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Regeneration of Upper-Elevation Red Oak in the White Mountains of New Hampshire

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ABSTRACT

Northern red oak occurs in limited amounts with a mixture of softwoods on the shallow soils at upper elevations in northern New England. These stands are important for wildlife habitat and forest diversity as well as a modest amount of timber harvesting. Little experience or research is available on how to regenerate upper-elevation oak. However, an examination of a 35-year-old clearcut on an upper slope of the Bartlett Experimental Forest reveals successful oak regeneration. We describe the species mix and tree sizes in the clearcut stand, the species composition and advanced oak regeneration in the adjacent uncut portion of the stand, and suggest methods for regenerating upper-elevation oak.

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KEY WORDS: northern red oak, oak regeneration, clearcutting

INTRODUCTION

Northern red oak (*Quercus rubra*) is an uncommon species in the White Mountains of New Hampshire and in other mountainous regions of northern New England. It is found in moderate amounts at low elevations, often with a component of eastern white pine (*Pinus strobus*), on the outwash sands and gravels in the valley bottoms. Past agricultural activity is partly related to its presence in these low-lying areas. However, the species is also found on southern to western exposures on dry, upper mountain slopes where the soils are fairly shallow with areas of exposed bedrock coupled with sections of deeper tills; these sites are similar to those recognized by Kabrick et al. (2008). Other species on these sites commonly include a mixture of red spruce (*Picea rubens*) and hemlock (*Tsuga canadensis*) as well as northern

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hardwoods. Elevations range from roughly 1000 to 2000 feet above sea level. Individual oak trees may attain diameters of 30 inches or more on these sites. Some suggest that the presence of red oak may be partly due to the past occurrence of occasional fires on these dry upper slopes; through its sprouting ability, oak is favored over other species in areas prone to fire.

Although these oak stands sometimes are not commercially attractive due to the shallow soils and difficult logging conditions, there is considerable interest in maintaining the species, or even expanding the populations, on these upper slopes for wildlife values and diversity objectives.

However, oak is notoriously difficult to regenerate even in its normal geographic range. The species depends on advanced regeneration prior to harvest. Acorn crops occur sporadically; most surface acorns are consumed by small mammals, and browsing by deer is severe (Brose et al. 2008, Marquis et al. 1976, Ward et al. 2006). Moreover, on the dry, shallow sites supporting upper-elevation oak stands, there is little or no experience with regenerating the species. The gradual disappearance of oak on these upland sites becomes more likely since fires, which still occur occasionally on these upper slopes, are rapidly extinguished.

Several of the upper-elevation sites on the Bartlett Experimental Forest in New Hampshire contain mixed oak-conifer-hardwood stands. One of these sites (Expansion Compartment E2) was clearcut in 1977. The harvest, a complete clearcut that removed most trees 2 inches (diameter at breast height, 4.5 ft above ground [d.b.h.]) and larger, was about 40 acres in size and extended up into the partially shallow soils at an elevation of about 1800 to 1900 feet that supported one of these mixed oak stands. Recent examination of this clearcut, now 35 years old, revealed that it supported a surprising component of dominant oak in mixture with the usual early successional northern hardwoods. It presented an opportunity to determine, to the extent possible, the conditions that led to this success.

METHODS

In the summer of 2012, beginning at the upper end (approximately 1900 feet elevation) of a west-facing portion of the clearcut, five cruise lines were run, about 1 to 1.5 chains apart, from an uncut portion of the stand, just above the clearcut, down into the clearcut. Three prism plots (20 factor) per line were in the uncut stand, which presumably represented conditions similar to the those in the upper portion of the clearcut prior to harvest. In addition to a tally of the overstory (4.5 inches d.b.h. plus), red oak advanced regeneration was tallied on four milacres per prism plot. If present, this tally was planned to include the smallest seedlings up through stems 4.4 inches d.b.h. In the clearcut, up to 16 prism plots (10 factor) were tallied (trees 2-plus inches d.b.h.) per line at half-chain intervals down the slope; four were excluded due to a residual overstory. Basal area per species was recorded as well as the d.b.h. of all red oak and the d.b.h. of the largest tree of all other species in the prism plot. In summary, there were 15 prism plots in the uncut stand and 60 milacres, coupled with 70 prism plots in the clearcut. The portion of the clearcut stand sampled was about 5 acres. Regenerated oak was still present below the study area (further away from the uncut stand), but in lesser numbers.

RESULTS

The <u>uncut</u> stand had an average basal area of 11 ft^2/acre of red oak coupled with 36, 43, and 27 ft^2/acre of hemlock/red spruce, beech (*Fagus grandifolia*), and red maple (*Acer rubrum*), respectively (Table 1). The oak ranged in size up to 24 inches d.b.h. (Fig. 1). The advanced reproduction of red oak under the uncut stand averaged about 480 stems per acre; most of these were about one-half foot tall; a few (approximately 83 per acre) were in the 1.0 to 1.5-foot range. Only 23 percent of the milacres contained any advanced oak.

The <u>clearcut</u> stand had an average basal area of 21 ft^2/acre of red oak, coupled with 19, 23, and 17 ft^2/acre of beech, red maple, and paper birch (*Betula papyrifera*), respectively (Table 1). The most striking feature of the clearcut stand was the size and dominance of the red oak

Table 1.—Stand characteristics of the uncut and clearcut stands in Expansion Compartment 2, Bartlett Experimental Forest, New Hampshire. Trees 4.5 inches d.b.h. and larger in the uncut stand; 1.5 inches d.b.h. and larger in the clearcut stand.

Measure	Beech	Yellow birch[a]	Sugar maple[a]	Red maple	Paper birch	Hemlock/Red spruce	Red oak	Pin cherry[a] plus other	All
Uncut basal area (ft^2/ac)	43	5	12	27	--	36	11	--	134
Clearcut basal area (ft^2/ac)	19	4	1	23	17	2	21	14	101
Average d.b.h. of the largest tree per species per clearcut plot (inches)	3.4	3.7	3.3	4.4	5.7	5.1	7.1	4.7	N/A

[a] Yellow birch (*Betula alleghaniensis*), sugar maple (*Acer saccharum*), pin cherry (*Prunus pensylvanica*).

Figure 1.—View of the uncut stand showing the size of the red oak. Photo by M. Yamasaki, U.S. Forest Service.

(Fig. 2). The average of the largest oak per plot was 7.1 inches, while the largest beech, red maple, and paper birch averaged 3.4, 4.4 and 5.7 inches, respectively. The oak ranged up to 10 inches d.b.h. Oak was present on 80 percent of the prism plots and there was an estimated 112 oak stems per acre. Only one oak appeared to be of sprout origin (one double-stemmed oak), therefore, the oak must have developed from advanced regeneration present at the time of harvest. Only three large residual oaks were seen in the clearcut stand (not part of the 21 ft^2 of basal area) and two large stumps. So, advanced regeneration probably was not plentiful at the time of harvest. Additional examination of this question seemed warranted.

Figure 2.—View of the dominant oak stems in the clearcut stand, now 35 years old.
Photo by M. Yamasaki, U.S. Forest Service.

The number and size of the advanced oak regeneration in the uncut stand (480 per acre, all no more than 1.5 ft tall) appeared to be minimal—possibly too few and too small to repopulate a clearcut if repeated again today. None of the advanced stems were large enough to be considered competitive (either 3-plus ft tall or a root-collar diameter greater than 0.75 inches) under the best available rules (Brose et al. 2008). Possibly, there had been a decline in advanced oak regeneration in the uncut stand since the clearcut was completed. So to gain a better perspective on typical amounts of advanced oak regeneration, a survey was made in a small adjacent stand of mixed oak on another, nearby shallow site (nine 20-factor prism plots and 36 milacres). This stand had an average basal area of 22 ft^2/acre of red oak, and supported oak trees over 30 inches in d.b.h. The stand had an estimated 2028 stems per acre of advanced oak regeneration in the half-foot-tall range, and 389 that were 1 ft tall. However, even though abundant, none of the stems qualified as "competitive" under the rule described above. Milacre plot stocking was 50 percent.

CONCLUSIONS

Apparently, it is possible to successfully regenerate red oak on these somewhat shallow, upper elevation sites with clearcutting (Kabrick et al. 2008) if advanced oak regeneration is present. Generally, there is enough natural disturbance at these upper elevations to provide small openings conducive to the maintenance of a limited amount of advanced oak. Small clearcut patches, removing as much understory as possible, should work as well as, or better than, larger harvests. Partial cuts/ shelterwoods probably would produce severe competition from beech. The site examined in this study had some rock outcrops, but seemed amenable to patch-cut harvests under current-day standards. The site should have a south to west aspect, and contain advanced oak regeneration 0.5 to 1.5 ft tall. In laying out the harvest, target the areas with the most advanced regeneration. The required number of advanced oak to provide full or acceptable stocking is questionable: up to about 2500 stems would seem to be safe; possibly fewer would be acceptable.

If sufficient advanced oak is not present in an uncut stand, but there are two to three or more seed trees per acre, it may be possible to encourage advanced oak. Possible approaches include underburning with a light fire; some losses might occur to the merchantability of the remaining trees. Another possible approach would be an understory biomass harvest after seedfall with feller-buncher equipment to remove the low shade, scarify the soil, and bury the dropped acorns. Some very light removals of overstory trees might be necessary to ensure a merchantable harvest, but even light removals will begin to encourage a beech understory.

This long-term example indicates it is clearly possible to successfully regenerate upper-elevation oak. Opportunities for additional research are certainly needed although long-term examples such as this are difficult to find.

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