CHESTNUT REPLACEMENT IN THE SOUTHERN HIGHLANDS

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Reprinted from *Ecology*, Vol. 36, No. 2, April, 1955

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Blight-killed chestnut (*Castanea dentata* (Marsh.) Borkh.) is being gradually replaced in the western North Carolina section of the southern highlands, and a knowledge of the species replacing it is one of the most important problems facing regional ecologists. Permanent cruise lines established in 1934 at the Coweeta Hydrologic Laboratory, in the mountains of western North Carolina, are among the few sets of undisturbed plots in the region that span the period during which chestnut was reduced from a major component of the forest stand to a rarity. Re-cruises in 1941 and 1953 on Watershed No. 41 show that yellow-poplar has been the most important of the replacement species. Ecologic trends here are similar to those on several other analyzed Coweeta watersheds.

Watershed No. 41 was cut between 1918 and 1923, with a lower cutting limit of 15 inches on the stump. It is known that there have been no fires in the area since 1918, and grazing was gradually reduced from that period until 1933, when it was completely stopped.

Watershed No. 41 was typed in 1934 as predominantly oak-chestnut, with areas along the creek channel classified as cove-hardwood. The seventeen $\frac{1}{5}$-acre plots that fall within this watershed form a line transect extending from the bottom of the watershed to the top—3250 to 4250 feet—perpendicular to the general slope and crossing the two main branches of the stream on the watershed.

The most striking change during the 19-year interim is the decrease in stand density in a forest which, because of the heavy cutting between 1918 and 1923, ordinarily should have approached a denser stocking. The principal reason for this occurrence is the gradual reduction of chestnut from approximately 41 per cent of

TABLE I. *Basal area and stems per acre on Watershed 41 in 1934, 1941, and 1953*

(All stems of tree species 0.5" d.b.h. and larger)

Species	Basal area (sq. ft.)			Stems (number)		
	1934	1941	1953	1934	1941	1953
Chestnut (*Castanea dentata* (Marsh.) Borkh.)	53.34	38.48	0.90	464.1	363.2	41.2
Hickory (*Carya* spp.)	18.80	16.11	20.70	138.2	153.8	182.4
Chestnut oak (*Quercus prinus* L.)	10.49	10.14	14.19	75.9	73.8	61.8
Northern red oak (*Quercus rubra* L.)	9.83	9.68	5.18	73.8	62.9	24.7
Black oak (*Quercus velutina* Lam.)	9.57	10.65	17.94	21.2	34.4	71.2
Yellow buckeye (*Aesculus octandra* Marsh.)	4.20	4.37	5.06	8.2	8.5	8.8
White oak (*Quercus alba* L.)	4.19	4.92	2.75	26.5	28.2	33.2
Black locust (*Robinia pseudoacacia* L.)	3.90	3.42	2.06	36.8	48.5	16.5
Yellow-poplar (*Liriodendron tulipifera* L.)	2.94	5.54	12.98	95.3	141.8	152.1
Red maple (*Acer rubrum* L.)	2.00	2.47	3.72	57.0	56.1	56.5
Sweet birch (*Betula lenta* L.)	1.98	2.07	2.96	15.0	15.0	25.3
Scarlet oak (*Quercus coccinea* Muenchh.)	1.50	2.17	6.94	4.7	14.1	10.9
Miscellaneous	6.22	7.30	8.02	135.7	153.5	150.4
Total	128.96	117.32	103.40	1152.4	1153.8	835.0

the basal area in 1934 to less than one per cent in 1953. The release was so gradual that the crowns of the older trees filled out without providing extensive openings in which reproduction could become established.

The cruise data indicate that northern red oak has shown a decrease in both basal area and number of stems per acre during the 19-year period, while black oak has increased more than would be expected. It is difficult to ascertain whether this difference is real or apparent. The change in number of stems per acre was principally in the size classes under 5 inches DBH—size classes in which black oak is difficult to distinguish from red oak. The fact that two of the cruises had only winter characteristics to rely upon, coupled with the known hybridization of these two species in the southern highlands, suggests that a summation of northern red oak and black oak values in Table I is most indicative of the real change in the 19-year period.

Observations indicate that the decrease in black locust was primarily the result of several patches of reproduction being suppressed and later killed by the locust leaf miner.

Most of the species responded favorably to the openings left by chestnut. Yellow-poplar increased from 3 to 13 square feet basal area between 1934 and 1953 and increased in number of stems per acre with many of the yellow-poplars now occupying dominant and subdominant positions in the crown canopy. The oak species in general showed an increase. Although white oak decreased in basal area, the decrease was due to the loss of overmature trees from the stand, and the remaining stems plus reproduction will adequately balance the loss. Hickory species and red maple—to the chagrin of forest managers—also show evidence of replacing chestnut.

The plots were too large to give detailed information on invasion by new species. However, sourwood (*Oxydendrum arboreum* (L.) DC.), cucumber magnolia (*Magnolia acuminata* L.), sweet birch, yellow birch (*Betula alleghaniensis* Britton), and eastern hemlock (*Tsuga canadensis* (L.) Carr.) had invaded areas by 1953 in which they were not present when chestnut was a major component of the stand.

Although it is too early for an equilibrium to be established, the trend to date indicates that chestnut is being replaced primarily by the advancement of species which were codominant with chestnut and secondarily by invasions and the advancement of subordinate species, especially yellow-poplar.

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