DISTURBANCE HISTORY OF OLD-GROWTH RED SPRUCE STANDS IN NORTHERN MAINE: LINKING TREE-RING AND STEM-MAPPED DATA

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The aim of this study was to reconstruct the detailed history of natural disturbance for three old-growth, mid-elevation red spruce stands in northern Maine. By linking dendroecological methods and stem-mapped data, we estimated the actual area encompassed by particular disturbance events, as well as their frequency and location within stands.

We conducted the work in the Big Reed Forest Reserve, which at *ca.* 2000 hectares is thought to be the largest remaining contiguous tract of old-growth forest in New England. Unlike many small, isolated old-growth stands that may not be representative of the surrounding landscape, the Reserve supports forest communities, soils, elevation ranges, and topographic settings typical of northern Maine. Thus, it affords a unique glimpse of forest structure, composition, and processes that represent what forests of this region might have been like in the absence of disturbances associated with European settlement and subsequent development.

Three 50-by-50 m spruce-forest plots from a larger study were selected for intensive sampling here. The X and Y coordinates were recorded for all living and dead trees (individuals ≥ 10 cm diameter at breast height [dbh]) and saplings (individuals ≥ 2 m in height but < 10 cm dbh) within each plot. For each living tree we recorded dbh, total height, height to base of the live crown, crown class (dominant, co-dominant, intermediate, and overtopped), and stratum. To determine canopy projection area for each tree, we measured the horizontal distance from bole center to the canopy drip line in four cardinal directions.

We found no evidence of stand-replacing disturbance in these three spruce stands. The disturbance dynamic appears to have two components: pulses of moderate-severity disturbances caused by host-specific disturbance agents (i.e. spruce budworm, spruce bark beetle) interposed upon a background of scattered small-scale canopy gaps, presumably from wind damage. Consequently, rates of disturbance fluctuated considerably over time; however, they rarely exceeded 35% of canopy area lost per decade. The overall mean decadal disturbance rate was 10.1%. Gap areas, even during peak decades of disturbance, were apparently too small or too densely occupied by advance spruce regeneration to admit shade-intolerant species, although at times they did admit mid-tolerant species. Spruce trees clearly benefit from relatively small canopy gaps scattered in space and time: 80.6 % of trees showed one or more releases before canopy accession. Thus, this pattern of disturbance maintains red spruce dominance of the canopy. Reconstructed gap areas reveal that, following budworm outbreaks, gaps were both larger and more numerous. Gap areas thus calculated were generally smaller (median 25.3 m^2, mean 46.7 m^2) than those from other *Picea* forests.