

Abstract

Production and decomposition are crucial biogeochemical cycles in nature. Despite numerous studies on these processes in forest ecosystems, little attention has been given to the herbaceous layer. This study aimed to fill this knowledge gap by investigating the dynamics of biomass production and decomposition rates of herbaceous plant species in oak-hornbeam forests. The following research hypotheses were formulated: (H1) the biomass of the herbaceous layer would undergo seasonal changes, with the highest biomass recorded in May, (H2) the contribution of the herbaceous layer to the annual net primary production (ANPP) would not exceed 5%, (H3) the decomposition rate of herbaceous plant litter would be higher than that of trees leaf litter from oak-hornbeam forests and would not exceed one year, (H4) spring ephemerals biomass would decompose the fastest, while summer-green plants biomass would decompose the slowest, (H5) the decomposition and nutrient release rates of herbaceous leaf litter would be significantly faster than those of stem litter. The study was conducted during four years (2012-2015) in an oak-hornbeam forest located in the Czmoń Forest District (W Poland).

During the study, it was found that the seasonal dynamics of herbaceous layer biomass showed a single-peak pattern, starting in spring and extending into early autumn, contradicting previous studies that suggested a bimodal biomass dynamics (H1). Additionally, the contribution of herbaceous biomass to the annual litterfall production was 9.23% of the total litterfall and 13.86% of the labile fraction during the three growing seasons studied, which was higher than previously described in the literature (H2). The decomposition rate of summer-greens was similar to that of leaf-litter from trees (H3). Complete decomposition of herbaceous plant-litter did not always occur within a year, challenging previous findings that suggested all herbaceous-litter belonged to the labile fraction of litter. The decomposition and nutrient release rates were highest for spring ephemerals (H4), and the decomposition rate and N and C release from *Alliaria petiolata* leaves biomass were approximately six times faster than those from *A. petiolata* stems biomass (H5).

The obtained results highlight the importance of the herbaceous layer in forest ecosystems, emphasizing the need for its protection. They also indicate a lack of comprehensive knowledge about its functioning, debunking some previously held

assumptions. Therefore, further research and dissemination of knowledge regarding the ecological significance of herbaceous layers in forests are encouraged.