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White-tailed deer activity reconstructed from tree-rings in eastern boreal Canada

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Abstract

We evaluated the potential of tree-ring techniques for the reconstruction of recent and past seasonal activity of introduced white-tailed deer in a boreal environment of eastern Canada. Hoof scrape scars on balsam fir stems and trampling scars on roots were used to reconstruct deer activity during the winter and snow-free seasons, respectively. Tree damage showed that there was continuous deer activity in the north-central part of Anticosti Island since the mid-1960s. High scrape scars along tree stems (3–3.5 m from the ground) indicate that 1975, 1976, 1981, 1983 and 1985 were years of intensive food search by deer on high balsam fir foliage. The annual number of hoof scrape scars was low between 1982 and 1985, when severe defoliation by the spruce budworm, combined with deer browsing, led to high fir sapling mortality, food depletion, degradation of the winter shelter forests and a decrease in deer activity. The lowest scrape scars 50 cm above ground correspond to the mean height of the residual snowpack in the shelter forest at springtime, when deer start searching for food in nearby open sites and use logging roads, where dead and bonsai-like fir predominate due to overbrowsing. The trampling scar age frequency distribution from two sites indicated that deer activity during the snow-free season started synchronously in the late 1960s. In response to degradation of winter shelter forests, deer may have moved from the southern part to the north-central part of the island and other sectors to survive. Deer-induced tree damage and tree-ring techniques can thus be used to reconstruct past seasonal activity of white-tailed deer.

Keywords: *Abies balsamea*; White-tailed deer activity; Tree-rings; Browsing; Hoof scrape and trampling scars; Balsam fir growth-forms

1. Introduction

The impact of large herbivores like caribou, moose and deer on native forest vegetation varies greatly in time and space (Pimlott, 1963; Bergerud and Manuel, 1968; Bergerud, 1980; Messier et al., 1988; Caughley and Gunn, 1993; Fuller and Gill, 1991; McLaren and Peterson, 1994; Rooney, 2001). In confined environments like islands, the introduction of large animals has caused severe damage to pristine ecosystems and tree regeneration (Huot, 1982; Leader-Williams, 1988; Brandner et al., 1990; Potvin et al., 2003; Chouinard and Filion, 2005). Ever since its introduction on Anticosti Island (Fig. 1A) at the end of the 19th Century, white-tailed deer (*Odocoileus virginianus* Zimmermann) experienced rapid population growth and reached almost 127,000 heads (mean density of 16 deer km^{-2}) during the last decades (Rochette et al., 2003). As a result, the structure and composition of native forest vegetation on the island changed drastically during a rather short period of time (Potvin et al., 2003; Chouinard and Filion, 2005).

White-tailed deer on Anticosti Island is far from its natural range in the remote, mixed and deciduous forests of eastern North America. Nowadays, the species thrives in a full boreal environment in absence of predators and under moderate hunting pressure. No detailed accounts exist on the demographic status of the species on the island although deer is said to maintain a fairly large population size from year to year (Potvin et al., 2003). However, annual deer mortality fluctuates greatly, and the changing snow environment is likely responsible for the large population drops reported repetitively each year. Boreal winters on Anticosti Island are associated with thick snow packs maintained by the maritime influences of the Gulf of St. Lawrence (Villeneuve, 1967).

Since its early introduction on the island deer has reduced forage abundance to a point which may compromise its long-term survival. Compared to moose and caribou, deer herbivory

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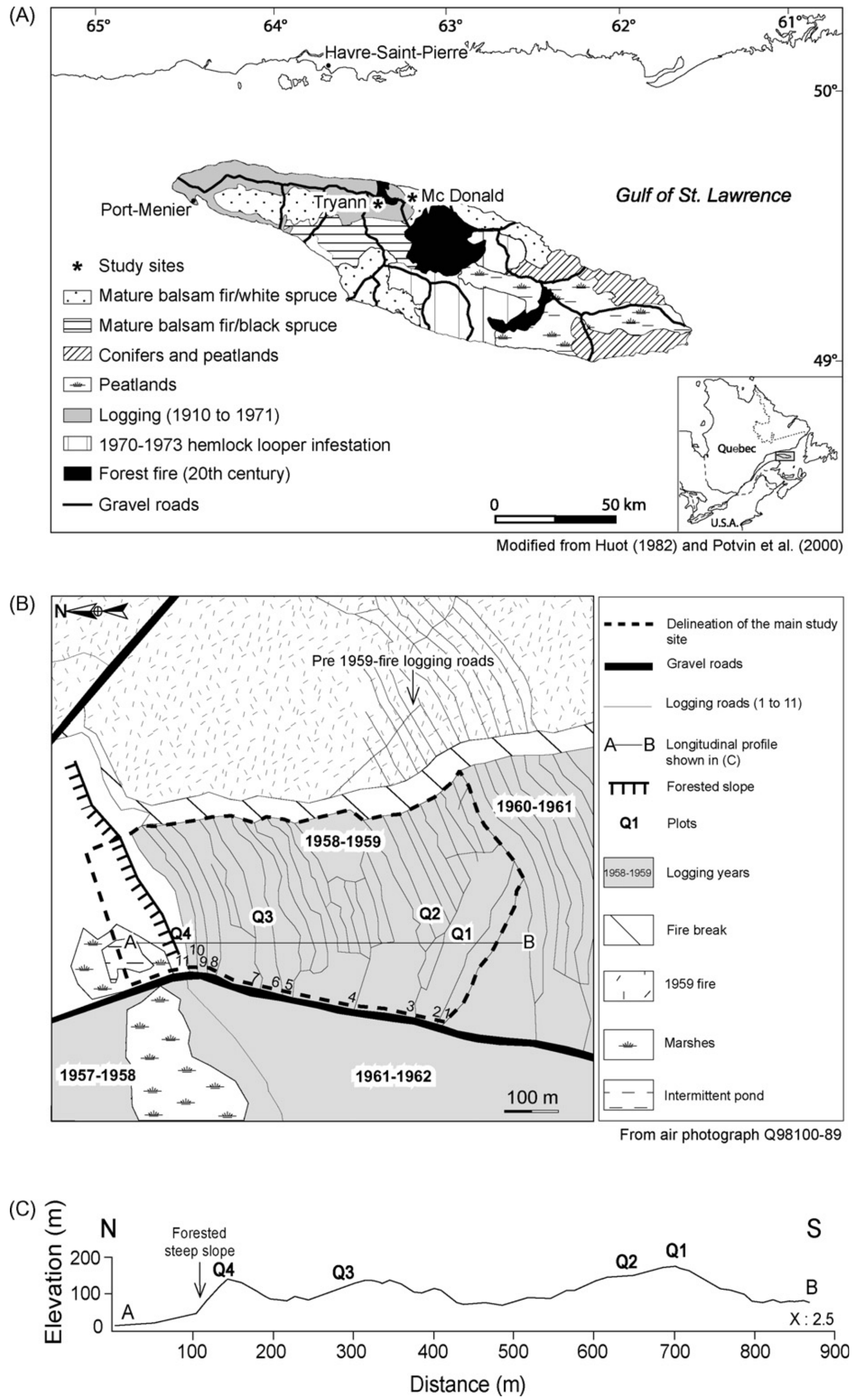

Fig. 1. (A) Location of the study area and sites. The map of Anticosti Island shows the main vegetation types and disturbances. (B) Map of the main study site (Tryann). The forest regenerated after logging in 1958–1959. Nearby areas were affected by a fire in 1959 and by logging (1960–1962). The position of the four plots (Q1–Q4) used for tree population surveys is also shown. (C) North–south longitudinal profile of the study site with the four plots.

is by far the most destructive (Crête et al., 2001) as it is able to eradicate the seedling and sapling bank necessary for forest regeneration (Chouinard and Filion, 2005). Changes in plant communities related to deer overabundance and overbrowsing have been documented since the 1930s (Rousseau, 1950; Pimlott, 1963). Several shrub species such as Canada yew (*Taxus Canadensis* Marsh.) and mountain maple (*Acer spicatum* Lam.) were extirpated and the abundance of other species was greatly modified (Potvin et al., 2000). For instance, the abundance of white cedar (*Thuya occidentalis* L.), edible cranberry-tree or pimbina (*Viburnum edule* Michx.) and yellow clintonia (*Clintonia borealis* Ait. (Raf.)) has decreased (Viera,