Current state of knowledge and research on potential effects of climate change on forest ecology

Dr. Jay Wason

School of Forest Resources

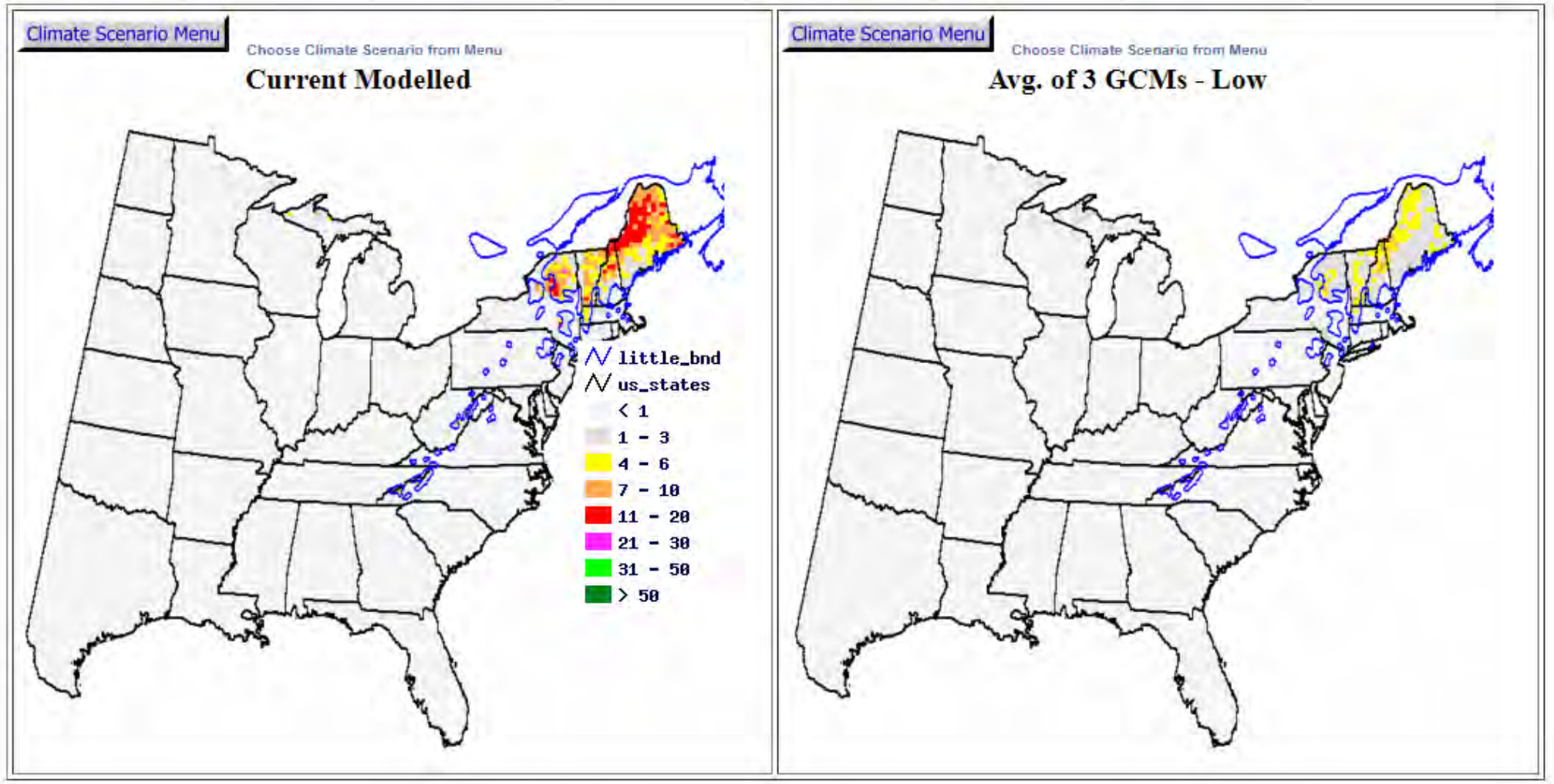
University of Maine

Overview

- Forest responses to climate change are complex
- Novel future climates
- Good and bad of climate change
- We determine what our forests will look like in 100 years

Changing climate and tree migration

Red spruce



McGill (2018)

Land-use drives forest composition

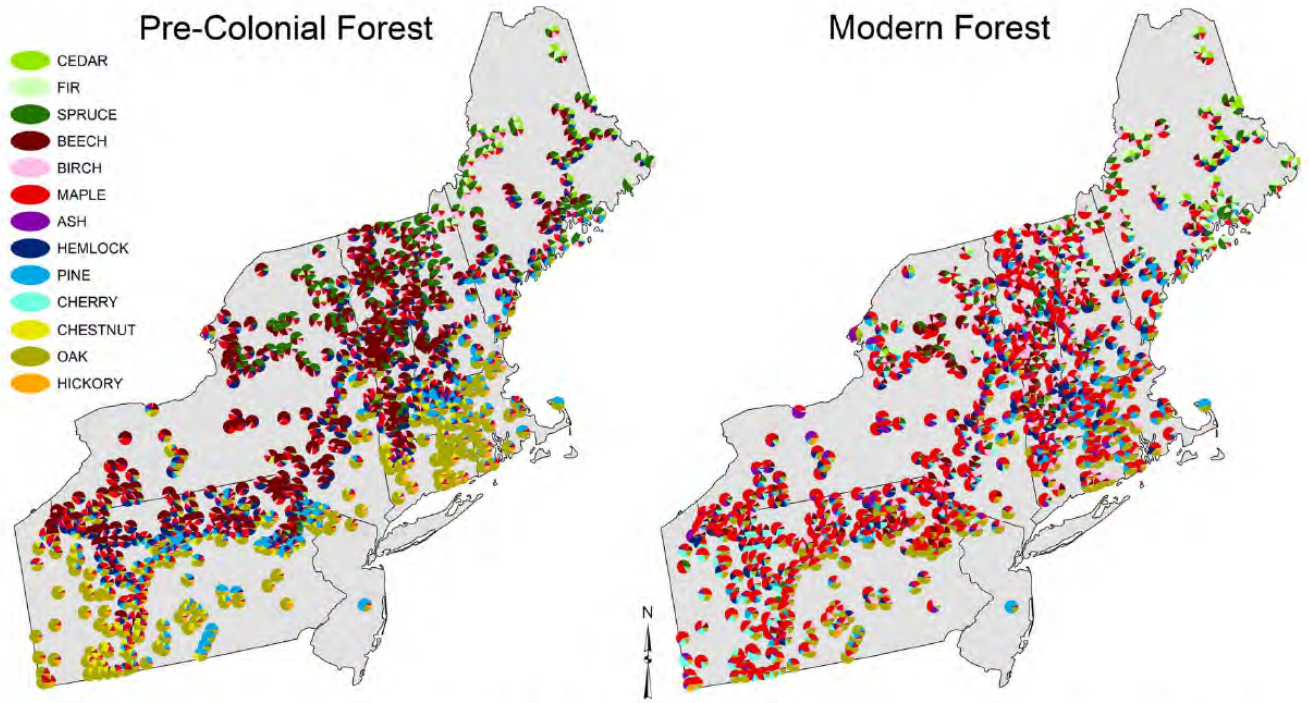
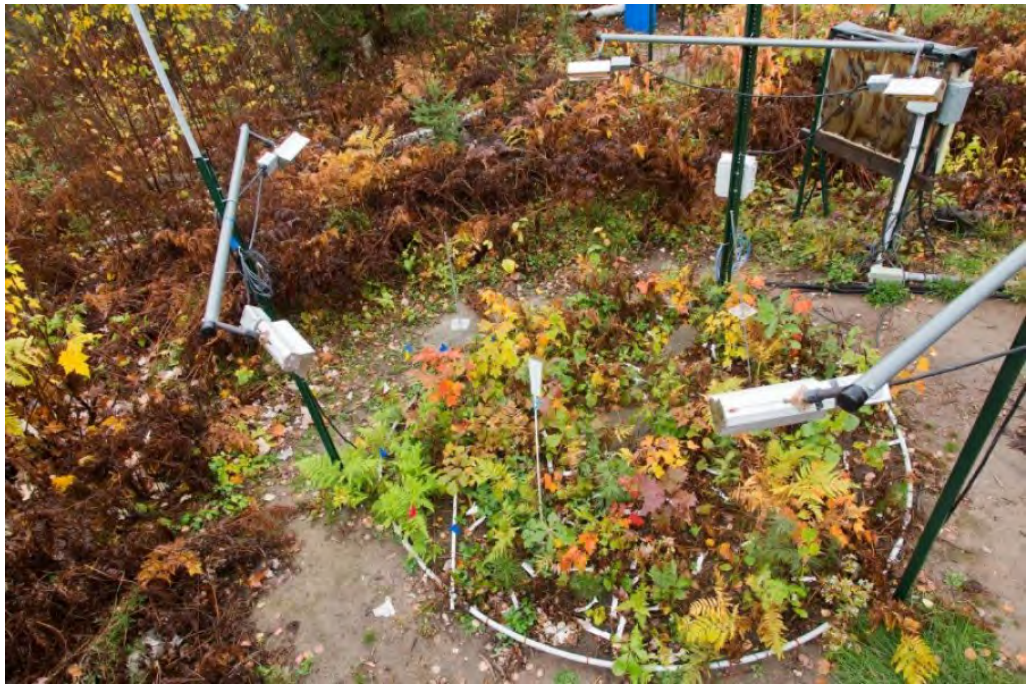


Figure 3. Relative composition of pre-colonial era Witness Trees and modern inventory trees in 701 colonial townships in the northeastern USA.
doi:10.1371/journal.pone.0072540.g003

Increased forest productivity? It depends…

- Warming reduces photosynthesis during normal dry periods
- Increased growth for trees at their northern range margin



David Hansen, University of Minnesota

CO_2 fertilization increases productivity in some situations

aspenface.mtu.edu/

Climate change events and shifting phenology

Freezing damage to roots that lack an insulating layer of snow

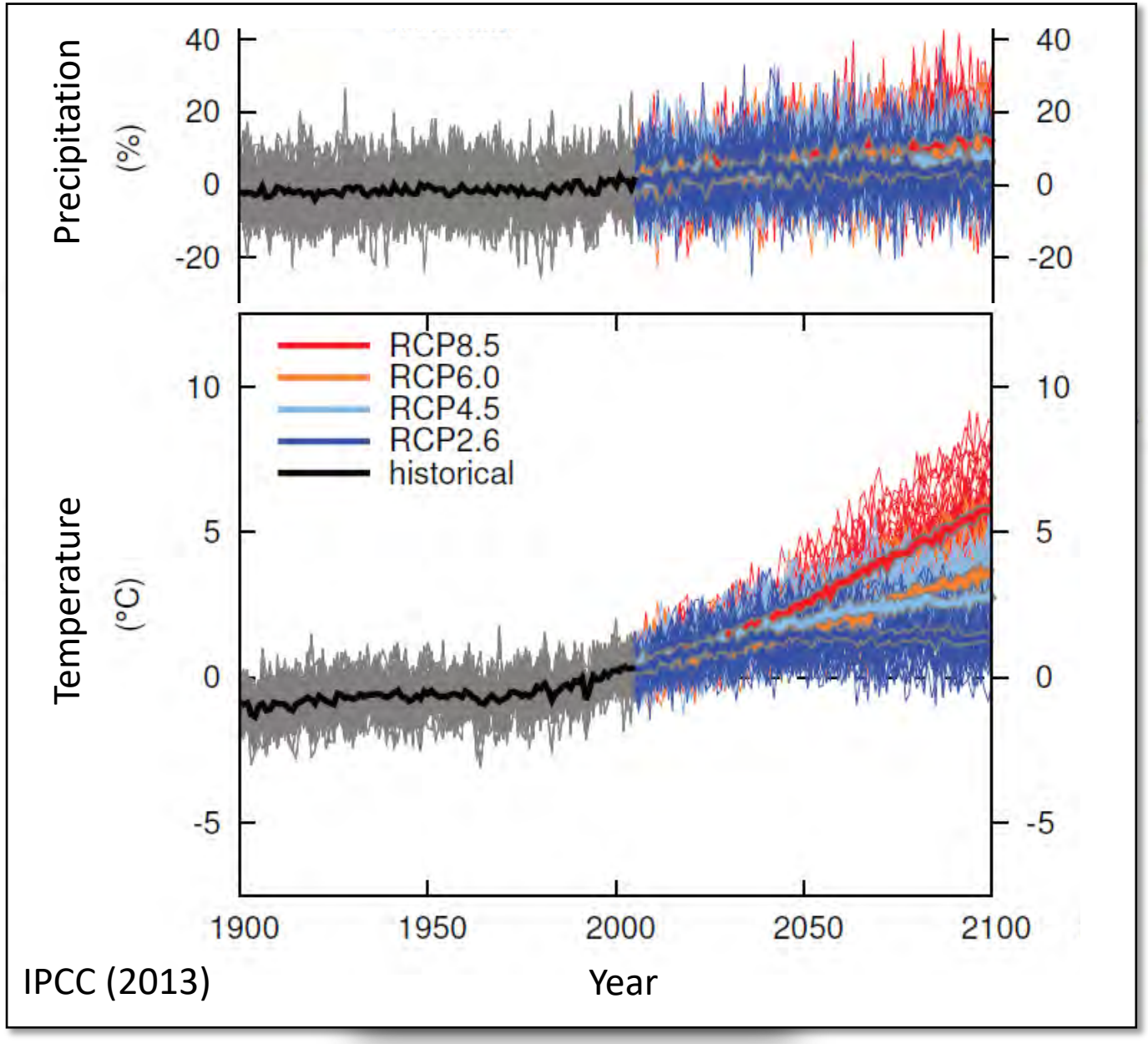
nsrcforest.org

Extreme winter warming event initiated budburst in ~50% of woody species in Wisconsin

Ladwig et al. (2019)

What to expect in the future

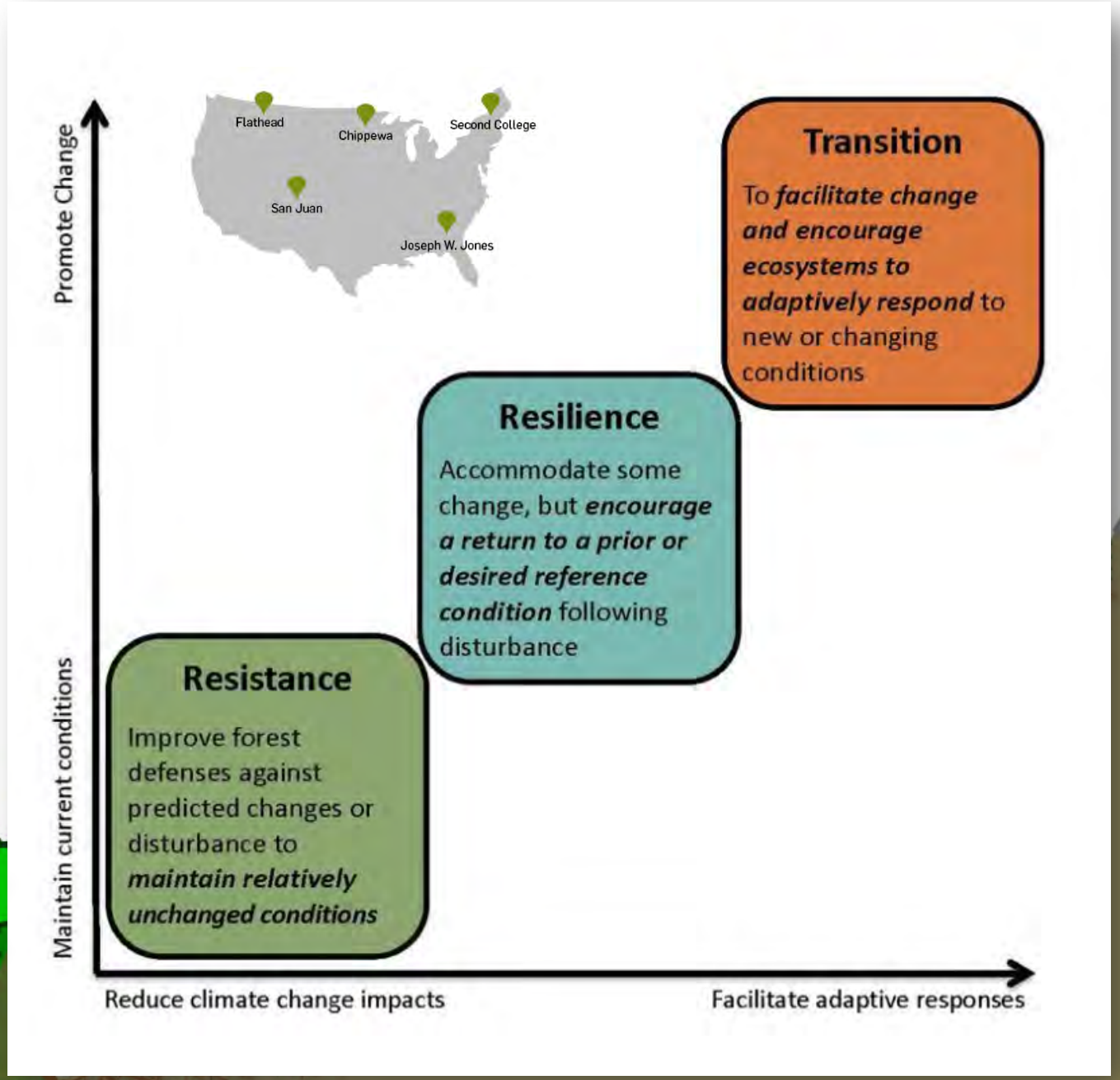
- Rapid warming and novel climate conditions
- Lags in natural forest migrations
- Complex and unexpected biotic interactions
- Uncertainty
  - Short- vs. long-term predictions



IPCC (2013)

Ongoing Research

- Forest migration and canopy gaps
- Physiological tolerance of trees at trailing edge
- Ecosystem impacts
- Adaptive Silviculture for Climate Change

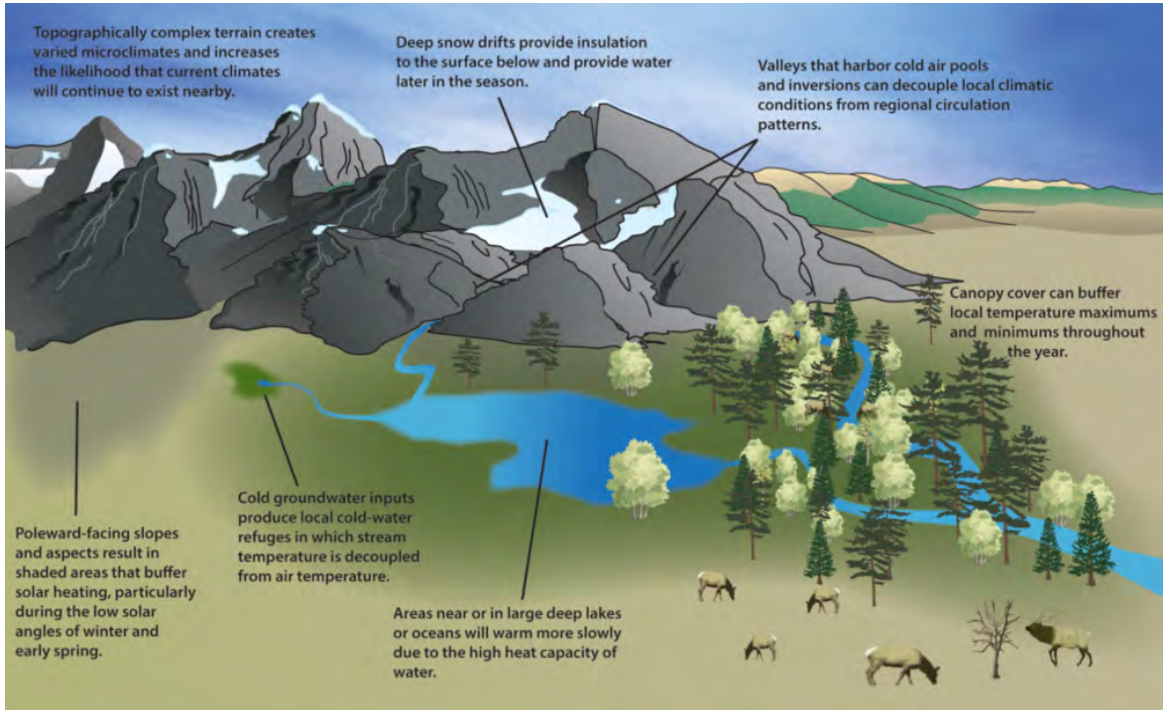


Research Outcomes

- Climate change winners and losers
- Forest **resilience** and **resistance** to change and novel climate conditions
- Changing ecological communities
- Improved understanding of adaptive management practices

Current Knowledge Gap

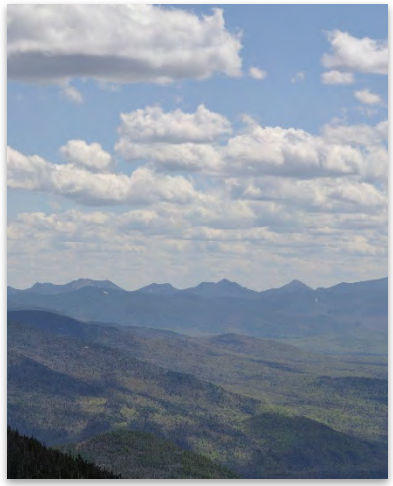
- Disconnect between suitable habitat models and tree migration
- Species ability to tolerate novel and rapidly changing climates (physiological ecology)
- Identifying climate refugia
- Biotic interactions of complex trophic webs

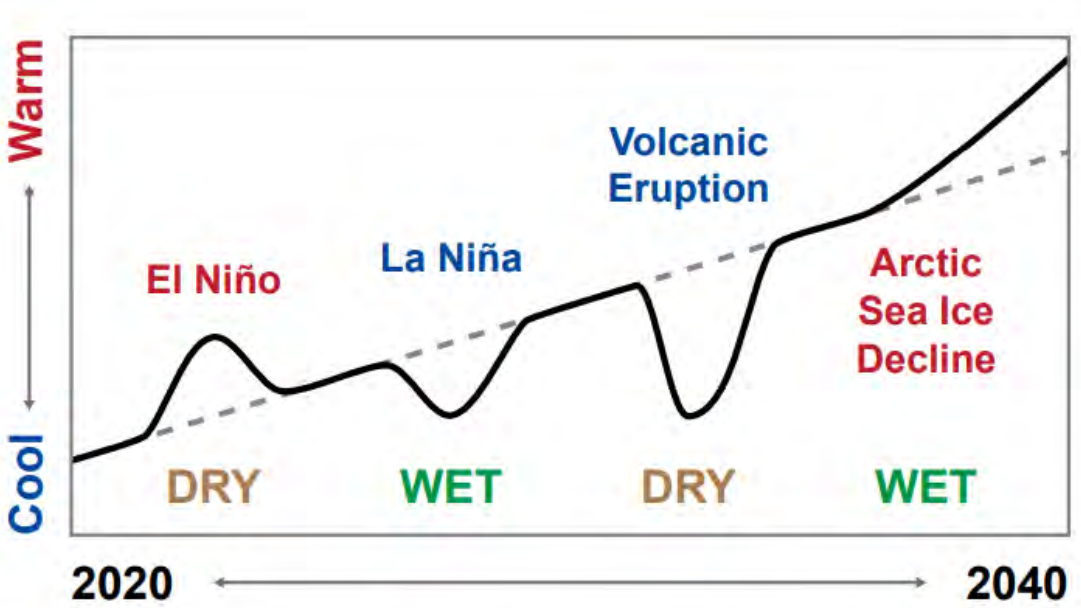


climaterefugia.org

Recommendations

- Determine physiological responses to changing climate across scales
- Identify climate change refugia and opportunities for facilitated migration
- Managing for and embracing uncertainty at different timescales
- Forest Management Workshops





Coastal Maine Climate Futures

Summary

- Forest responses to climate change are complex
- Novel future climates present unique challenges but also opportunities
- Good and bad impacts in forests
- We determine what our forests will look like in 100 years

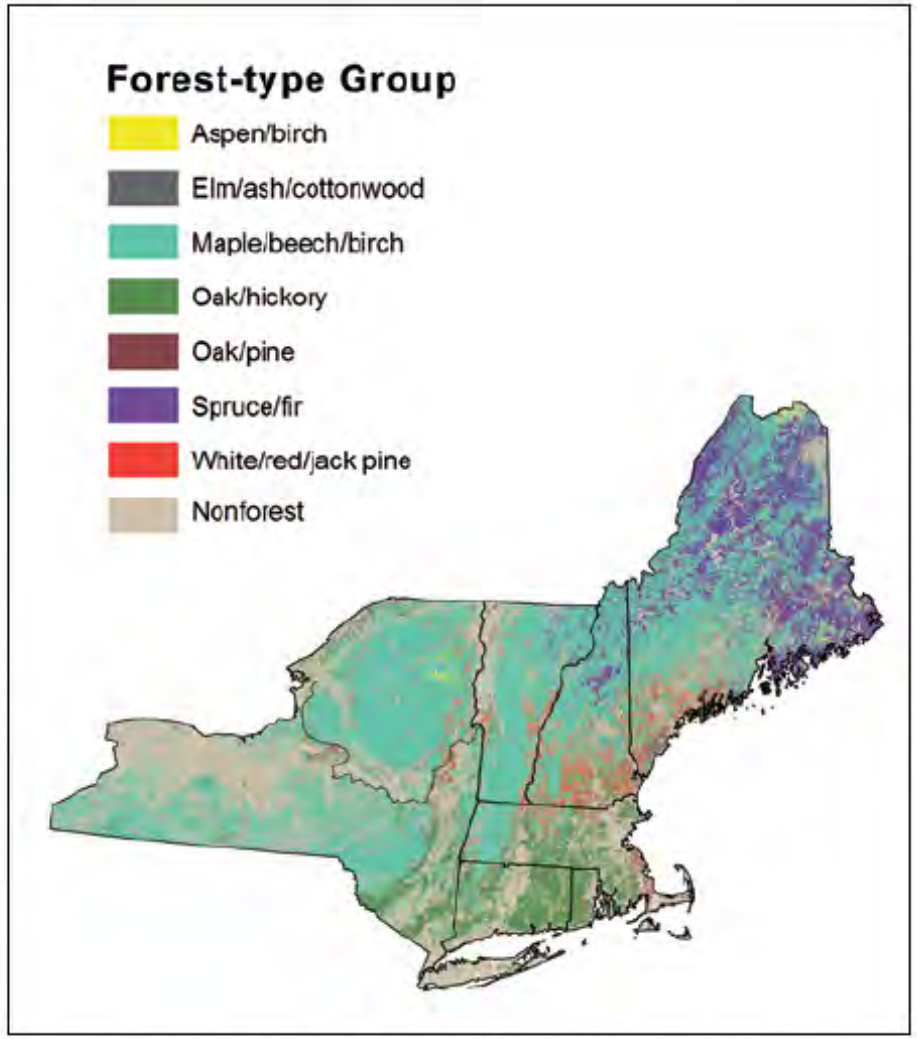


Figure 6.—Distribution of forest-type groups in the Northeast. Data source: Ruefenacht et al. (2013).

Acknowledgements

Question/Comments

Center for Research on Sustainable Forests

5755 Nutting Hall, Room 263

Orono, ME 04469-5755

Tel: 207.581.3794

Fax: 207.581.2833

crsf@maine.edu

https://crsf.umaine.edu/forest-climate-change-initiative/