

Introduction

European settlement had an enormous effect on forests in the Lake States. Suppression of both wild fires and fires used by Native Americans to manage the land, coupled with deforestation has drastically altered forest compositions (Miller *et al.*, 2010). Tree species like pine need fire or fire conditions for seeds to properly germinate (Ahlgren & Ahlgren, 1984). Without fire, regeneration of pine is negatively affected.

The purpose of this study was to compare how the frequencies of certain tree species have changed from pre- to post-settlement.

I also investigated how dominance has changed in these forests following the suppression of fire.

Methods

- I performed a comprehensive literature review to investigate the effects of fire on forest composition and tree species frequency from pre- to post-settlement in Lake States forests.
- I studied changes in frequency of jack pine (*P. banksiana*), red pine (*P. resinosa*), white pine (*P. strobus*), red oak (*Quercus rubra*), white oak (*Q. alba*), aspen (*Populus spp.*), and maple (*Acer spp.*).
- I recorded the number of forests where frequency of each tree species increased or decreased and performed a chi-square analysis to determine if the difference between categories was statistically significant.

Results

- 15 study sites were found from 12 different articles

Fig. 1. Number of observations of increased or decreased tree species frequency

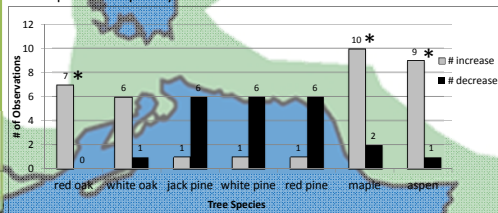


Fig. 2. Number of observations of increased or decreased tree species group frequency

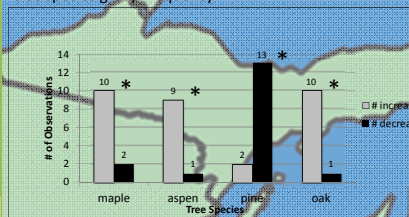


Fig. 3. Pre-settlement species dominance

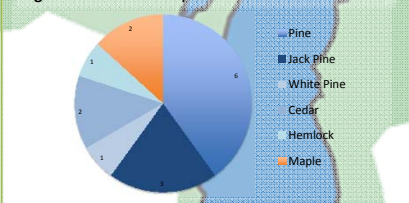


Fig. 4. Post-settlement species dominance

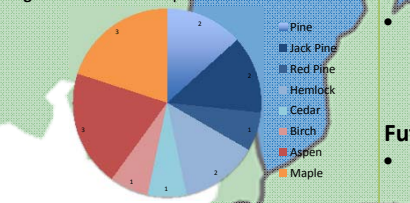


Table 1. Comparison of historically and currently dominant tree species in Lake States forests and changes in frequency of individual tree species from pre-settlement to post-settlement periods.

Author, year	State or province	Description of historic disturbance	Historic fire interval	Change in fire regime post-settlement	Hist. dom. species	Curr. Dom. species	Individual tree species													
							O	RO	WO	JP	WP	RP	A	M						
Newacki & Abrams, 2008	MI, MN, WI	fire regime change	infrequent-frequent	suppressed burning, introduction of agriculture	P, O	A, B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Palik & Pregitzer, 1992	MI	fire proliferation after deforestation	---	suppressed burning	H	A	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Palik & Pregitzer, 1992	MI	fire proliferation after deforestation	112-227 yrs	---	JP	A	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Leahy & Pregitzer, 2003	MI	fire proliferation after deforestation	200 yrs	suppressed burning	JP	JP	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Stearns & Likens, 2002	MN, WI	suppression of fire	---	suppressed burning	WP	RP	+	+	+	-	-	-	-	-	-	-	-	-	-	-
Radeloff, 1999	WI	suppression of fire	---	suppressed burning, suppressed burning, logging	JP	JP	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Pinto, 2008	ON	industrial land use	---	---	P	M	+	+	+	+	-	-	-	-	-	-	-	-	-	-
Leadbitter, 2002	ON	selective logging, suppression of fire	---	---	M	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VanDeelen, 1996	MI	logging, wildlife management	---	---	C	C, A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jackson et al., 2000	ON	suppression of fire	---	suppressed burning	P	B	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Jackson et al., 2000	ON	suppression of fire	---	---	M	M	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Suffling et al., 2003	ON	logging and slash fires	26 yrs	suppressed burning	P	H	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Suffling et al., 2003	ON	logging and slash fires	26 yrs	---	C	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Whitney, 1987	MI	fire proliferation after deforestation	172-342 yrs	---	P	P	+	+	+	-	-	-	-	-	-	-	-	-	-	-
Whitney, 1987	MI	fire proliferation after deforestation	172-342 yrs	---	P	P	+	+	+	-	-	-	-	-	-	-	-	-	-	-

Discussion

Effects on tree species and dominance

- Suppression of fire has created conditions difficult for pine to regenerate.
- A lack of pine has allowed for other hardwood species to become increasingly dominant, most notably in this study maple and aspen.
- Oak has also increased in frequency in pine forests. While both oak and pine prefer the soil conditions fire provides for seedling regeneration, the seeds of each species react very differently to fire. Jack pine cones need intense heat to open, while oak acorns are very moist and do not survive the heat of fire.
- Without fire, oak can safely sprout with lack of competition from jack pine (Tirmenstien, 1996).
- Changes in forest composition may change food sources or habitat for wildlife.

Management suggestions

- To eliminate aspen in jack pine forests where aspen has rapidly increased in dominance, Leadbitter (2002) suggests clear-cuts of aspen stands to allow jack pine to better regenerate.
- Prescribed fire may help decrease frequency of less fire adapted species and restore forests to their pre-settlement condition.
- Working directly with Native American populations can increase understanding of indigenous fire management techniques and help restore the forests to pre-settlement conditions (Miller *et al.*, 2010)

Future research

- Focus on the change in frequency in other conifer species such as cedar and hemlock could still be further investigated.
- Full implications of the effect forest composition change has on wildlife, such as dispersion patterns, are yet unknown.
- Expanding knowledge on the impact that fire suppression has had on soil composition and nutrition could also be beneficial.
- Identifying gaps in current information to develop a greater understanding of the complexity of Lake States forest ecosystems is key to restoring and preserving our forests.

References

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