Technical Note #22 from Watershed Protection Techniques. 1(2): 79-80

Loss of White Cedar in New Jersey Pinelands Linked to Stormwater Runoff

One of the impacts of suburban stormwater runoff in the New Jersey Pinelands is the conversion of classic Atlantic white cedar wetlands to swamps dominated by hardwoods. Researchers Ehrenfeld and Schneider (1990, 1991) documented the link between human disturbances and vegetative changes at a series of wetland sites defined by differing levels of suburban intrusion. Importantly, they found that cedar wetlands directly influenced by stormwater runoff were much more strongly altered than all other wetland sites.

The cedar swamp is a unique habitat and serves as home to many rare and endangered plants and animals. In New Jersey and other states in the mid-Atlantic region, this habitat is typified by a nearly monospecific canopy of Atlantic white cedar with perhaps small amounts of several deciduous species including red maple, black gum, and sweetbay magnolia. The understory usually contains a variety of shrub species and the undulating swamp floor is carpeted with *Sphagnum spp*. The cedar swamp is a stressful environment, combining extreme acidity with low nutrient availability. The conditions result in a sensitive plant community with low diversity structure.

Virtually all water entering these wetlands is derived from infiltration in the uplands. This tight hydraulic connection assures that upland development will impact the quantity and quality of the water. Constituents of concern include nutrients, chloride, heavy metals, and organic chemicals from sources such as septic systems, lawns, and road surfaces. In addition, impervious surfaces reduce groundwater recharge and influence the seasonal dynamics of the water table. Drainage ditches, and stream channelization also can act to change wetland hydrology.

Ehrenfeld and Schneider defined four groups of sites within the Pinelands to represent a gradient of suburban impact:

- *Control sites* were located within undisturbed watersheds and completely isolated from engineering features associated with development.
- *Near sites* were proximate to, and upstream of, unpaved roads within undisturbed watersheds.
- *Developed sites* were located within suburban developments with septic systems present along the wetland edge.
- *Runoff sites* were located in developed areas, and had stormwater sewer outfalls directly to the wetland.

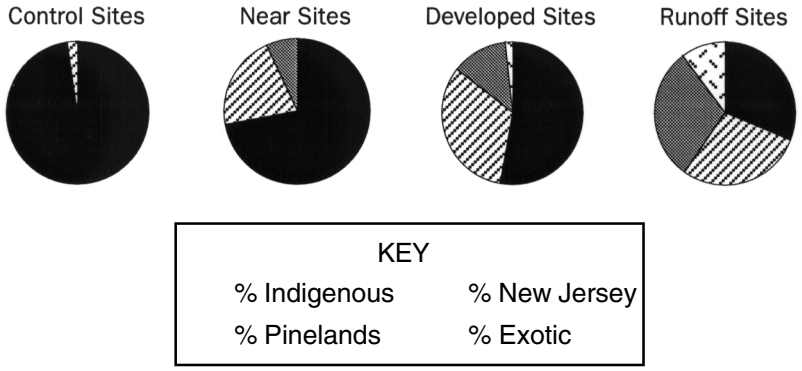
Each individual site chosen for the study (four to five sites within each group) had a closed canopy of white cedar and was sampled for hydrologic, water quality, species composition, and community structure. Table 1 presents water quality data from each of the groups.

Species composition in cedar wetlands is highly sensitive to development. As part of the study, the researchers classified all species observed into four habitat categories: *indigenous* to cedar swamps; found in other *Pineland* habitats; found in non-Pineland

Table 1: Mean Water Quality Parameters Measured During the Growing Season at the Four Site Types - Sample Sizes in Parentheses (Ehrenfeld and Schneider, 1991)

Parameter	Control	Near	Developed	Runoff
Ammonia (µg/l)				
Surface water	3.9 (38)	2.2 (46)	141.3 (18)	229.4 (54)
Ground water	42.1 (50)	98.4 (50)	506.2 (48)	583.3 (60)
Orthophosphate (µg/l)				
Surface water	14.4 (64)	12.5 (88)	7.6 (24)	55.0 (92)
Ground water	11.0 (80)	12.7 (100)	30.9 (72)	68.0 (98)
Chloride (mg/l)				
Surface water	4.71 (40)	6.25 (46)	6.93 (18)	12.99 (54)
Ground water	4.93 (50)	7.04 (50)	16.4 (50)	15.4 (60)

Figure 1: Percentage of Plant Species From Different Habitats Within Each Site Type (Ehrenfeld and Schneider, 1991)



habitats in *New Jersey*; and *exotic* to the state. As shown in Figure 1, the control sites were highly dominated by species indigenous to cedar swamps. However, as development intensity increased, indigenous species were dramatically displaced by species not traditionally associated with cedar swamps. Thus, cedar swamps impacted by development gradually lost species that define their uniqueness.

Reproduction of white cedar itself proved especially sensitive to development stress. Cedar stands in the Pinelands are typically even-aged, reflecting establishment after a large-scale disturbance such as fire, extensive windthrow, or clearcutting. As seen in Figure 2, mean densities of white cedar seedlings were greatly reduced in the developed and runoff sites. The implication is that when the next large-scale disturbance occurs, the current stands will not be replaced by new cedar growth.

This decline in cedar seedlings may be directly related to the decline in *Sphagnum* in these sites. *Sphagnum* is the most common substrate on which cedar reproduction is generally found and holds a large reservoir of buried viable seed. Unfortunately, the plant is especially sensitive to chloride, trampling, hydrological changes, elevated nitrogen concentrations, and other consequences of suburban development. Thus, the loss of the carpet of *Sphagnum* in a cedar swamp may foreshadow the eventually loss of the cedar trees themselves when a large-scale disturbance decimates the stand. The decline of *Sphagnum* cover as a result of increasing runoff is shown in Figure 3.

In summary, the study shows that protecting the integrity of white cedar wetlands requires careful planning to reduce suburban influences. Runoff must be diverted away from the cedar swamp and a buffer area maintained. The health of the *Sphagnum* in a particular swamp can potentially be used as an indicator of the future viability of white cedar wetlands.

—JS

References

Ehrenfeld, J.G. and J.P. Schneider. 1990. "The Response of Atlantic White Cedar Wetlands to Varying Levels of Disturbance from Suburban Development in the New Jersey Pinelands." *Wetland Ecology and Management: Case Studies 63-77.* (Ed. by D.F. Whigham, R.E. Good and J. Kvet). Junk. Dordrecht.

Ehrenfeld, J.G. and J.P. Schneider. 1991. *"Chamaecyparis thyoides* Wetlands and Suburbanization: Effects on Hydrology, Water Quality and Plant Community Composition." *J. Applied Ecology*. 28:467-490.

Figure 2: Mean Densities of White Cedar Seedlings per Square Meter for Each Site Type (Ehrenfeld and Schneider, 1991)

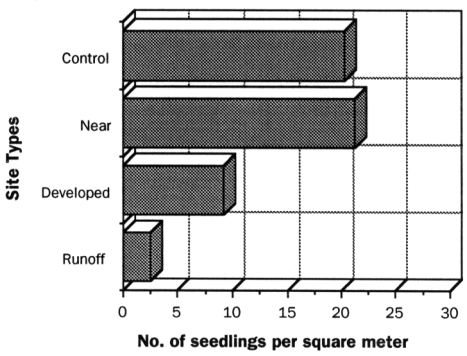


Figure 3: Mean Percent Cover of Sphagnum for Each Site Type (Ehrenfeld and Schneider, 1991)