

Public Abstract

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Title:A MULTI-DIMENSIONAL INVESTIGATION INTO THE EFFECTS OF FLOODING ON THE PHYSICAL, CHEMICAL AND BIOTIC PROPERTIES OF RIPARIAN SOILS

The need for wetland preservation and restoration has become increasingly apparent in recent years. In order for these efforts to be successful, however, understanding soil abiotic and biotic influences on ecosystem processes and vegetational patterns is essential. Studies have shown that flooding and subsequent anaerobic decomposition of plant materials may be responsible for the accumulation of phenolic compounds in soils which in turn may contribute to N deficiencies in plants. The objectives of this project were to characterize the effects of flooding on soil chemical and microbial properties, and to evaluate how changes in these soil properties affect the survival and growth of riparian species. A three-tiered approach that included simulated floods in a greenhouse and in a field-based, flood tolerance laboratory (FTL) as well as a riparian forest inventory was used to address these questions. Experiments in the FTL and greenhouse included characterization of environmental variables such as redox potential and pH as well as soil chemical and microbial analyses. Measurement of redox potential, which provides information on the relative oxygen status of the soils, revealed that anaerobic soil conditions developed regardless of flood type. Flooding did not affect soil total organic C or total N; however, residue additions in the greenhouse simulations increased total organic C and total N over control treatment levels. In both simulations, NH₄-N and phenolic compounds accumulated in flooded soils. Redox potential was positively correlated with NO₃-N and negatively correlated with NH₄-N and soil phenolic levels. Changes in soil NH₄-N and phenolic content with flooding are likely to be temporary; phenolic levels declined over the last two weeks of the simulated greenhouse floods. In addition, NH₄-N and phenolic levels declined under dry-down conditions in the intermittent flood treatment in the greenhouse. A follow-up germination study revealed a negative relationship between phenolic content and percent germination and shoot length. Microbial community structure changed with flooding under greenhouse but not field conditions (i.e., FTL). Microbial biomass, the response of microbial groups and enzyme activity decreased under stagnant flood conditions; while stress indicators increased. These changes may have implications for decomposition reactions. Microbial responses in the FTL varied with soil type, sampling depth, and sampling date. Floodplain investigations using distance from river as a proxy for flood frequency revealed no trends in inorganic-N, phenolic content or ground flora characteristics with increased flooding. However, microtopography (i.e. slope and elevation) affected soil NO₃-N, total organic C and total N. Herbaceous and woody understory vegetation were negatively correlated and responded differently to microtopographical variables as well as TN. Site differences contributed to these results, necessitating additional studies for confirmation of relationships.

Changes in microbial community structure and function as well as the accumulation of TSP with flooding may affect nutrient availability and thus negatively affect plant species establishment following flooding. Of particular note is the effect of stagnant flood conditions on mycorrhizal fungi. Fungi are important decomposers of recalcitrant C compounds, such as lignin, within the soil. Therefore, a decline in fungal response may affect nutrient availability for plants. In addition, many plants rely on mycorrhizae for enhanced nutrient and water absorption; therefore, loss of mycorrhizal associations may have implications for plant establishment and survival.