



# Wetter Is Not Always Better: Flood Tolerance of Woody Species

There is debate on the contribution of impervious cover to flood frequency and severity and the degree to which natural wetlands and riparian environments are affected. A related and controversial issue is whether natural wetlands should purposely be used to intercept stormwater runoff. Results of studies on the flood tolerance of herbaceous and woody plants would help in resolving this issue. Drawing on the separate literatures of flood tolerance and wastewater loading, Niering (1990) summarizes the multiple effects of submergence and pollutants on woody and herbaceous species of the Northeast US. The information can be used in assessing the impact of increased impervious cover on natural plant communities or in the design of vegetative buffers for intercepting stormwater runoff.

Studies of flood tolerance are also helpful for designers of constructed wetlands (either for water treatment or loss mitigation) in deciding whether and what woody species can be successfully established. Good choices cannot be made based simply on stereotypical examples of flood tolerant species, such as alder. “Obligate” wetland species do not necessarily have superior flood tolerance. To further complicate the decision, different ecotypes of a single species can respond very differently to flooding (Tiner, 1991 in McIninch, 1994). Furthermore, “wet acclimation” of nursery trees and shrubs before planting does not really improve their chance of survival (McIninch, 1994).

## Multiple Aspects of Flooding

An increase in paved surfaces and greater channelization of streams increases the rate and volume of runoff delivered to streams, thus altering the hydroperiod of wetlands and riparian environments. Groundwater recharge is affected and, typically, the frequency, duration, and depth of flooding in wetlands is increased to some degree. An excess of water—even unpolluted water—is deleterious to plant health and growth as it results in higher or sustained water levels in wetlands and increased soil saturation in upland zones. The severity of these effects depends on the species of plant and on various aspects of the flood: season, degree of soil saturation, flow, rainfall, water temperature, and most especially *frequency, duration, and water depth*.

## Flood Sensitivity of Wetland Plants

In riparian environments, flooding can cause the death of trees. The seedlings of trees are more vulnerable than adults and all are more vulnerable in the growing season. In bogs, floating mats of vegetation survive but the surrounding trees may die. Increased frequency of flooding can lower species diversity by eliminating the herbaceous species. An increase in duration of flooding results in leaf drop, chlorosis, and decreased growth—all not necessarily fatal.

An increase in water depth is significant if the root collar of a tree is covered, inhibiting respiration. This is more significant an impact to the tree than is saturation of the soil and is the reason for seedling sensitivity to flooding. Adults, seedlings, and seeds have different requirements. For example, adult cypress trees are very flood-tolerant; however, periodic fluctuations in water level in needed for the fruit to dry and germinate.

In examining these effects, Niering (1990) uses the forested swamps of New England as an example wetland. Different studies have made apparently contradictory observations on the survival of different woody species. The flood tolerance of species such as red maple, black gum, ash, alder, and buttonbush varies greatly depending on, among other factors, the age of

**Table 1: Survival of Adult Trees in Flooded Wetlands of New England (Whitlow and Harris, 1979)**

| Flood-tolerant | Moderately tolerant | Intolerant      |
|----------------|---------------------|-----------------|
| Black alder    | American elm        | American beech  |
| Black willow   | Basswood            | Black cherry    |
| Red maple      | Bigtooth aspen      | Chinquapin oak  |
| Silver maple   | Hop hornbeam        | Eastern hemlock |
|                | Ironwood            | Paper birch     |
|                | Red oak             | Quaking aspen   |
|                | White ash           | Red spruce      |
|                |                     | Sugar maple     |
|                |                     | White birch     |
|                |                     | White oak       |
|                |                     | White pine      |
|                |                     | Yellow birch    |

Flood-Tolerant: Survive season-long deep flooding  
Moderately Tolerant: Survive flooding/saturated soil for 30 days in growing season  
Intolerant: High mortality if flooded in growing season for more than a few days