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## Abstract

Red pine (*Pinus resinosa*), eastern white pine (*Pinus strobus*) and jack pine (*Pinus banksiana*) are major components of upland mixed pine forest ecosystems in eastern Upper Michigan. Prior to European settlement (late 1800s), these ecosystems comprised approximately 40% of the region; however, the distribution and extent of these forests have been greatly reduced due to past timber harvesting, agricultural conversion and fire suppression practices during the 20th century. Consequently, these forest ecosystems are of great conservation priority and in need of restoration. Before we can develop restoration strategies for these ecosystems, more detailed information on their successional dynamics is needed, including a better understanding of the extent and impacts of past timber harvesting. Using historical timber harvesting records dating from 1935 that are included in the annual narratives of Seney National Wildlife Refuge (SNWR), we identified the species, timber volumes, and locations of past timber harvests. Past harvesting locations were focused primarily on addressing SNWR wildlife objectives and other refuge developments such as pool construction, particularly during the past 30 years. Jack pine and aspen (*Populus* spp.) were the primary species harvested, and most was removed as pulpwood. In terms of red pine and white pine, a total of 2,077,518 bd ft was removed from 1935 to 2007, with most being harvested during the 1950s, 1970s and early 1980s. Currently, several different silvicultural treatments (e.g., group selection, shelterwood) are being utilized in some areas at SNWR to regenerate these stands and restore stand structure. Prescribed fire is also being integrated into these treatments to maintain those red pine and white pine stands that presently still have a high degree of ecological integrity. Future research will include comparing how these managed stands compare both structurally and compositionally with naturally regenerated red pine and white pine stands that experience frequent surface fires (14 to 33 years).

## Introduction

In the northern Lake States, timber harvesting has altered the species composition of many forest ecosystems. In mixed pine ecosystems, longer lived red pine and white pine have been replaced by the shorter lived jack pine and aspen. As part of a larger study examining the role of fire and past management of mixed pine forest ecosystems of Upper Michigan, our goal in this study was to examine the past timber harvesting activities in the region to determine how these activities have influenced current stand composition, structure, and fuel loadings.

In this poster we examine the past harvesting history of Seney National Wildlife Refuge (SNWR) which is located in the eastern part of the Upper Peninsula of Michigan (Fig. 1). The 95,238 acre refuge is part of the Seney Sand Lake Plain Ecoregion containing mainly mixed pine ecosystems with scattered northern hardwood stands. Prior to Refuge establishment, most areas of SNWR were harvested following European settlement in the late 1800s (Fig. 2). Our analyses of fire history also suggest that larger, stand replacing fires were more common during this period.

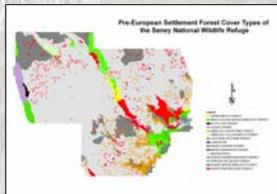


Figure 1: Map of Seney National Wildlife Refuge

Timber harvesting has been a part of SNWR's forest management since its establishment in 1935. The Refuge's main objective was to provide habitat for migratory birds. In the early years the trees harvested were in the areas that would be flooded to create pools for the water fowl. This timber was either sold for a profit or used to create structures around SNWR. As early as 1945 SNWR started to manage the forest ecosystems of the Refuge for wildlife, and was one of the first refuges to start this practice. Initially, jack pine and aspen stands were harvested to create younger stands to promote wildlife species that utilize early successional habitat (Fig. 3).



Figure 2: Pre-European settlement mixed pine forest of Upper Michigan. These forests were harvested in the late 1800s and the slash left behind often resulted in large stand replacing fires. After these fires, jack pine tended to dominate these forests.



Figure 3: Typical timber harvesting operation of a jack pine stand in the 1930s likely originating following the first cutover of mixed pine forests in the late 1800s in Upper Michigan.

## Objectives

1. Determine timber harvesting intensities of different species at SNWR from 1935 to present, with a particular emphasis on mixed pine forests.
2. Determine the periods of intensive harvesting and explore potential reasons for these events.

## Methods

The annual narratives and timber harvesting receipts of SNWR have been kept since the SNWR's establishment in 1935. These records were reviewed to find the following for each harvest: location, species, volume, year and general notes. This data was entered into a database and analyzed to characterize past timber harvesting activities at SNWR.

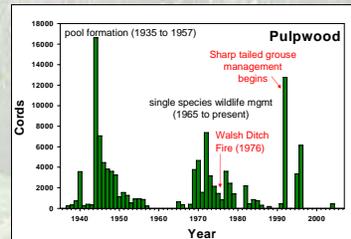


Figure 4: Pulpwood harvested for all species combined from 1935 to 2004.

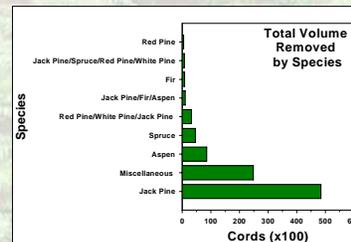


Figure 5: Most harvested species at SNWR, for each species the left column volume is in cords and the right column is on board foot.

## Results: Total Volume Removed

Total volume includes harvested volumes from both hardwood and softwood species. The forests of SNWR had two main periods of increased harvesting, one in the 1940's and one in the mid 1970's (Fig. 4), and overall jack pine was the most common species harvested (Fig. 5). These two periods were associated by an increase in the need for pulpwood and the stands maturing to a merchantable size following turn of the century logging activities and associated slash fires that tended to favor jack pine establishment (Fig. 6).

## Results: Species

As time progressed, timber harvesting practices of SNWR also went through cycles that favored certain species including jack pine and aspen (Fig. 6). Years with low pulp prices for jack pine caused harvesting to decline and by the 1950's most of the waterfowl habitat (e.g., large pools) had been created, resulting in fewer timber sales at SNWR. Timber harvesting began again at SNWR in the mid 1960's and lasted until the late 1970's. After this time period harvesting was limited to the promotion of certain wildlife species through the manipulation of forested stands (e.g., small openings for sharp tailed grouse). Currently, harvesting is being used in conjunction with prescribed fire to promote red and white pine regeneration on portions of SNWR.

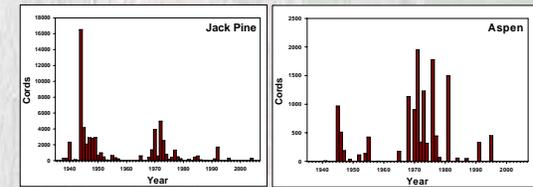


Figure 6: Yearly volumes of jack pine and aspen harvested at SNWR. The volume units is cords.

## Legacy of Past Harvesting

The timber harvesting at SNWR has maintained some areas of the Refuge as early successional forests. Currently, the younger stands usually have higher fuel loads and less structural diversity than the original mixed pine forest ecosystems. The future management of these forested stands should incorporate silvicultural methods, in association with prescribed fires, that emulate natural disturbance to help restore these mixed pine ecosystems (Fig. 7).



Figure 7: Red pine stand following prescribed fire. Note the low fuel loadings and open understory.

## Acknowledgements

Thank you to the staff of Seney National Wildlife Refuge for their assistance in reviewing the annual narratives and past timber harvesting records.