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# Freshwater-Intermediate Marsh Plant Responds to Increased Water Depth

Vegetation patterns in wetland habitats are influenced by biological (e.g., competition, herbivory) and physical (e.g., water flooding depth) factors. Increased water depth depletes soil oxygen that in turn affects plant metabolism and growth. Whereas some freshwater emergent, herbaceous marsh plants temporarily increase growth in response to increased flooding, others reduce or cease growth.

## Consequences of Stress From Flooding

Wetland plants that survive and adjust to flooding may have reduced vigor and, consequently, lowered productivity. They may become more susceptible to additional stressors such as increased salinity, resulting in increased population mortality. In Louisiana, where more than 40% of the coastal wetlands of the contiguous United States are located, wetland loss is a major resource management issue. Based on wetland-loss rates through the 1970's, projected annual rates in Louisiana in the 1980's were 100 $km^2$/year to 130 $km^2$/year. Analyses of aerial photographs, however, indicated that the actual annual loss was 66 $km^2$/year between 1983 and 1990. Inland marsh fragmentation and loss, as opposed to shoreline erosion, is considered the main cause of large-scale and widespread habitat change in Louisiana.

## Study of a Common Marsh Plant

*Sagittaria lancifolia* is a common perennial in coastal Louisiana marshes and composes about 15% of vegetation cover in fresh (< 0.5 ppt) and 7% in intermediate (0.5 to 5.0 ppt) marsh types. We studied the effects of flooding on *S. lancifolia* by manipulating water depths in a marsh in the Barataria Unit of the Jean Lafitte National Historical Park in Louisiana. Sods were dug from the marsh and replaced at lower elevations of 7.5 and 15.0 cm in relation to the surrounding marsh surface. We monitored plant growth during two summers and compared it with the growth of plants that were dug up and replaced at their original elevations (disturbed control plants). We also monitored environmental physical parameters, namely, soil redox potential, salinity, and concentrations of soil interstitial water sulfide and nutrients. Differences were considered significant when $P \leq 0.05$.

## Plants Alter Growth Form

The growth form but not the standing crop (aboveground dried biomass) of plants exposed to increased flooding (decreased elevation) was affected. Maximum and mean stem heights ($n = 18$) were significantly greater in the 15-cm treatment plants than in disturbed control plants. These differences were established early in the first growing season and were apparent at first measurement in the following year (Fig. 1). Analyses of tissue elemental concentrations indicated that the 15-cm treatment plants had significantly lower concentrations of Cu, Fe, Na, and Zn in the leaves.

## Affected Physical Environment

Interstitial water around the roots of plants in the 15-cm treatment had significantly higher concentrations of K, Mg, Mn, Na, and P and higher salinity and conductivity. However, Fe, Zn, and the mean redox potential (Eh, a measure of electron availability) were significantly less at the greater water depths of 7.5 and 15 cm. Trends of increasing sulfide, a phytotoxin, and increasing ammonia–nitrogen concentrations with greater water depth were apparent (Fig. 2). Reduced forms of Fe and Zn react with hydrogen sulfide and produce insoluble sulfide compounds, which are probably the cause of lowered concentrations of these elements in the interstitial water.

## Management Implications

Although the altered growth form by itself does not indicate that *S. lancifolia* was harmed by increased water depth, other data substantiate that the conditions of the experiment may represent a threshold level of stress that, if exceeded, will reduce biomass. Plant root biomass—but not rhizome biomass—decreased in the 15-cm treatment. Mature *S. lancifolia* has thick, extensive rhizomes that persist for many years, and a below-ground growth response to stress would probably first be manifested in young root material. The decreased nutrient concentrations in young leaf tissue and the increased ammonia and nutrient concentrations in the interstitial water indicated reduced nutrient uptake by plants in the 15-cm treatment. Nutrient uptake, an active process, would be affected by a lowered energy status, which is associated with metabolic changes in response to stress from flooding.

Common marsh management activities, such as impoundment and freshwater diversion, may increase water depth. Factors that should be considered before management that alters water depth is implemented include flooding tolerance of existing plant species and, if the area is sparsely vegetated, the germination requirements and flooding tolerance of species in the seed bank.

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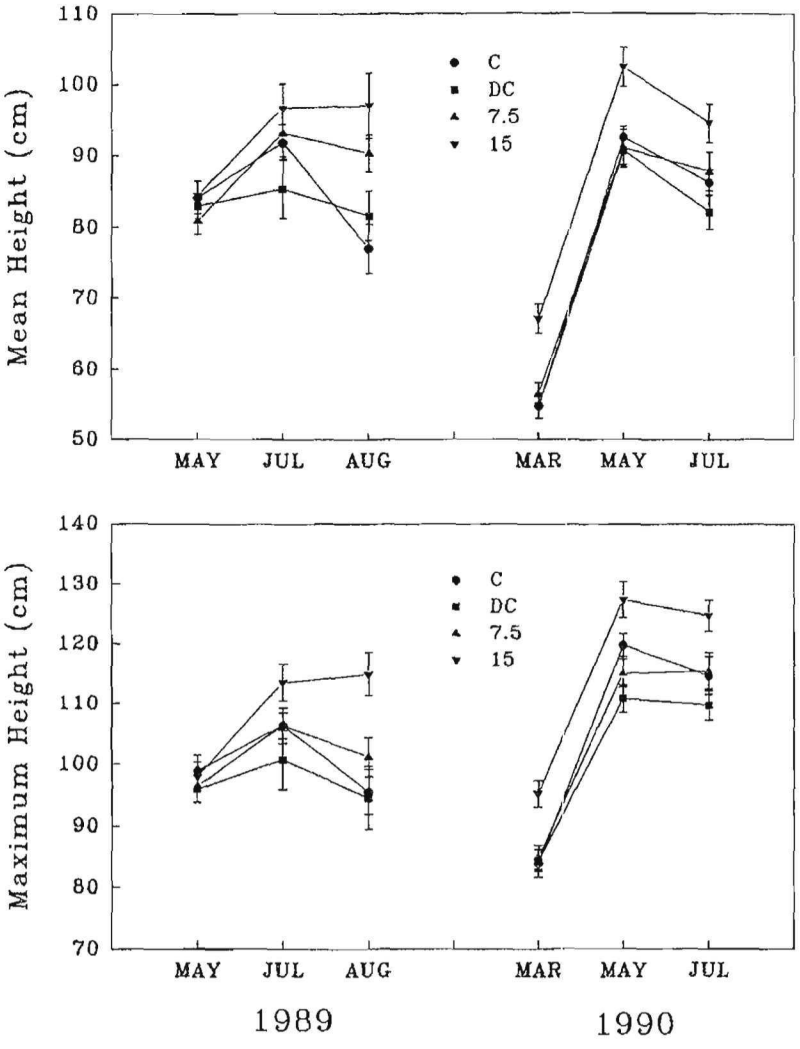


**Fig. 1.** Mean and maximum stem heights of *Sagittaria lancifolia* in a marsh in the Jean Lafitte National Historical Park, Louisiana, during the 1989 and 1990 growing seasons. Treatment symbols: C = control, DC = disturbed control, 7.5 = elevation decreased 7.5 cm, 15 = elevation decreased 15.0 cm.

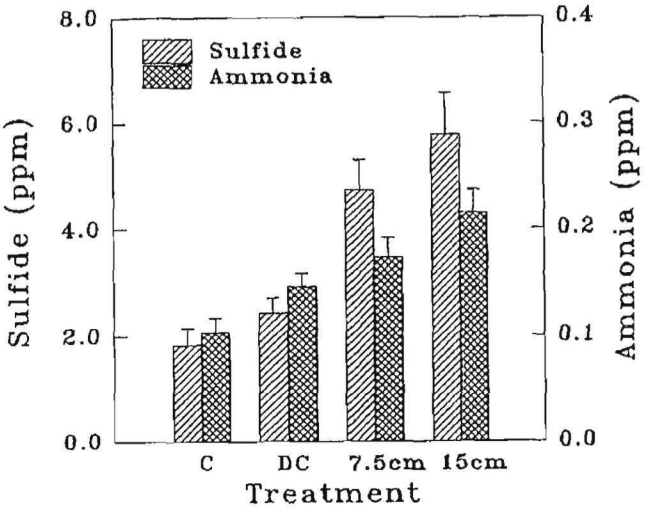


**Fig. 2.** Posttreatment mean concentrations of interstitial water sulfide and ammonia–nitrogen concentrations in a marsh in the Jean Lafitte National Historical Park, Louisiana. Treatment symbols as in Fig 1.