

Ecology of Hemlock (*Tsuga canadensis*) in Algonquin Provincial Park, Ontario and Ungulate Browsing

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We investigated size and age gaps in eastern hemlock (*Tsuga canadensis*) populations of Algonquin Provincial Park. Several hypotheses are proposed, each involving a period of high seedling mortality or limited seedling establishment. The hypotheses are seed predation, seedling establishment, hare browsing, ungulate browsing, stem exclusion and canopy suppression. We classified 216 randomly placed 0.04 ha plots by stand type, aspect, cut/uncut, lakeshore/non-lakeshore and deeryard/non-deeryard. All stems ≥ 5 cm dbh were recorded by: species, diameter, height, and age. All hemlock seedlings and saplings < 5 cm dbh were recorded by: height; age at ground level; percentage of seedling damaged by browsing; and whether hare or ungulate browsed. We measured 5159 stems ≥ 5 cm dbh from 25 species and 19,794 hemlock seedlings < 5 cm dbh. A gap was present in the age structure with a distinct scarcity of stems between 40 and 125 years of age. The ungulate browsing hypothesis had the most support, as the gap was most distinct in deeryard-non-lakeshore sites, and least distinct in non-deeryard-lakeshore sites. Past browsing by white tailed deer (*Odocoileus virginianus*) had limited hemlock recruitment in former deeryard areas, while moose (*Alces alces*) browsing appears to be limiting hemlock recruitment in upland areas and extending the age gap. There was little support for the other hypotheses. Sugar maple appears to be replacing hemlock, especially in areas with heavy browsing pressures.

We tagged 2000 hemlock seedlings in 1992 and monitored them for 5 years. Variables recorded included seedling leader growth, diameter at 10 cm height, height loss from browsing, percentage of the seedling damaged by browsing and mortality. Environmental variables measured include percent canopy closure and snow depth for one season. After five years, 8.5% for the seedlings were dead from browsing, decline, or physical damage from logging operations. Height growth increased with greater initial seedling height, and was greatest at 60% and least at 100% canopy cover. Moose browsed 11.9% and snowshoe hares browsed 1.7% of all seedlings annually. Mean height losses were 10% of a seedling's initial height. Of the seedlings browsed each year, 42% had not been previously browsed. At current browsing and growth rates, few saplings will be able to grow out of the reach of moose and recruit into the canopy, except for areas with low browsing pressure.