Environmental Research and Education Technology for Conservation

NEWS FROM HUDSONIA

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ECOLOGICAL RESTORATION

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The term "ecological restoration" means different things to different people, but in this article I use the term broadly to mean the use of native species and natural processes to establish ecologically functional ecosystems. Restoration projects may involve massive amounts of earthmoving, soil amendments, planting, seeding and extensive maintenance, or they may be as simple as manipulating one or two environmental factors, such as raising the water level in a wetland or reintroducing a key predator species.

The current interest in ecological restoration has been spurred by a growing alarm over the degradation and destruction of many kinds of natural habitats with intrinsic as well as cultural values. Wetlands, streams, prairies, pine barrens, and coastal dunes have all been the focus of significant restoration efforts. There have been enough success stories to illustrate the real potential of habitat restoration as a tool for conservation and ecosystem enhancement. But there have been enough failures and ill-conceived projects to warrant caution and even skepticism among ecologists and environmentalists.

Since the late 1930s pioneers in ecological restoration have restored thousands of hectares of midwestern prairie and oak savannah. Nationwide we are now routinely "restoring" freshwater wetlands and salt marshes in response to regulations associated with the federal Clean Water Act. We have reduced the pollution of water and air and are proud of the recovery of once-threatened animals such as wild turkey, bison, and bald eagle. An increased awareness of the importance of biodiversity conservation in the U.S. has further stimulated the restoration initiative.

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Repair, enhancement, or even replacement of damaged ecosystems is sometimes necessary if we are to conserve the world's ecological function and biological diversity. Ecological restoration, however, is mostly experimental, very expensive, and sometimes controversial; there have been dramatic successes and many failures. Hudsonia is taking a cautious but optimistic approach, conducting biological surveys for restorationists and collaborating on the replacement of habitats for rare species. *E. Kiviat*

1995 - A LOOK BACK

At Hudsonia, we use our knowledge of the biota and habitats of the Hudson Valley to analyze the impacts of environmental projects and management actions. Here are some highlights of our work in 1995 (reports may be requested from Hudsonia).

A citizens' group, **It's Not Easy Being Greene**, invited Hudsonia archaeologist Chris Lindner to review the archaeological survey conducted for a Wal-Mart proposed to be built on the floodplain of Catskill Creek at Leeds in Greene County, New York. The adequacy of the survey conducted by Wal-Mart's consultants, and the potential significance of the architectural finds, have become critical elements in the public debate on the Wal-Mart site.

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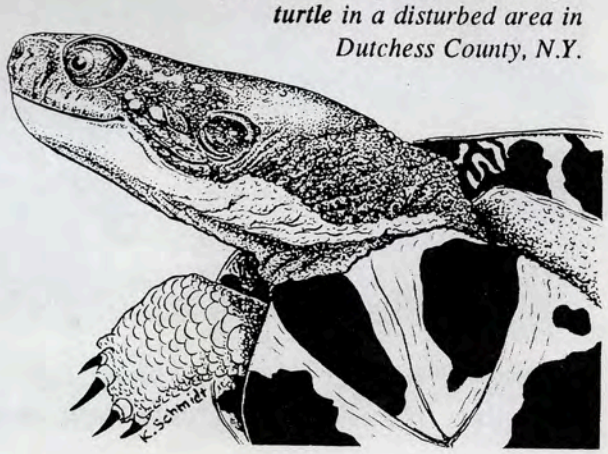
*Hudsonia is helping to develop appropriate habitat for the **Blanding's turtle** in a disturbed area in Dutchess County, N.Y.*



Ecological restoration can have a variety of goals: a return to a prehistoric condition or an historic condition, an improvement in a particular ecological function (e.g. flood storage or water quality amelioration) or group of functions, enhancement of habitat quality or quantity for a plant or animal species or a biological community, a scientific experiment, or a visual effect. The goals of any restoration project should be explicit and provide a solid basis for design, evaluation, and monitoring. In most cases, unfortunately, the success of restoration efforts is not evaluated beyond visual appearance, and long-term success is not monitored at all.

Restoration efforts are complicated by issues of human safety from flooding, fire, landslides, insect outbreaks, dangerous animals, and human diseases. These issues are often addressed by heavy-handed engineering and infrastructure solutions or wildlife management solutions that may be incompatible with the needs of naturally functioning ecosystems. Innovations in ecological management and public education are especially needed to expand restoration initiatives in heavily developed areas. How, for example, can fire be restored to grassland or shrubland ecosystems on the margins of suburban communities of Long Island, southern New Jersey, or the Hudson Highlands of New York? How can floodplain wetlands be restored in developed areas of the Mississippi River corridor and in suburban areas of Westchester County, New York?

WETLAND MITIGATION

The term "wetland mitigation" refers to any measures taken to reduce the adverse impacts to wetlands of development projects. The term thus covers avoidance of wetlands and minimization of impacts, but is more commonly used to mean restoration or creation of wetlands to compensate for wetland loss or degradation. Mitigation is often required by federal and state regulatory agencies if wetlands are damaged by developments. Unfortunately, wetland mitigation often produces low-value wetlands that support neither a full range of local wetland plants and animals, nor the important biogeochemical processes (such as denitrification) of a more natural wetland. This is because many restoration practioners and regulatory agencies take a superficial approach to restoration conception and design. To avoid this problem, restorationists must understand how wetlands of a particular type in the particular region function ecologically. This allows accurate consideration of the trade-offs germane to a mitigation plan, establishment of goals encompassing a fuller complement of ecosystem processes, and appropriate design of replacement wetlands.

"Mitigation banking" is the creation of larger areas of replacement wetlands clustered in a single or a few locations rather than scattered small wetlands adjoining development sites. This scheme potentially allows better control over wetland construction, maintenance, and monitoring. Banking also may allow wetland construction on land (such as mined-out areas or post-industrial land) that does not have special biodiversity values or other important ecological functions.

Environmentalists and ecologists distrust the ways that wetland mitigation and banking are used in the regulatory process. Mitigation can be used to justify unnecessary development because it can appear to achieve the goal of "no net loss" of wetlands. But mitigation wetlands often do not match the array of ecological functions of the lost natural wetlands. Wetland mitigation nonetheless has a place if society has determined, based on thorough assessment and weighing of socioeconomic and ecological benefits and costs, that a supermarket, a better highway, or a residential development is needed.

RESTORATION EXAMPLES

In the 1930s the University of Wisconsin Arboretum decided to recre-

"Before" (L) and "after" (R) photographs of a restoration site at Tibbett's Brook, an urban park in Yonkers, N.Y. The photographs were taken upstream and downstream of the tree in 1991 and 1994.

ate 50 acres of native tall-grass prairie for use in future research in the midst of the suburbs. Restorationists such as Aldo Leopold, Theodore Sperry and the taxonomist Norman Fassett, among many others, were associated with this project, which eventually became known as "Greene Prairie." Thousands of Civilian Conservation Corps members and volunteers transplanted prairie plants by hand, and over the years scientists learned much from the problems they encountered. A major research effort helped the project succeed.[2] The lessons learned about plant community dynamics, fire as a habitat maintenance tool, and soil development have been applied to other projects throughout the Midwest, and today a small industry of restoration specialists, prairie plant growers and wildlife experts is applying the concepts to similar ecosystems.

Another example is the yearly planting of miles of dunes with American beachgrass (*Ammophila breviligulata*). Primary coastal dunes are piles of wind- and water-deposited sand held together by the roots and rhizomes of dune plants, including beachgrass. Where plants are damaged by foot or vehicle traffic, the dunes are vulnerable to wind and wave erosion, and can be destroyed in a single storm. Of course most planting projects are undertaken primarily to protect coastal property and infrastructure from future storm damage. A happy side effect of the plantings, however, is the restoration and protection of ecologically valuable dune habitat which has been decimated as a consequence of intensive coastal development for human uses.

The single most ambitious restoration project under way in the United States is the restoration of the Kissimmee River ecosystem in Florida.[3] This project, sponsored by the U.S. Army Corps of Engineers and the South Florida Water Management District, seeks to eliminate water control structures, remove dredge spoil from the floodplain, fill in canals, and restore more than 70 km of meandering river channel and floodplain wetlands. This would turn the clock back on decades of channelizing and ditching promoted by the Army Corps for flood control. Such endeavors reveal the real price tag of large scale engineering and infrastructure projects of the past - an estimated $100 million or more for the restoration of the Kissimmee alone! This does not include the economic losses caused by the malfunctioning of the system itself over the last 30 years.

Winged monkeyflower, a rare plant propagated and planted at the Annandale restoration site, survives there two years later.

Closer to home, the Army Corps and the New York State Department of Environmental Conservation are planning restoration projects on the Hudson River, with the goal of improving the ecological function of selected areas that were altered by the dumping of dredged material or the construction of the railroads. Actions proposed by the Corps include increasing the circulation of tidal waters to marshes now blocked by fill, and the removal of common reed (*Phragmites*). Lack of good historical information on Hudson River marshes, and the massive physical and chemical alteration of the estuary in the last two centuries, preclude a literal restoration to pre-fill conditions. Also, some of the restoration goals for this project may be mutually incompatible: for example, should vegetated shallows for fish nurseries be restored at the expense of upper intertidal zone habitat for nesting marsh birds? There are also debates about the actual ecological functions of reed-dominated marsh. Nonetheless, the Hudson River restoration program offers opportunities to experiment with restoration methods and conduct research on biological communities and biogeochemistry before and after restoration.

In 1993 Hudsonia collaborated with Creative Habitat Corp. on a stream bank restoration project at the site of the historic Annandale Hotel in Dutchess County, New York. We were asked by the landowner, Historic Hudson Valley, to remove a crumbling wall at the stream edge, and an unsightly tangle of weedy plants that further obscured the Saw Kill from view. But what should replace them? We had no knowledge of the stream bank condition prior to installation of the retaining wall. We considered soil stability, native plant communities, and accessibility of the stream to amphibious animals. We decided to pursue a restoration in the broadest sense, and establish an ecologically functional and self-maintaining stream bank community of native sedges and wildflowers. Regrading the site and restoring 60 meters of bank cost $40,000 (this seems like a lot of money until it is compared with the costs of highway improvements, for instance).

Most restoration projects focus on common habitat types and common species, but restoration can in some cases be used to increase the extent of rare habitats and benefit rare species. A recent clay pit reclamation project in New Jersey saw the restoration of wooded wetlands in an effort to save an endangered wildflower, the swamp pink (*Helonias bullata*).[1] Our Annandale restoration included the propagation and planting of winged monkeyflower (*Mimulus alatus*), a rare wildflower that occurs elsewhere along the Saw Kill, and survives at the planting site two seasons later. Hudsonia is now designing wetlands and upland nesting habitat for the threatened Blanding's turtle on a highly disturbed site in Dutchess County where an expansion of public facilities is planned.

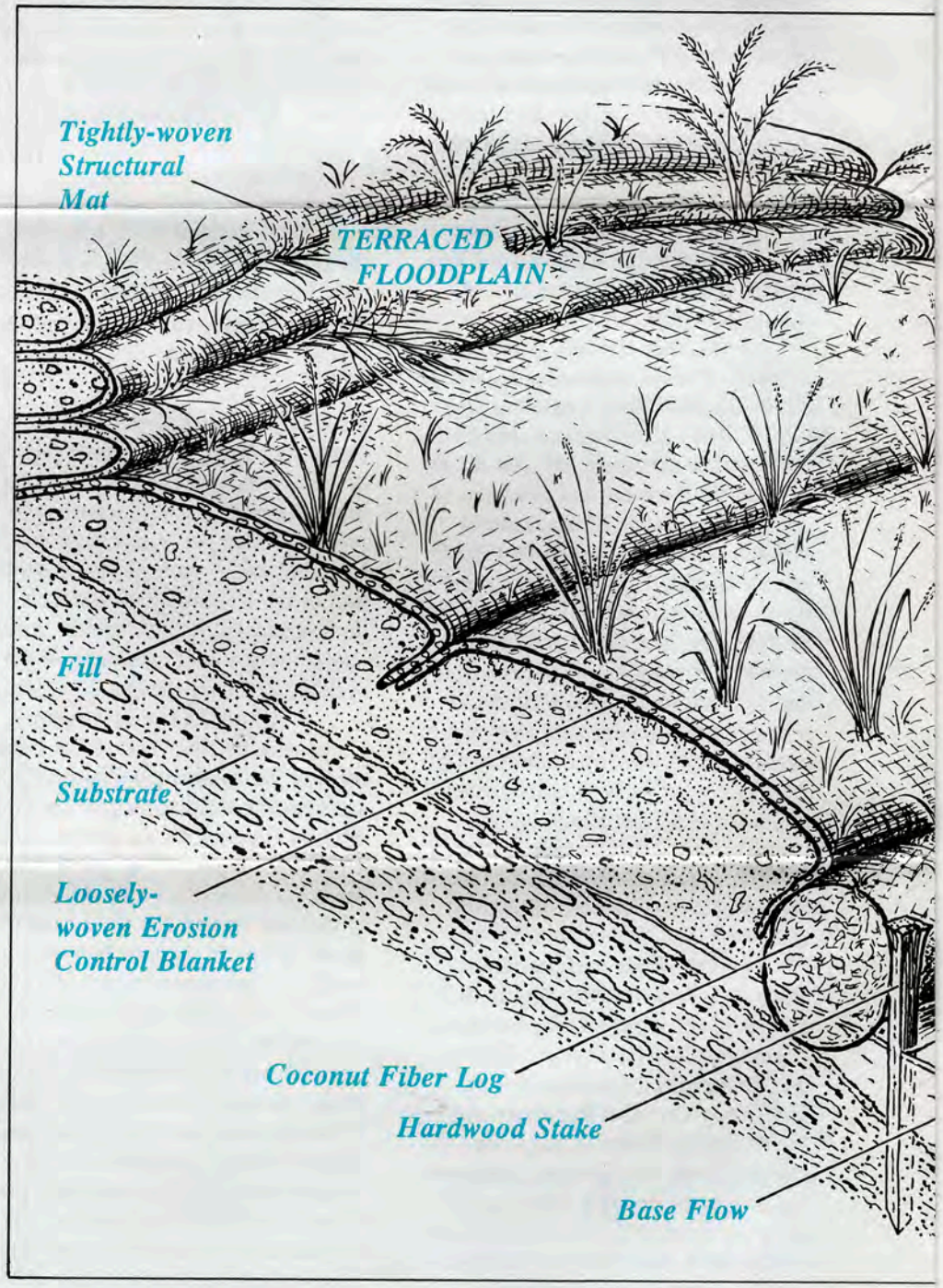
SOIL BIOENGINEERING

"Bioengineering" means the use of living or dead plant materials to stabilize and rebuild soils and vegetation. Bioengineering applications have been successful in restoring ecologically appropriate plant communities on hillsides, road embankments, and waterway banks. Large amounts of live woody cuttings from willows, dogwoods and other species that root readily are incorporated into the soil in various ways.[7] These installations can develop into shrubby thickets which effectively stabilize soils. The shrubby growth is a "nurse crop" that facilitates the establishment of a diverse plant community once the soils are stabilized. As early as 1936 Charles Kraebel,[4] a forester in California, used willow "wattles" (bundles of cut twigs) to stabilize dry clearcuts on steep mountain slopes. No trace of his original work remains, but the slopes have recovered their native pine-dominated vegetation.[5]

The use of "geotextiles" has widened the range of potential applications to sites where woody vegetation is inappropriate. Geotextiles are fabrics used to hold soils and plants in place temporarily. I have successfully used geotextiles to facilitate the establishment of herbaceous wetland plant communities along streams and on coastal mudflats. I prefer biodegradable fabrics and logs made of processed coconut husk fiber called "coir." These are tough and flexible materials that eventually biodegrade. By the time the geotextile disintegrates, the restoration plantings effectively bind the soil. By the summer of 1994 a four-year-old saltmarsh restoration planting at Fresh Kills landfill on Staten Island, New York, had expanded well beyond its original limits. The prolific growth of the only species planted - smooth cordgrass (*Spartina alterniflora*) - and silt accumulations made it almost impossible to locate the 30 cm diameter geotextile logs used to stabilize the site. I used the same kind of logs to provide a stable embankment toe at three other stream bank sites in New York and Pennsylvania that are subject to intense stormwater surges. All three sites show the same general trends: they are erosion resistant; they provide a stable anchorage for the roots of the planted species; they allow propagules of other wetland species to take hold, grow, and successfully compete alongside the planted species; and on all three sites approximately 60 per cent of the planted species spread, and the total number of species increased significantly.

INFORMATION NEEDS

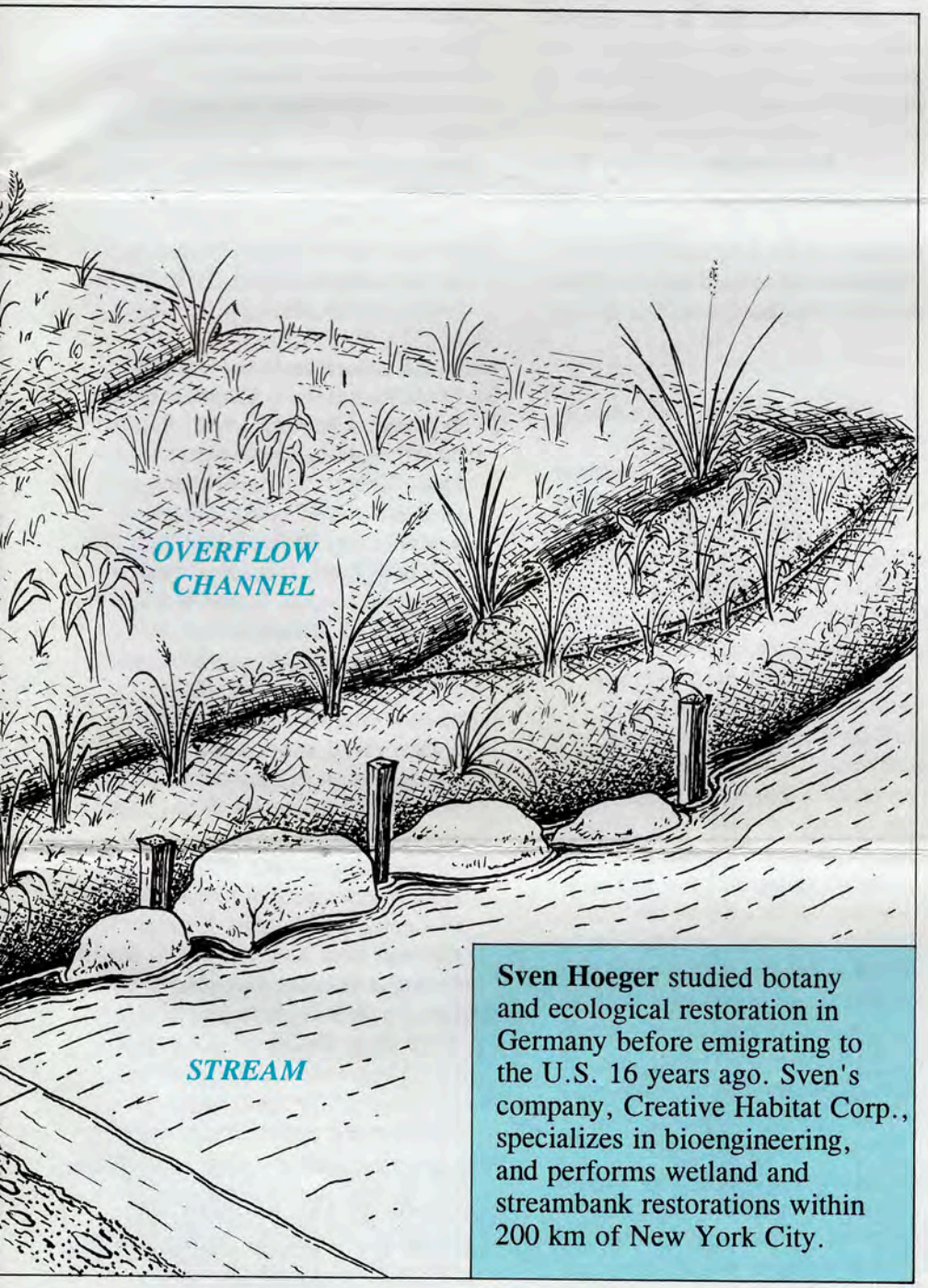
Ecological restoration was practiced in the past with little more than shovel and pick, a specialized form of landscape gardening. Even now, despite gains in knowledge, policy advances, and willingness to restore natural areas, the science is still in its infancy. We know little about the genetics, life history, physiology, or



A typical stream-edge restoration pro

ecology of some of our most prevalent wetland plants, such as cattail and common reed. Still less is known about rarer plants, most insects, soil microbes, and nutrient cycling. Many vascular plants, for example, cannot thrive without particular soil fungi, and these mycorrhizal relationships are now receiving attention from restorationists. Opportunities for failure arise at all stages of restoration planning and implementation: inadequate background data, poorly conceived design or objectives, competing goals of involved agencies, unforeseen problems (drought, grazing by geese or deer, other disturbances), inadequate funds for monitoring and remediation. Ecology is the study not of "the balance of nature", but of "the flux of nature".[6] This concept is essential to the design and implementation of effective restoration which can respond successfully to the array of natural fluctuations and processes that continually reshape our world. Successful ecological restoration is complicated and expensive, but necessary.

In the coming decades, many damaged marshes, abandoned mines, eroded slopes, and other degraded or derelict areas will be restored using native flora, dead plant materials, geotextiles, and fungi. The success of these efforts will depend on careful ecological studies, appropriate goal-setting, careful design and implementation, long-term monitoring, and appropriate remediation where failures occur. Needless to say, none of this will occur in the absence of adequate funds. Careful documentation of pre-existing conditions and all stages of the restoration project are essential if restorationists, regulatory agencies, and land owners are to learn from past mistakes and improve the science. Good restoration projects can repair or replace damaged ecosystems, can provide habitat for declining species, and can serve as sites for research on the structure and function of nature.



ile showing the use of "geotextiles".

Sven Hoeger studied botany and ecological restoration in Germany before emigrating to the U.S. 16 years ago. Sven's company, Creative Habitat Corp., specializes in bioengineering, and performs wetland and streambank restorations within 200 km of New York City.

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A LOOK BACK *(cont. from p. 1)*

Hudsonia's botanist Gretchen Stevens was asked by the group **Concerned Citizens of Cattaraugus County** to survey the site of a proposed landfill for the rare plant shrubby St. Johnswort. She found the plant at four locations previously unreported by the landfill developer, and found 11 federally regulated wetlands, also previously unreported.

Another citizens' group, **St. Elmo's Association II** requested a review of the Draft Environmental Impact Statement for a proposed 17-lot residential subdivision in the Town of New Castle, Westchester County. Gretchen Stevens and Spider Barbour discovered numerous features that had not been reported in the DEIS prepared by the developers, including a mature hardwood forest, a ravine with steep, erodible slopes, a seepage sedge meadow, and a large population of toothwort that could provide habitat for a rare butterfly, the West Virginia white.

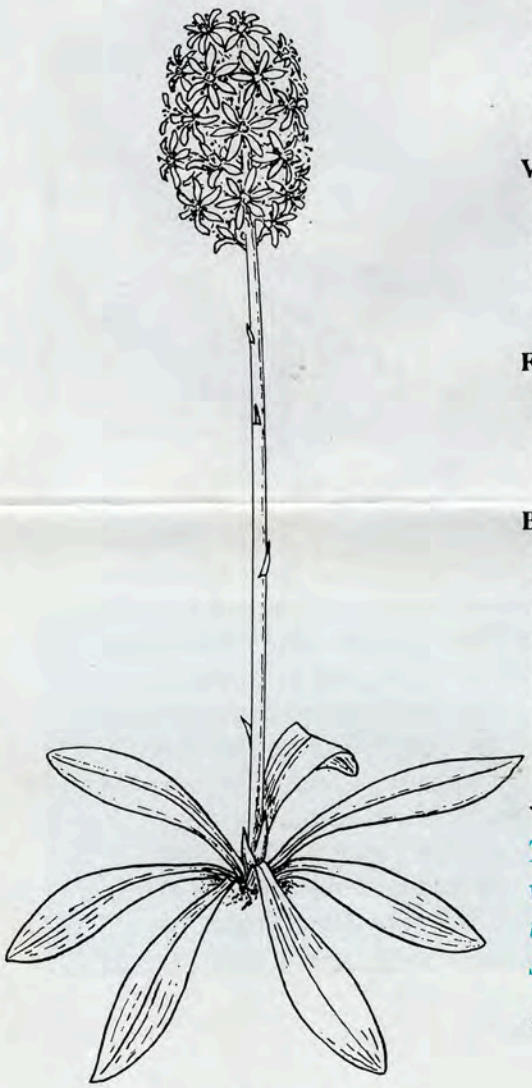
Ferry Sloops asked Hudsonia to analyze channelization of the lower Saw Mill River (Westchester Co., NY) being performed by the U.S. Army Corps of Engineers for flood control. Erik Kiviat found the alteration was damaging the river bank habitat of the rare river birch (*Betula nigra*), and he suggested that an earth berm at the upper margin of the floodplain could reduce the flood hazard without channelizing the stream.

Scenic Hudson retained Hudsonia for an ecological assessment of a new open space preserve, Shaupeneak Mountain, in the Town of Lloyd (Ulster Co., NY). Erik and Paul Huth identified significant habitats of a bog lake (Louisa Pond) and an extensive talus slope, and made recommendations for reducing the impacts of public recreation.

Hudsonia's **Manual for the Identification of Biodiversity Resources in the Hudson River Greenway Corridor**, nearing completion, addresses many biological issues we regularly encounter in technical assistance projects. The Manual will be ready early in 1996, and we are seeking funding to cover the cost of 200 free copies for Conservation Councils and citizens' groups in the study area (other groups will be able to purchase the Manual at cost). (Funded by the Sweet Water Trust and the Hudson River Foundation.)

Erik Kiviat conducted some preliminary research on insects associated with plants of the Hudson River tidal freshwater marshes. The early data show that common reed supports greater biomass and numbers of overwintering insects than do purple loosestrife or narrow-leaf cattail. This introduces a provocative field of inquiry to the debate on the ecological values of reed, a sometimes invasive plant.

Bob Schmidt surveyed 80 tributary mouths along the Hudson River to determine the feasibility of installing fishways to allow spawning runs of migratory fish to pass barriers. (Funded by the Hudson River Foundation.)



Gretchen Stevens completed improvements to our Herbarium that include an upgrading of the software for cataloguing and printing specimen labels, retrospective identification and verification of 4000 vascular plant specimens by Jerry Jenkins, and the addition of much material to the teaching collection. Gretchen also reported to the New York Natural Heritage Program 78 localities for 21 species of state-listed rare plants discovered by Hudsonia in the last several years. (Funded by the Bay Foundation and the Hudson River Foundation.)

Erik Kiviat has begun a study of wetland imagery in English language fiction and its relationship to wetland ecology.

SOME RECENT REPORTS AVAILABLE FROM HUDSONIA (prices postpaid)

Biological reconnaissance of the Little Beaver Kill, Esopus Creek drainage, Ulster Co., N.Y. Report to the Woodstock Land Conservancy, by S. Barbour, R. E. Schmidt, and G. Stevens. 1995. 32 p. ($7)

Vegetation in the fresh-tidal habitats of Tivoli Bays, Hudson River. Corrected version. Report to National Oceanic and Atmospheric Admin., Washington, DC. by E. Kiviat and E. Beecher. 1991. 62 p. ($12)

Fishes of Manitou Marsh with comments on other aquatic organisms. Report to Museum of the Hudson Highlands, by R.E. Schmidt, 1993. 64 p. ($12)

Biological assessment of the Jane E. Lytle Memorial Arboretum, Village of Croton-on-Hudson, Westchester County, New York. Report to the Croton Arboretum and Sanctuary, Inc., by G. Stevens and E. Kiviat. 1995. 22 p. ($3.50)

The swamp pink, an endangered wildflower that we hope will thrive at a clay pit reclamation site in New Jersey.

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Michael W. Klemens is our newest Board member. Michael is Director of Program Development at the Wildlife Conservation Society, and conducts research on reptiles and amphibians in North America and Africa.

GRADUATE SCHOOL

The 1996 catalog for the M.S. degree program may be requested from The Graduate School of Environmental Studies, Bard College, Annandale-on-Hudson, NY 12504.

WISH LIST

Light table (for drafting and examining slides).

CREDITS

Photographs, Sven Hoeger; editing, Gretchen Stevens, Erik Kiviat; design and drawings (© 1990-1995) Kathleen A. Schmidt; production, Patti Kelly. This issue of News from Hudson was underwritten by the Hudson River Foundation. The Fresh Kills salt marsh restoration was supported by the New York City Department of Sanitation. The Annandale restoration project was supported by the J. M. Kaplan Fund. The opinions expressed herein are not necessarily those of Hudsonia's donors or underwriters.

IN THE NEXT ISSUE

The spring issue of **NFH** will feature migratory fish - the shad, alewife herring, striped bass, American eel, white sucker, and less well-known species. Where do they come from, what are they doing in the Hudson, and how are their populations faring?

ERRATA

News from Hudsonia vol. 11 no. 2, 1995. The paragraph beginning at bottom of p. 4 should read as follows (omission in italics): IES ecologists Stuart Findlay, Cathy Wigand, and Peter Groffman are examining the relationships between marsh plants and the belowground processes associated with nutrient cycling. Different plants, such as cattail, purple loosestrife, and reed, may produce litter with different *chemical and physical characteristics that has different "quality" as a base for the growth of microorganisms. The different plants may also release more or less oxygen into the sediments, and may or may not have symbiotic relationships with fungi. These factors influence the actions of bacteria and fungi on nitrogen and other substances in the sediments, and may affect the retention or release of nutrients and the subsequent growth of vegetation.*

Also, the list of sponsors on page 8 should include the following: *In memory of Charles Kiviat, from Bert and Carol Nelson, Diane and Steve Hirsch, and Mr. and Mrs. Aaron Rosenthal.*

Smooth cordgrass, Spartina alterniflora, ***used for saltmarsh habitat restoration.***

Dear Friend,
For over 14 years, Hudsonia has quietly provided the science which is the cornerstone of all environmental successes. During this season of gift-giving, won't you please consider making a contribution to Hudsonia. We need your support to keep that cornerstone solid.

***Every* donation helps & *Every* donation makes a difference.**

Vernon Benjamin, Chair, Board of Directors Erik Kiviat, Executive Director

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