under three future scenarios (Green = High resiliency; Yellow = Moderate; Pink = Low; Brown = Not resilient/functionally extirpated).

Unit	Current Resiliency	Future Scenario 1				Future Scenario 2				Future Scenario 3			
		2021-2040	2041-2060	2061-2080	2081-2100	2021-2040	2041-2060	2061-2080	2081-2100	2021-2040	2041-2060	2061-2080	2081-2100
1	High												
2	High												
3	High												
4	Moderate												
5	Extirpated												
6	Moderate												

Takeaways

- Lynx habitat in the West – naturally more restricted; fragmented and lynx naturally rarer then thought when the DPS was listed
- Many more resident lynx in CO and ME now than likely historical numbers; many more there and in MN than known/suspected when the DPS was listed
- Threat for listing, inadequate regulatory mechanisms on federal lands, addressed by formal amendments/revisions to USFS and BLM plans that incorporate science-based conservation measures
- Long-term threat – projected, continued, accelerated, anthropogenic climate warming will likely shift habitats and populations northward and upslope, increasing risk of DPS extirpation
- Continuing uncertainty regarding timing, extent, and consequences of potential climate-mediated impacts

Summary of Recovery Plan Components

Maintain or improve:

- Population resiliency - 5 DPS populations
- Connectivity - between DPS populations and the core of the species' range in Canada and among DPS populations
- Habitats capable of supporting resident breeding populations
- Regulatory mechanisms and voluntary conservation efforts – to ensure habitat conservation and population viability

Useful Links

- Ecology and Conservation of Lynx in the United States (Ruggiero et al. 1999): https://research.fs.usda.gov/treesearch/4546
- Canada Lynx Conservation Assessment and Strategy (LCAS 2013): https://www.fs.usda.gov/biology/resources/pubs/wildlife/LCAS_revisedAugust2013.pdf
- USFWS Environmental Conservation Online System (ECOS) – Species Profile: https://ecos.fws.gov/ecp/species/A073?
- Canada Lynx Species Status Assessment (SSA 2017): https://ecos.fws.gov/ServCat/DownloadFile/213244
- Canada Lynx SSA Addendum (2023): https://ecos.fws.gov/ServCat/DownloadFile/242379

Questions