

ABSTRACT OF THE THESIS

Litter Accumulation Through Ecosystem

Development

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Ecosystem development on the New Jersey Piedmont passes from a stage dominated by annuals to a stage characterized by perennial forbs, which in turn develops independently into stages composed of either broomsedge grass, bayberry shrub, or successional forest, or into a system characterized by a mosaic of these stages. The grass and shrub stage converge into successional forest, which develops into a mature mixed oak forest. Sites representing these 6 vegetationally and structurally different stages were selected and litter production, decomposition, and accumulation measured from September 1971 to March 1973.

Litter was at a minimum in all sites during August 1972 and thus unbiased comparisons were made among sites. The perennial fields showed large variation in litter biomass, the amount of dead organic matter, with values ranging from 154-434 gm m⁻² for sites abandoned for 6, 12, and 22 years. A one way ANOVA revealed no statistical difference between the combined L and F litter layers among grass and shrub sites both abandoned for 31 and 82 years and forest sites 31, 82, 150, and 275 years old. A temporary steady-state condition is estimated at approximately 460 gm m⁻², suggesting a structural convergence regardless of vegetation structure. The amount of woody twigs increased linearly with age, from 0 gm m⁻² in the grass sites to 400 gm m⁻² in the mature forest.

Two patterns of litter accumulation were observed. In some fields, there was a rapid build-up from an annual field with 16 gm m^{-2} to a perennial field with 434 gm m^{-2} . Other perennial sites show a temporary stabilization around 200 gm m^{-2} followed by a second rise to the steady-state condition at approximately 30 years. The slower 2-step rise was related to lower soil moisture conditions and subsequent reduced net primary production.

Litter production was measured by using either permanent plots or litter traps. Yearly production ranged from 287 gm m^{-2} in the annual field to 750 gm m^{-2} in bayberry shrub and mature forest sites. Perennial fields abandoned for 6 and 12 years produced 350 and 676 $\text{gm m}^{-2} \text{ yr}^{-1}$; successional forests and broomsedge grass sites averaged 425 and 475 $\text{gm m}^{-2} \text{ yr}^{-1}$ respectively. Litter production of herbaceous tissue in the successional forests was much less than in the late perennial forb or grass sites due to a greater deviation of energy to woody tissue. The ratio of the combined leaf and fragmented litter biomass/production was 1.58, 1.55, and 1.43 for 2 successional and 1 climax forest, suggesting a functional steady-state condition for these stages. For all sites, litter production appears to be the major factor controlling litter biomass.

Decomposition rates were obtained for each site using 15 x 15 cm fiberglass litter bags which contained a mixed composition of species in order to simulate the actual litter present in an ecosystem. Fifty-eight per cent of the initial weight was lost in the first year from bags placed in the annual and perennial field sites while only 35% was lost in the grass and shrub sites; the successional forests (39 and 48%) and the climax forest lie in between.

Varying the bag size and the amount per bag had no effect on