THE EFFECT OF NUTRIENTS ON WETLAND VEGETATION

QUESTION 3

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DO THE EFFECTS OF NUTRIENTS OUTWEIGH THE BENEFITS OF SEDIMENT DIVERSIONS?

Most scientists would agree that, in theory, diversions can help build wetlands. However, the water brought into the system by diversions contains pollutants from upstream sources, such as nutrients. Some researchers have questioned whether the harmful effects of nutrients carried into the system by river water could cancel out the benefits of diversions.

OUR ANALYSIS

We reviewed a number of documented effects of nutrients on wetlands. In so doing, we examined several theories about how excess nutrients could harm vegetation. For example, some researchers have proposed that adding nutrients speeds up root system decay in wetland plants, which would make Louisiana's wetlands more susceptible to sea level rise. While much research on this subject remains to be done, we were able to draw some conclusions.

WHAT THE SCIENCE SAYS

Coastal wetland systems are affected by an array of stressors, including flooding, salinity changes, and nutrients. All of these stressors act on the system in combination, and the effects of nutrients should be evaluated in combination with these factors rather than in isolation.

Plants are affected by excess nutrients in a variety of ways. Many studies have shown that increased nutrient loadings decrease the ratio of belowground tissues (roots plus rhizomes) to above ground shoots. However, the absolute production of roots and rhizomes increases as nutrient loading increases. Contradictory results have been found when evaluating how nutrients affect plant responses to flooding. Adding nutrients appears to increase select species' resistance to flooding while decreasing other species' resistance. Given the range of plant responses, it is difficult to draw simple cause and effect conclusions about nutrient effects. We do know that plant species do not benefit equally from nutrient enrichment, and that river diversions will change the competitive interactions among plant species as well as the composition and locations of plant communities. Moreover, river diversions will reduce salinity, and this too will shift plant species. In certain areas, species typical of salt or brackish water habitats will lessen in favor of freshwater species.

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One of the key factors to keep in mind about marsh health is elevation, or how high the marshes are situated above water. In general, high marshes are healthy because they are better able to resist flooding and they have stronger root systems. The fresh water and nutrients put into the system by diversions have the potential to increase the productivity of plants and reduce salinity. These factors, in turn, could help wetlands trap sediment, thereby raising surface elevation. There is ample empirical evidence that vegetation typical of coastal wetlands can thrive when sedimentation rates are experimentally raised. This line of reasoning supports the utility of diversions.

Some studies have shown that added nutrients accelerate the decomposition of plant root systems in certain kinds of soil, but we found conflicting views in the literature about this claim. Another question about nutrients, particularly nitrates, concerns their effects on the sustainability of peat marshes. In our view, mineral sediment and nutrients will likely change plant community composition in peat dominated wetlands, resulting in a marsh community that can build elevation more quickly and thus be more resilient to storms and high tides. The creation of lower salinity wetlands by diversions can result in weaker soils because lower salinity marsh soils have fewer live roots than higher salinity marsh soils. However, lower salinity marshes can recover from disturbances with relative speed because the vegetation in these marshes includes perennial plants that reproduce quickly and convert open water to emergent marsh.

The focus on the sustainability of a single landform—peat marshes—can also be misleading. Peat marshes, like other deltaic landforms such as bay bottoms, active deltas, and barrier islands, are not sustainable by themselves. Instead, all of these landforms are built by and degrade within the larger deltaic cycle. By seeking to replicate a version of this natural cycle, diversions offer the best long term option for nourishing marshes and other landforms. In order to create the varied salinities that most coastal plants and animals prefer, diversions could be operated in pulses; the flow of water could be increased from late summer through late fall, and the flow would be halted or reduced in other seasons. This approach would mimic the natural flooding cycle and allow periodic salt intrusion.

IMPLICATIONS FOR POLICY MAKERS

Diversions will have impacts on vegetation, particularly on the locations of some plant species. However, without diversions and other methods for introducing sediment-rich fresh water into the ecosystems of coastal Louisiana, the wetlands will degrade to open water. Thus, the effect of nutrients is not significant enough to offset the larger benefits of diversions for coastal Louisiana, particularly if diversions are pulsed to maximize sediment introduction.

- Climate change will make the restoration and maintenance of coastal wetlands more difficult. Rising sea level will lead to both more flooding and salinity increases. The risk of losing large wetland ecosystems to these stressors outweighs the potential harm posed by nutrients.

- Marshes receiving high levels of both sediments and nutrients are more stable. Diversions should be designed to convey as much sediment and freshwater and as many nutrients as possible, so that marshes with stronger soils will be formed.

- In areas without access to river water, energy intensive restoration techniques, such as building marshes by piping in sediments, will become more costly in future years. These areas can receive increased nutrient rich fresh water through other sources (e.g., pump stations, streams, assimilation wetlands).

- The effectiveness of sediment diversions will depend on the concentration of sediments in the diverted water, the volume of discharge, how the sediments are distributed, and how rapidly the receiving area is subsiding.