



# Tree-ring records of human influence on historical fire regimes in the Boundary Waters Canoe Area Wilderness

Evan Larson,<sup>1</sup> Kurt Kipfmueller,<sup>2</sup> and Lane Johnson<sup>3</sup>

# Lakes States Region: Arrival of humans to the present day

Humans have modified the landscape and fire regimes of the Great Lakes region since Paleo-Indians migrated to the area c. 14,000 years ago. Europeans arrived c. 400 years ago and began utilizing existing Indigenous trade networks soon after. *Land cession treaties* for northern MN in 1854 and 1866 were designed to remove Indigenous people and their ways of life and open the region for Euro-American settlement. Beginning in 1902 a series of policies were enacted to maintain federal ownership of what is now called the Boundary Waters Canoe Area Wilderness (BWCAW), including its designation as a wilderness in 1964 (*Fig. 1*). The collective results of these actions disrupted the eco-cultural factors that historically shaped the forests of the BWCAW.

## **Management Implications**

- 1. Fire history and forest stewardship. Understanding the fire history of a region is important for evaluating present and future forest management options including the eco-cultural restoration of fire.
- 2. Humans amplified landscape vegetation patterns in the BWCAW. The activities of people likely influenced the distribution and abundance of historically open red pine woodlands in the BWCAW, particularly along the historical Border Route.
- 3. Landscapes influence patterns of human travel, fire, and vegetation. Residents of the Border Lakes landscape chose water routes and resting places based on several factors, including convenience of travel and the strate-gic geography of habitation sites along these travel corridors. This consequently influenced patterns of fire on the landscape.
- 4. Resiliency under climate change. Open stands of red pine that developed under frequent, mixed-severity fire regimes in the 1700s and 1800s had structural and compositional qualities that made them more resilient to the effects of climate change than they are at present.

Today, forests in the Border Lakes retain tangible reminders of the human ecology of the region. Tree-ring research, called dendrochronology, helps interpret the rings of living and remnant fire-scarred and culturally-modified red pine to share this story. Larson et al. (2021) examined tree-ring samples from 413 fire-scarred red pine and 246 culturally-modified trees (CMT) to reconstruct 527 years of fire and landuse history in the BWCAW (*Fig. 3*). Forest age structure from over 900 trees was compared to the fire and landuse record, and when set in the context of archaeological and ethnographic records, made evident the interplay and mutual influences of people, landscape, and fire in the BWCAW.



**Top:** A multi-aged red pine stand on Lac La Croix, BWCAW, with long-lived culturally-modified and fire-scarred red pine. **Bottom:** Red pine stems colored by their relative age to demonstrate forest change in the absence of people and frequent fire.

#### Humans influence landscapes

Fire-scarred red pine and CMTs show (Fig. 4) (1) a high occurrence of fire along the historical Border Route that spans the Border Lakes region and (2) suggest human augmentation of surface fire frequencies at these locations. Evidence of historically frequent surface fires were linked with the occurrence of open red pine woodlands in areas of high cultural use. Indigenous landuse and fire activity over the 18th and 19th centuries led to an increase in xeric pine communities, which resulted in a more diverse forest mosaic through localized alteration of successional patterns when compared to sites that experienced less human influence. Humans reinforced and enhanced xeric forest patterns to promote native plant community conditions optimal for subsistence, such as increased blueberry production, and more open, accessible forest conditions for hunting and overland travel. The open forest structure and low fuel loads maintained by frequent surface fire also reduced the risk of catastrophic fire in these sites which afforded fire protection to the communities utilizing them. Beginning in the 1890s and coming to bear in the early 1900s, state and federal enforcement of fire prevention policy constrained traditional subsistence practices of the Border Lakes Anishinaabeg and reduced fire activity, which in turn initiated marked changes to forest structure that included in-fill of formerly fire-maintained stands.

#### Landscapes influence humans

Resting places during travel along the Border Route were chosen for their xeric conditions, viewsheds, accessibility, and convenience. Persistent use of strategic sites over time increased fire probability and influenced the spatial patterns of fire occurrence. For example, a south-facing peninsula that extends into Crooked Lake, an important node along a major travel corridor, experienced fifteen surface fires over the 1700s and 1800s (*Fig. 6*). Similarly, a south-facing site near Fish Stake Narrows on Lac La Croix overlooks a junction of two traditional canoe routes connecting the regional Anishinaabe economy to the North American fur trade. This site holds abundant evidence of long-term human engagement in the disturbance history and development of the stand (*Fig. 7*).

#### Fire history, equity, and inclusion

Understanding the historical influence of humans on landscapes and landscapes on humans is important for (1) encouraging shared stewardship of protected areas inclusive of both Western and Indigenous perspectives; (2) developing land management plans aligned with cross-cultural stewardship goals; (3) crafting legislation that considers the role humans play in shaping and maintaining landscapes; (4) promoting cultural exchange, healing, and reparative justice for Indigenous and Descendant communities. Interdisciplinary research from the BWCAW offers evidence for time and place-specific Indigenous use of fire that spanned multiple human generations while shaping local and regional forest conditions. However, it remains unclear how broadly Indigenous fire

stewardship contributed to historical fire regimes across the Great Lakes. In place of lost historical knowledge, and building on oral traditions, paleoecological and archaeological records can help reconstruct regional surface fire history and clarify the driving mechanisms of frequent fire activity in a manner accessible to Western science perspectives. These records offer an opportunity to build lines of communication and understanding between resource managers and Indigenous communities. Further, this research provides an example where site-specific data provides land managers and the public with important context for the development of management plans (e.g., Indigenous-altered fire regimes, climate change adaptation). In the Great Lakes region, this information is becoming more common, but additional site-specific research is needed.

#### The future

Human landuse practices that included the augmentation of local fire regimes enhanced forest diversity and resilience by building and reinforcing forest heterogeneity and breaking up the continuity of heavy fuels. A growing body of research suggests that the lingering open red pine stands of the Border Lakes region developed under mixed-severity fire regimes that included an important surface fire component linked to people, and that these stands would be more resilient to the projected effects of climate change than the fire-free forest conditions observed at present. The reduction of Indigenous landuse, and of human activity, and a century-long decline in fire occurrence across the BWCAW is a result of longstanding legal protections that have perpetuated the dispossession of Anishinaabe communities from their traditional territories. This, in turn, produced a more homogenous forest landscape that is more susceptible to insects, drought, and catastrophic fire (Fig. 9). Fire reintroduction to the BWCAW has the potential to be an act of both ecological and cultural restoration with a multitude of benefits for the forested landscape and the people to whom they are connected.

## **For Further Reading**

Kipfmueller, K.F., Larson, E.R., Johnson, L.B., et al. in press. Human-augmentation of historical red pine fire regimes in the Boundary Waters Canoe Area Wilderness. Ecosphere.

Larson, E.R., Johnson, L.B., Wilding, T.C. et al. 2019. Faces in the Wilderness: a New Network of Crossdated Culturally-Modified Red Pine in the Boundary Waters Canoe Area Wilderness of Northern Minnesota, USA. Hum Ecol 47, 747–764. <u>https://doi.org/10.1007/s10745-019-00109-4</u>

Minnesota Conservation Volunteer, 2017. What is Wilderness? <u>https://www.dnr.state.mn.us/mcvmagazine/issues/2017/</u> <u>mar-apr/BWCAW-fire-history.html</u> (accessed 25 March 2021).

Visit our website for more briefs and webinars on regional fire science and research.