



## Fire regime characteristics in relation to physiography at local and landscape scales in Lake States pine forests

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Studying fire regime characteristics over time and space is important for understanding the interaction between fire and landscape physiography. Because there are limited fire history studies and a lack of detailed disturbance data in the Lakes States region, understanding disturbances, like fire, have relied on broad-scale survey records from the Euro-American settlement era. Research has shown that topographic features influence fire regimes, including fire behavior, and fire frequency. This study by Meunier and colleagues (2019) aimed to quantify fire frequency and origin-to-first-scar (OFS) intervals — the period between estimated tree germination and first fire-scars — as related to physiographic features at local and ecological landscape scales. They also examined the commonly cited 50-year survival threshold of pines to wildfire.

The study was conducted across five distinct ecological landscapes in Wisconsin, USA. Sections of remnant stumps, snags, and fire-scarred living trees at 10 cm height were collected to calculate origin-to-first-scar (OFS) intervals. The OFS intervals were determined for 357 samples, within 28 sites across the five ecological landscapes. Mean fire return intervals (MFRI) were cal-

## **Management Implications**

- This study improves knowledge of natural (pre-settlement) disturbance regimes in Lake States pine forests, providing important information for forest management and ecosystem restoration decisions.
- 2. Red pine stands experienced fire at approximately 8-11 year intervals between 1717 to 1860 at all studied sites in Wisconsin, but fire exclusion became the rule after the early 1900s.
- 3. During the 1717 to 1860 time period, approximately 12 years supported widespread fires that resulted in fire scars evident in multiple ecological landscapes and sites.
- 4. The average tree origin-to-first-scar (OFS) interval was 18.6 yrs. and was similar across multiple sites, indicating that pine seedlings and saplings survived fire (and were scarred by fire) at much younger ages than the widespread assumption of a 50-year age threshold for pine survival.



**Figure 1:** Example of an open fire-scar from a red pine (*P. resinosa*).



culated for all sites. Topographical roughness and terrain ruggedness were quantified with a terrain roughness index (TRI) along ecological divisions and mapped at local (study site with a 250 m buffer around each sample point) and ecological landscape scales.

The authors found that the OFS intervals ranged from two to 80 (avg. 18) years and were similar across ecological divisions, even as landscape context of sites varied greatly. OFS intervals were on average less than half of the commonly assumed 50-year threshold. Pine seedlings and saplings commonly survived and were scarred by low- to moderate-severity fires, potentially meaning that fire resistance may have a greater role in pine survival of wildfire than has been previously assumed. Saplings and small trees may have survived fires due to (1) patchy fuel consumption; (2) the moderately wet climate of the Lakes States region which led to frequent fires that scarred trees but did not cause mortality; and/or (3) the low density of red pine stands, which promotes development of thicker bark which increases fire resistance.

The results also showed that 63% of samples contained scars created before trees were 19 years of age, and 96% of trees were scarred by the time they were 50 years old (the age at which pines are believed to withstand fire). The MFRIs were similar across sites. The TRI was negatively correlated with water near sites, and study sites had high-

er TRI than the surrounding landscape. No differences were found in OFS intervals among ecological landscapes; variation in OFS was better accounted for at the local site level. There was high variability in physiography at a local scale, but this did not impact OFS intervals as hypothesized by the authors. This could be due to heterogenous fuel characteristics (e.g., fuel loading and moisture) which are known to influence fire behavior and severity.

## **For Further Reading**

Meunier, J., Holoubek, N. S., and Sebasky, M. 2019. Fire regime characteristics in relation to physiography at local and landscape scales in Lake States pine forests. Forest Ecology and Management 454: 117651. <u>https://doi.org/10.1016/j.</u> <u>foreco.2019.117651.</u>

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