
Reproduction of Woody Plants in the Absence of Grazing

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The floodplain community in the Oliver Wildlife Preserve has been studied by Penfound (1948) and by Rice and Penfound (1956). In 1948, the dominants were green ash and American elm, although both were exceeded by cottonwood in the basal area. In the 1956 analysis, the green ash was found to be the dominant tree with an importance percentage about three times that of its major associates: American elm, persimmon, and cottonwood. According to Rice and Penfound (1956), "The considerable number of dead trees, the meager number of saplings, and the data from previous studies demonstrated that this forest has been deteriorating since 1948." Although no analyses were made subsequent to 1956, this deterioration apparently continued until late 1961 when the grazing animals were removed.

The present investigation was designed to determine the time and amount of reproduction of all woody species in the Oliver Wildlife Preserve. Three areas of study were utilized: (1) The inner (wet) portion of the floodplain forest in which green ash was almost the only tree present; (2) the outer (moist) portion of the forest in which bur oak, green ash and hackberry were dominant; and (3) a bermuda grass pasture just east of the forest. This pasture comprised a very dense sward of bermuda grass and very few red cedar and pecan saplings in 1961.

METHODS

The wet and moist portions of the forest were both sampled by means of 50 quadrats of 0.05 m² each. These quadrats were dispersed every 20 paces along predetermined lines of traverse. In each quadrat the species, number and age of each seedling (or sapling) were determined. The species are listed in Table I according to Waterfall (1961). From these data relative frequency, relative density and number of seedlings per acre were calculated. In the bermuda grass pasture, a similar procedure was followed except that 140 quadrats of 0.25 m² each were utilized. A comparison of subsamples of 25 quadrats each in the forest plots indicated that 25 quadrats constituted an adequate sample.

The wet (inner) part of the floodplain forest included very few species but a great number of individual seedlings (Table II). Only four

TABLE I. A LIST OF SPECIES WHICH PRODUCED NUMEROUS SEEDLINGS IN THE OLIVER WILDLIFE PRESERVE

Scientific Name	Common Name
<i>Acer Negundo</i>	Box elder
<i>Bumella lanuginosa</i>	Chittamwood
<i>Carya illinoensis</i>	Pecan
<i>Celtis laevigata</i>	Hackberry
<i>Fraxinus pennsylvanica</i>	Green ash
<i>Morus rubra</i>	Red mulberry
<i>Prunus angustifolia</i>	Sand plum
<i>Rhus radicans</i>	Poison ivy
<i>Smilax Bona-nox</i>	Greenbrier
<i>Symphoricarpos orbiculatus</i>	Coralberry
<i>Ulmus americana</i>	American elm
<i>Viburnum rufidulum</i>	Black haw

TABLE II. FREQUENCY AND NUMBER OF TREE SEEDLINGS PER ACRE IN THE BOTTOMLAND FOREST IN THE OLIVER WILDLIFE PRESERVE. BASED ON 50 QUADRATS OF 0.05 m².

Species	Relative frequency		Seedlings per acre	
	Wet	Moist	Wet	Moist
Green ash	61.8	20.0	710,500	37,174
Sugarberry	25.0	31.5	51,701	55,009
American elm	11.8	12.9	19,584	14,844
Red mulberry	1.5	1.5	1,567	1,690
Poison ivy	—	12.9	—	33,982
Greenbrier	—	10.0	—	30,602
Other species (4)	—	12.1	—	14,645
Totals	100.1	99.9	783,352	187,746

species of woody plants were represented by seedlings and only three species (green ash, sugarberry and American elm) were either frequent or abundant. On the basis of distribution (frequency) or number of seedlings, green ash was the predominant species. In many places, it was impossible to walk without stepping on one-year-old ash seedlings (Table IV).

The moist (outer) portion of the sanctuary comprised seedlings of 10 woody species but with fewer individuals per species than the wetter area (Table II). Five of the six common species had a relative frequency of 10 or more and comprised a considerable number of seedlings per acre (Table II). However, the number of seedlings of green ash in the moist portion was meager compared to the number in the wet section (Table II). In order of decreasing number of seedlings per acre, the order was as follows: sugarberry, green ash, poison ivy, greenbrier and American elm. The abundance of poison ivy and greenbrier in the moist area contrasts strongly with the absence of these vines in the wet portion of the sanctuary (Table II). This absence is due, undoubtedly, to the wet, and often flooded, condition of the wet part of the preserve.

The number of seedlings of woody species in the bermuda grass pasture was much lower than that in the forest plots (Tables II and III). This was due, probably, to the competition offered by the bermuda grass. In order of decreasing abundance, the tree seedlings were as follows: American elm, sugarberry, sand plum, green ash, pecan, chittamwood and box elder (Table III). This order suggests that the future forest will

TABLE III. FREQUENCY, DENSITY, AND NUMBER OF TREE SEEDLINGS PER ACRE IN A BERMUDA GRASS PASTURE ON THE EAST SIDE OF THE OLIVER WILDLIFE PRESERVE. BASED ON 140 QUADRATS OF 0.25 m² EACH.

Trees	Relative Frequency	Relative Density	Seedlings Per Acre
American elm	35.5	37.4	4,277
Sugarberry	25.8	23.2	2,659
Sand plum	17.7	25.3	2,890
Green ash	9.7	6.1	694
Pecan	4.8	3.0	347
Chittamwood	3.2	3.0	347
Box elder	3.2	2.0	231
Totals	99.9	100.0	11,445
Shrubs and vines			
Coralberry	82.4	84.3	8,670
Poison ivy	11.8	9.0	925
Black haw	2.9	4.5	462
Greenbrier	2.9	2.2	231
Totals	100.0	100.0	10,288

TABLE IV. NUMBER OF SEEDLINGS OF VARIOUS AGES IN A TOTAL OF 50 QUADRATS OF 0.1 m², IN THE BOTTOMLAND FOREST OF THE OLIVER WILDLIFE PRESERVE. W, WET PART; M, MOIST PORTION.

Species	Age groups in years									
	One		Two		Three		Four		Five	
	W	M	W	M	W	M	W	M	W	M
Green ash	406	11	30	7	3	2	1	3	—	—
Sugarberry	23	7	2	3	2	6	1	15	2	1
American elm	7	2	3	—	—	—	—	4	2	—
Poison ivy	—	21	—	—	—	—	—	—	—	—
Greenbrier	—	19	—	—	—	—	—	—	—	—
Totals	436	60	35	10	5	8	2	22	4	1

be less hydric than the potential forests on either the wet part or the moist portion of the current bottomland forest. It seems probable, however, that the sand plum will be eliminated as the forest develops.

Of the shrubs and vines, coralberry was much the most important (Table III). It should be pointed out, however, that many of the shoots, here counted as seedlings, were off-shoots of established colonies. If all the coralberry shoots are counted as seedlings, the total number of seedlings of shrubs and vines approximates that of the trees (Table III).

The number of one-year seedlings in the forest plots was much greater than that of any other age group (Table IV). In general the number of seedlings decreased from the one-year age group to the five-year-old plants. A possible reason for this trend, especially in the wet portion of the forest, was the possibility that seedlings may have been destroyed by flooding especially in June, 1962; July, 1963; and May, 1964. The number of seedlings, especially in the one-year-old group, was greater in the wet portion of the forest (482) than in the moist area studied (101). Except for the number of one-year seedlings of green ash, the number of young plants was similar in any given year (Table IV). An interesting exception is the abundance of young seedlings of poison ivy and greenbrier in the moist portion of the preserve and their complete absence elsewhere.

Although seedlings of eleven woody species were sampled in the bermuda grass pasture, data on ages are presented for only the four commonest species. It will be observed that the number of seedlings decreased gradually from the one-year group to the five-year-old class. The reason for this decrease is probably related to competition since the possibility of flooding was not present (Table V).

DISCUSSION

The number of seedlings per acre for the three study areas was as follows: wet part of forest 783,000; moist portion of forest 187,000; and bermuda grass pasture 21,000. Aikman and Smelser (1938) indicated a reproduction count per acre of only 2,200 in the floodplain community. Buell and Wistendahl (1955) reported the following number of seedlings and saplings per acre (3.9 inches dbh or less): terrace 43,700; inner (wet) floodplain 2,710 and outer (moist) floodplain 5,140. These counts were much lower than in our floodplain forest study. It should be pointed out, however, that reproduction by seeds in the Oliver Wildlife Preserve had been prevented by livestock prior to the growing season of 1962, and that a very open forest was thus available for invasion at that time. The number of tree stems per acre in shortleaf pine stands declined from 19,008 in nine-year-old stands to 180 in a 70-year stand (Turner 1936). It seems probable that a similar number of trees (180) might be expected in these bottomland stands at a comparable age.

TABLE V. THE AGES OF COMMON SEEDLINGS SAMPLED IN THE BERMUDA GRASS PASTURE OF THE OLIVER WILDLIFE PRESERVE.

Species	Age Groups in Years				
	One	Two	Three	Four	Five
Coralberry	55	16	2	2	—
American elm	11	10	11	4	1
Sugarberry	10	5	2	5	—
Sand plum	14	8	2	1	—
Totals	90	39	17	12	1

SUMMARY

1. The reproduction of woody species was studied in two bottomland forest plots and a bermuda grass pasture in the Oliver Wildlife Preserve during the spring of 1966.
2. In the bottomland forest, the number of seedlings per acre was very high in the wet portion (783,000); high in the moist portion (187,000); and moderate in the pasture (21,000).
3. In all plots, one-year-old seedlings were very abundant, but the number of woody seedlings declined gradually to the five-year age group.
4. The tremendous number of seedlings in the forest plots is ascribed to the open condition of the stand due to grazing by livestock.

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