Restoration and Reclamation Review
Student On-Line Journal
Vol.1, No.5, Spring 1996
Department of Horticultural Science
University of Minnesota, St.Paul, MN

# A Decade of Recovery in Three Wetland Ecosystems:

# Differences and Policy Implications

**Natasha A. Reed**

Research on the structure and function of different wetlands improves our ability to protect and/or restore sensitive areas. As our understanding becomes more complex, however, confusion over regulatory policy threatens to undermine public commitment to wetland protection. The extreme beliefs that a wetland "just needs water" to recover or, on the other hand, that one hundred years may be insufficient, could inspire either a careless attitude or an equally fatal hypersensitivity towards wetland protection.

In the real world, susceptibility to disturbance and amelioration to restoration varies dramatically among the many types of wetlands, although little comparative research data is available. Scientific evidence is needed to evaluate which uses can be allowed without compromising ecosystem integrity; other proposed uses (or, similar uses in more sensitive areas) shown to cause too much damage may then be denied. Policy makers have to make these decisions regardless of the state of the science, but would be aided by proof of how certain types of disturbances affect different types of wetlands.

To this end, data gathered over a ten-year period in northeastern Massachusetts show that resilience in a cattail marsh, a wooded swamp, and a bog decreases respectively as each type attempts to recover unassisted from a similar drastic disturbance. A series of papers documents the study led by Dr. Norton Nickerson, director of environmental studies at Tufts University in Medford, Massachusetts.(1)

Nickerson documented the impact on each of three ecosystem types by construction of a utility line right-of-way. No intervention was made to promote or discourage growth; this was a study of natural recolonization. The primary disturbance consisted of a one-time, massive impact destroying vegetation but leaving soil and surrounding areas intact.

The study sites all are located in northeastern Massachusetts, not far from Boston. They include 1) a 2.59 square kilometer shrub-swamp bog in Tewksbury, 2) a 5.19 square kilometer wooded swamp in North Reading, and 3) a 3.89 square kilometer cattail (*Typha latifolia*) marsh in Wakefield, along the Saugus River. The bog is densely vegetated with *Chamaedaphne calyculate* (leatherleaf) and *Sphagnum sp.* (peat moss) and is within the Merrimack River watershed. Little species specific data was given except for species of concern to utility maintenance crews: *Vaccinium corymbosum*(high bush blueberry), *Betula populifolia* (gray birch), *Rhamnus alnifolia* (alder-leaved buckthorn), *Nemopanthus mucronata* (catberry), *Ilex verticillata* (winterberry), *Rhododendron viscosum* (swamp azalea), and *Pyrus* *melanocarpa* (black chokeberry).The swamp is part of the Ipswich River basin and has a canopy of *Acer rubrum* (red maple) and *Alnus rugosa* (speckled alder) 10-15 m high. A dense shrub layer of winterberry, swamp azalea, and *Clethra alnifolia* (sweet pepperbush) is underlain by hydrophilic herbs and immature trees and shrubs at the lowest layer.

In 1977-78, New England Power Service constructed a 345-kV transmission line through a portion of all three sites. In the bog and the swamp, the transmission line was planned to run parallel to existing power lines built over 40 years before. The researchers established permanent, 10 m2 experimental plots 20 to 30 m apart two years before the construction began in the bog and the swamp. To control for spatial variability, the researchers laid out three replicate plots in each of three areas: at the site of the planned line; under pre-existing lines, and in an untouched control area nearby. Data from each of the three replicates were averaged before analysis. At the cattail marsh, experimental plots were one meter square, with eight replicates under the right-of-way and eight controls, located randomly within the marsh. All vegetation one meter or taller was inventoried before construction and for five consecutive years after, plus at a ten-year follow-up in 1987.

The rights-of-way to the preexisting line had been maintained manually and, in the bog, with herbicides as well to clear tall shrubs and trees. One early paper (Nickerson and Thibodeau, 1984) reports that no maintenance was conducted during the monitoring, but the most recent paper (Nickerson and others, 1989) indicates that two incidents of maintenance occurred in both the swamp (manual tree cutting and mowing) and the bog (herbicides). Although this apparent discrepancy is unsettling, it does not detract from the main conclusions or the bulk of the research data. It does, however, make it difficult to determine whether maintenance itself contributed to depressed recolonization. An interesting experiment would compare the effect of maintenance practices alone (no initial disturbance) to a reference area with no maintenance. It is unlikely that recolonization is affected to any great extent by simple trimming and mowing. Herbicides may produce more lasting effects. High bush blueberry recovered particularly slowly from impact: before construction, almost 2,000 were found in each reference location and only six under existing lines, with many dead clumps evidence of maintenance control. This number increased to 33 after six years of no maintenance, an increase that hardly suggests a robust comeback. Nickerson himself suggests that maintenance practices be revised to exclude removal of high bush blueberry, catberry, winterberry, swamp azalea, and black chokeberry, all shorter-growing species that may be left to grow with no danger to the overhead lines.

To overcome the temporal variability inherent in plant communities, Nickerson and his colleagues sampled consistently over a long time frame (12 years). Sampling was done in the summer at approximately the same time every year (June and July). This aspect is a great asset to the study, adding a level of stability to the data not often available in restoration reports.

Construction consisted of clearing a 125 ft strip of land of all vegetation by removing, crushing, or pushing it underground using heavy equipment. The cattail marsh escaped such severe disturbance as the construction there occurred in winter when icy conditions protected dormant plant material and prevented major soil compaction. Heavy machinery was driven over oak mats laid directly over vegetation and no herbicide use or physical clearing occurred either for initial construction or maintenance, further protecting existing vegetation in the cattail marsh. Nickerson suggests similar methods could be employed as standard practice to reduce damage in other ecosystem types, as well.

Nickerson and his colleagues describe the plant communities of each experimental plot based on total stem counts and numbers of identified species of all vegetation one meter or higher. They analyzed this data using standard measures to describe plant diversity, species richness, and species evenness. Calculations involved the Shannon and Weaver equation for species evenness and an indexing function for heterogeneity, and Margalef's species richness equation. Community composition among the experimental plots was compared using these values.

Data from the first seven years were subject to a one-way analysis of variance (ANOVA). Ten year data were log transformed for normality as well as left untransformed for graphing. When significant differences were found between ANOVA results and other treatments, the authors applied Tukey's honestly significant difference (HSD) test.

There were significant differences in how each wetland type rebounded from the disturbance. The cattail marsh showed complete recovery after two years in both numbers and community composition values. The wooded swamp recovered more slowly, still showing signs of reduced numbers (but not of species richness, diversity or evenness) at five years but not by ten. The bog was the least resilient, with significant numbers of individuals reduced in the cleared and managed areas still at five years. This discrepancy of the disturbed area persisted in the ten-year observation data. Again, however, the overall species measurements recovered more quickly; they were close to values for the uncut region by the fifth year after the initial disturbance.

Assessment of the recovery focused on plant recolonization and includes discussion of the type as well as the number of plant species. Since this was not so much a restoration as an observation of natural recovery, the authors have more comments about the use to which their data might be put than to the evaluation of the recovery itself. They do point out that their results suggest the difficulty of defining a single, complete, measure of recovery, (Nickerson and Thibodeau, 1984) and state specifically that vegetation recovery may or may not be indicative of functional recovery, (1986).(2)

Despite this hesitation, the authors conclude that various wetland types do have differential resilience to construction impacts and suggest that this information should be addressed when planning protection and management strategies (Nickerson and others, 1989). Part of the difference lies in the vegetation community; within a single ecosystem, some species recovered more quickly when given the opportunity. A summary of natural recolonization in the pre-existing bog right-of-way by three species reflects the difference:

| **Plant name** | **Number of plants before construction** | **After seven years of no maintenance** |
|---|---|---|
| High bush blueberry | 6 | 33 |
| Gray birch | 12 | 222 |
| Alder-leaved buckthorn | 0 | 16 |

Some species were quick to respond to the open window of reduced maintenance, others less so. Accordingly, wetland types with a higher composition of sensitive responders will be more delicate overall than a type composed largely of resilient, aggressive colonizers such as cattail.

In the initial study of the wooded swamp (Thibodeau and Nickerson, 1986), researchers report qualitative data on species found in the reference, undisturbed area versus the ever-disturbed right-of-ways (both pre-existing and new). Some species, *Fraxinum nigra* (ash) and *Rhus glabra*, did not return after disturbance while others, Rubus idaeus and cattail, existed only in ever-disturbed areas but not in the undisturbed one. Although the number of species was retained, the type of vegetation for that wetland ecosystem apparently experienced some shift.

This species-specific information was not reported in the ten-year follow up study but it is debatable whether even at that milestone the relatively blind measures of species number and richness would make a distinction between an invasive species (like cattail) just beginning to take hold and another species holding its own only until the challenging invader edges it out. Proper analysis of this situation requires information on the relative vigor of the plant samples collected as well as value judgments that weigh the ecosystem benefits or productive value of one species against those of the other.

Nickerson and his colleagues did not discuss any implications due to the minor (+/- 2.6 km2) size difference among the three wetlands. Because the wetlands are of different types, a hypothetical comparison would require significant additional data to support it; a basic study comparing resiliency of a larger bog to a smaller bog would be necessary before any comparisons could be made between any bog and a larger cattail marsh.

Once resilient types are identified, some uses could be allowed. Electric utilities, specifically, covet wetlands for transmission line corridors because they often are linear, contiguous, undeveloped, and hidden from public view. Unlike with housing or industrial use which transform the landscape, once transmission line construction is complete, the land remains relatively undisturbed.

One of the stated goals of this research was to assess whether existing wetland protection legislation is sufficient or overly restrictive with respect to utility rights-of-way. The authors suggest that current right-of-way management techniques limit the species diversity unnecessarily, but that such use does not constitute a major negative impact on the ecosystem. The authors point out that the problem of successional plants moving into a disturbed area does not seem to be a problem in bog wetlands where the substrate remains substantially unaltered; however, the number of individuals and species remains depressed even after ten years. This interpretation of the data implies that while legislation could be altered to allow certain uses, wetland areas need to be assessed with careful consideration of the type of wetland, nature of the disturbance, and the potential impact of any continued interference, such as line maintenance.

A conservative but flexible approach to wetland management could ease tensions between regulators and land-owners, allowing for the preservation of more delicate areas while realistically addressing development needs and wetland availability. Vigilance for new developments in wetlands research is necessary, however; blind reliance on any one theory of wetland behavior ignores the inherent difficulties and flaws of any scientific research effort.

One major shortcoming of this study may be the lack of data on short-growing species (less than one meter). The report notes that 25 perennial species greater than one meter tall were found in the wooded swamp (Thibodeau and Nickerson, 1986), but no information is available on species or species number under one meter. Especially in a nutrient-limited area such as a bog, plants may be restricted to smaller size; rarer species most highly adapted to such an environment may be the most sensitive to perturbation. If this is so, the full effect of construction activity may have been much more significant than was noted. A follow-up study might be done to look at low-growing species, especially in the bog. The established sampling areas would provide a suitable zone for data collection, given sufficient funding and expertise.

Overall, the project appears a valid description of recovery potential in a sensitive environment coveted by utility companies. While it would seem that the disturbance of established species opens a path for opportunistic species, the nature of the disturbance and perhaps of the environment, as well, may prevent significant community alteration. This positive interpretation, however, is tempered by the understanding that any damage takes many years to recover. The authors point out that, because wetland types differ in their resiliency, regulation must incorporate variable responses to applications for their potential use.

The challenge posed by promising mitigation and restoration efforts raises wetland management to a new level of complexity. Nickerson's study of natural recovery may be considered a base line for analyzing the relative success or failure of human intervention in restoration ecology. Regardless of the outcome of those projects, Nickerson's conclusion remains fundamental to understanding the science and making good wetland management decisions: while some wetland types may absorb an occasional disturbance, others require our absolute protection and avoidance.

## NOTES

1 Various colleagues co-authored different papers using the data from twelve years of observation. For clarity, they are considered here as a single study. Specific papers or authors are noted only when necessary.

2 In their discussion, the authors note that vegetation is an easily studied, short-term parameter. In Massachusetts, as in many states, vegetation composition is part of what is used to define a wetland for regulation purposes.

## LITERATURE CITED

Nickerson, N., and Thibodeau, F. Modification of bog vegetation by power utility rights-of-way. Journal of Environmental Management, 1984: vol. 19; 221-228.

Thibodeau, F., and Nickerson, N. Impact of power utility rights-of-way on wooded wetland. Journal of Environmental Management, 1986; vol. 10; 809-214.

Nickerson, N., Dobberteen, R., and Jarman, N. Effects of power-line construction on wetland vegetation in Massachusetts, USA. Journal of Environmental Management, 1989; vol. 13; 477-483.