News from....

Hudsonia

Bard College Field Station
Annandale, N.Y. USA 12504
Telephone: (914) 758-1881

Volume 9, Number 2, June 1993

BLOSSOMS AND CLAY: LANDFILL SITING, WETLANDS, AND BIODIVERSITY

Article by Erik Kiviat, Gretchen Stevens, and Spider Barbour; drawings by Kathleen A. Schmidt

And look--a thousand Blossoms with the Day
Woke--and a thousand scatter'd into Clay.

- Edward Fitzgerald, The Rubaiyat of Omar Khayyam

Many New York counties are establishing regional solid waste landfills. In the Hudson Valley, state regulations encourage selection of candidate sites on natural clay deposits. We have found extensive wetlands on some candidate sites in Dutchess, Ulster, and Saratoga counties as well as rare wetland plants on several sites in Dutchess, Greene, and Ulster. The clays of the Hudson Valley tend to be calcareous (containing calcium carbonate),[9] and calcareous habitats, wet or dry, are of limited extent in New York and very important for rare plants and animals. It is important to conserve all genetically different populations within each native species, because these variants may play crucial roles in the integrity of ecosystems. Furthermore, nature is a "gene bank" of potential pharmaceuticals, industrial chemicals, improvements to crops, and least-toxic pesticides; for example, related species in five of the six genera of plants discussed below have potential uses for pest control.[12]

Downy ground-cherry, 25-60 cm tall

Thorough application of biological knowledge to facilities siting can reduce the loss of native biological diversity and the cost of infrastructure. Soil maps and other extant information can be used to identify potential habitats for rare biota, but this is seldom done early in the environmental planning process. For economic and conservation reasons, we recommend that ecological analysis of maps, followed by expert surveys of wetlands and rare species, be required in the initial stages of landfill site selection. The landfill site-selection process is typically conducted by an engineering firm under contract to a county agency. The New York State Part 360 Regulations of 1988 (revised 1991) require that low permeability soils be used, along with heavy plastic membranes, to construct the landfill liner system. A site underlain by deep, low permeability clays may use a single plastic liner, while other sites must use a double plastic liner. Because it is less expensive (in the short term) to use on-site soils for liner construction, landfill site selection processes often focus on clay. (Nonetheless, natural clay is ineffective for detecting and collecting leachate that seeps through an upper plastic

liner.[21]) In the Hudson Valley extensive clay and silt beds were deposited in large lakes formed during the melting of the last glaciers (Fig. 1). Notable among these "clays" is the Rhinebeck-Madalin soil association, described as calcareous soils with a silt loam surface texture and silty clay subsoils.[10]

Among many public-interest consultations concerning biological resources in relation to proposed land use changes, we have conducted field surveys of proposed county landfill sites in Columbia County (1 site, Town of Stockport), Dutchess County (1 site each in the towns of Red Hook and Washington), Greene County (2 sites, Town of Durham), Saratoga County (1 site, Town of Moreau) and Ulster County (3 sites in the Town of Saugerties) (Fig. 1). We also studied riparian areas along a stream which drains two of the Saugerties sites. We did not systematically examine all candidate sites in any one county. Our surveys of the Town of Stockport and Town of Washington sites were brief, and we visited the Town of Moreau site only in winter. We documented previously unreported or under-reported wetlands on at least 6 of the 9 sites, and vascular plant species listed as rare in New York by the New York Natural Heritage Program (NHP) on 4 of the 6 sites on which we did growing-season rare plant surveys (Table 1). We reported details of Hudsonia's landfill site studies previously.[2-8,15-17,24]

Wetlands

Clay soils often support wetlands overlooked in wetland mapping and delineation. Because of the low permeability that makes clay useful as a landfill liner, water tends to collect on the surface of clay soils. The extent of wetlands on all sites we studied, with the possible exceptions of the Town of Stockport and Town of Washington sites, exceeded that described in environmental documents prepared by the site-selection consultants. The most egregious example of under-reporting was on the Red Hook site (Fig. 1), which was finally determined to have 37 ha (93 ac) of wetlands on a ca 86 ha (212 ac) site; consultant documents had briefly mentioned 18 ha (45 ac) of Federally regulated wetlands and the New York State Department of Environmental Conservation (DEC) Freshwater Wetlands Maps had failed to recognize wetlands meeting even the 5 ha state regulatory threshold. Large areas of this wetland were sedge meadow, a category that we find consistently under-mapped by the DEC and private consult-

Table 1. New York Natural Heritage Program (NHP) status ranks, approximate number of known sites (11 county region) and habitat characteristics of statewide-rare plants discussed in this report. Frank's sedge and small skullcap occurred on similar clay meadows but not on a proposed landfill site. Data from NHP and Hudsonia.

Species	Rank	Sites	Habitats
Small-flowered agrimony, *Agrimonia parviflora*	S3	22	Mildly disturbed, calcareous, sunny or semi-sunny, dry-end wetlands[a]
Small white aster, *Aster vimineus*	S2	5	Mildly disturbed, calcareous, sunny, dry-end wetlands; also gravelly riparian and lacustrine areas of unknown carbonate status
Bush's sedge, *Carex bushii*	S2S3	13	Calcareous, full or partial sun, dry-end wetlands[b]
Frank's sedge, *Carex frankii*	S1	2	Calcareous nontidal & fresh-tidal wetlands
False hop sedge, *Carex lupuliformis*	S2S3	3	Calcareous, very wet, light shade
Winged monkeyflower, *Mimulus alatus*	S2	12	Calcareous, shade or partial shade; streambank, floodplain, or fresh-tidal wetland[c]
Downy ground-cherry, *Physalis pubescens* var. *integrifolia*	S1	1	Mildly disturbed, calcareous, sunny wetland edge
Small skullcap, *Scutellaria parvula* var. *parvula*	S2S3	2	Low vegetation in calcareous clay wet meadows

The New York Natural Heritage Program reviews the occurrences and ranks the status of rare plants in the state;[27] S1 to S5 indicate decreasing rarity. False hop sedge and downy ground-cherry have uncertain taxonomic status.

[a] Includes a beaver meadow, transmission line right-of-way, horse pasture, oldfield, abandoned recreation park, and mowed fields.

[b] Includes an overgrown beaver meadow, and both mowed and unmowed fields.

[c] Includes freshwater irregularly-flooded tidal stream deltas in the Hudson River, and nontidal streams of various sizes.

ants. The Part 360 landfill siting regulations state that the bottom of the leachate collection system beneath a landfill must be at least 5 ft above the seasonal high water table; this regulation effectively prohibits the establishment of a landfill in wetland (unless the water table can be lowered artificially beforehand).

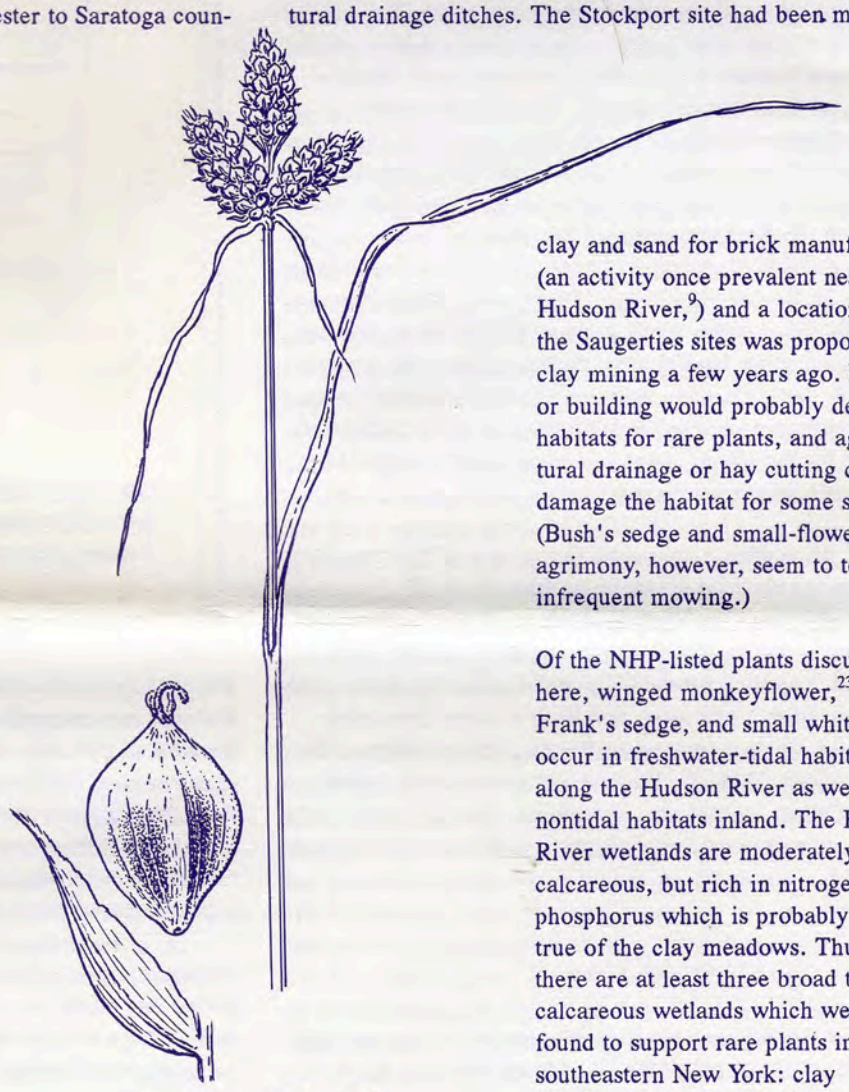
Rare Plants

During 1986-92, Hudsonia found NHP-listed rare plants on only 16 of 76 New York sites studied (these figures include growing-season surveys on sites of all sizes, but exclude proposed county landfill sites and sites bordering the Hudson River). Therefore, we were intrigued to find 6 statewide-rare plant species on half of the landfill sites we surveyed. One of the Durham sites yielded Bush's sedge and false hop sedge; the Saugerties sites had small-flowered agrimony and winged monkeyflower; and the Red Hook site yielded small white aster and downy ground-cherry. Table 1 indicates the habitat affinities and rarity status of these species in New York, and Fig. 1 shows their currently reported distributions in the 11 county Hudson Valley region (Westchester to Saratoga counties).

In addition to the statewide rare plants listed by NHP, we found a number of regionally-rare plant species on the sites. (The unofficial designation "regionally-rare" means rare in a county, group of counties, or physiographic region of the state; the species mentioned here have been seen by us at fewer than 10 locations in the respective county during the last decade.) For example, one of the Greene County sites had Allegheny vine (*Adlumia fungosa*), and the other had Vasey's pondweed (*Potamogeton vaseyi*). The Columbia County site had stiff gentian (*Gentianella quinquefolia*). The Saugerties sites had green dragon (*Arisaema dracontium*), seedbox (*Ludwigia alternifolia*), squarrose sedge (*Carex squarrosa*) and hairy-fruit sedge (*C. trichocarpa*); Saugerties and Red Hook sites had slender-leaved gerardia (*Agalinis tenuifolia*); and Red Hook had mossy-cup oak (*Quercus macrocarpa*).

We have found that calcareous glaciolacustrine clays (e.g. Madalin and Rhinebeck soil series) often support wetlands of significance for NHP-listed rare flora, but calcareous clay wetlands have not previously been described as generally significant habitats for native biodiversity in New York.[22] We observed, for example at the Red Hook site, that calcareous clay wet meadows supported some plants typical of non-clay, groundwater-fed fens in the Hudson Valley, including fringed gentian (*Gentianopsis crinita*), yellow sedge (*Carex flava*) and drooping bulrush (*Scirpus pendulus*). Many characteristic fen species such as shrubby cinquefoil (*Potentilla fruticosa*), and grass-of-Parnassus (*Parnassia glauca*), however, were absent from our clay sites. The Red Hook site appears principally surface-water fed (i.e. perched), but may have an area of spring seepage where some of the fen plants are more common and where we noted abnormally small blue flag (*Iris versicolor*) and purple loosestrife (*Lythrum salicaria*) (see Table 3).

Some, perhaps all, of the clay wetlands in our studies were farmed historically. Although wet clay soils warm slowly in spring and are difficult to cultivate, they can produce hay and possibly other crops. The Red Hook site had silted-in agricultural drainage ditches. The Stockport site had been mined for clay and sand for brick manufacture (an activity once prevalent near the Hudson River,[9]) and a location near the Saugerties sites was proposed for clay mining a few years ago. Mining or building would probably destroy habitats for rare plants, and agricultural drainage or hay cutting could damage the habitat for some species. (Bush's sedge and small-flowered agrimony, however, seem to tolerate infrequent mowing.)



Bush's sedge, 30-75 cm tall

Of the NHP-listed plants discussed here, winged monkeyflower,[23] Frank's sedge, and small white aster occur in freshwater-tidal habitats along the Hudson River as well as in nontidal habitats inland. The Hudson River wetlands are moderately calcareous, but rich in nitrogen and phosphorus which is probably not true of the clay meadows. Thus, there are at least three broad types of calcareous wetlands which we have found to support rare plants in southeastern New York: clay meadows, groundwater fens, and

Hudson River fresh-tidal wetlands (Table 3).

Downy ground-cherry is the rarest of our finds; it is now known from a single site in New York. All six rare plants of the landfill sites are associated with calcareous habitats near their northeastern range margins in New York or New England, although they are not necessarily calcicoles (species of calcareous habitats) farther south. At their extreme northeastern limits in at least portions of the Hudson Valley, but not southwards, the bog turtle and the northern cricket frog are also calcicoles.[11,19] We do not know the reasons for regional calcicoly, but it suggests that these peripheral populations are genetically different, and underlines their importance to biological diversity.

Soils

County soil maps, available for most counties, are useful for detecting ecological patterns in geographic distributions of rare species, as well as for classifying biological communities. Soil maps are not precise, however, and must be used only as indicators of potential habitat occurrence. Potential habitats identified on soil maps may turn out to be unsuitable, and suitable habitats may be identified in the field where a suitable soil type was not mapped. At a Saugerties site, Barbour found wetlands where no soils with poor drainage were mapped, and in the Town of Durham we found calcicolous plants where the mapped soil types were not described as calcareous. In the latter case, we hypothesized that calcicoles grew on pockets of glacial drift containing calcium carbonate from the Helderbergs ca 25 km (16 mi) away. Table 2 shows the predominant mapped soil types on the Dutchess, Greene, and Ulster County landfill sites. Although resources such as soil maps, geologic maps, and rare species records are valuable for providing preliminary information, field studies are essential for the identification and assessment of wetlands, significant habitats, and rare biota.

In 1992, we studied a large area (not proposed for a landfill) of calcareous clay wet meadows on Rhinebeck, Hudson, and Madalin soils near the Wallkill River in Ulster County. Plant communities had similarities to the landfill sites discussed here, and supported substantial populations of small-flowered agrimony, small white aster, and Bush's sedge. Two other NHP-listed plants were rare on the site: Frank's sedge and small skullcap (Table 1). We have not surveyed the existing Orange County landfill site, underlain by Madalin soil, on the Wallkill; this site could support some of the rare plants listed in Table 1.

Improving the Site Selection Process

Biological studies are usually inadequate, or lacking entirely, during the early stages of the site selection process for a landfill or other high-impact facility. During a previous

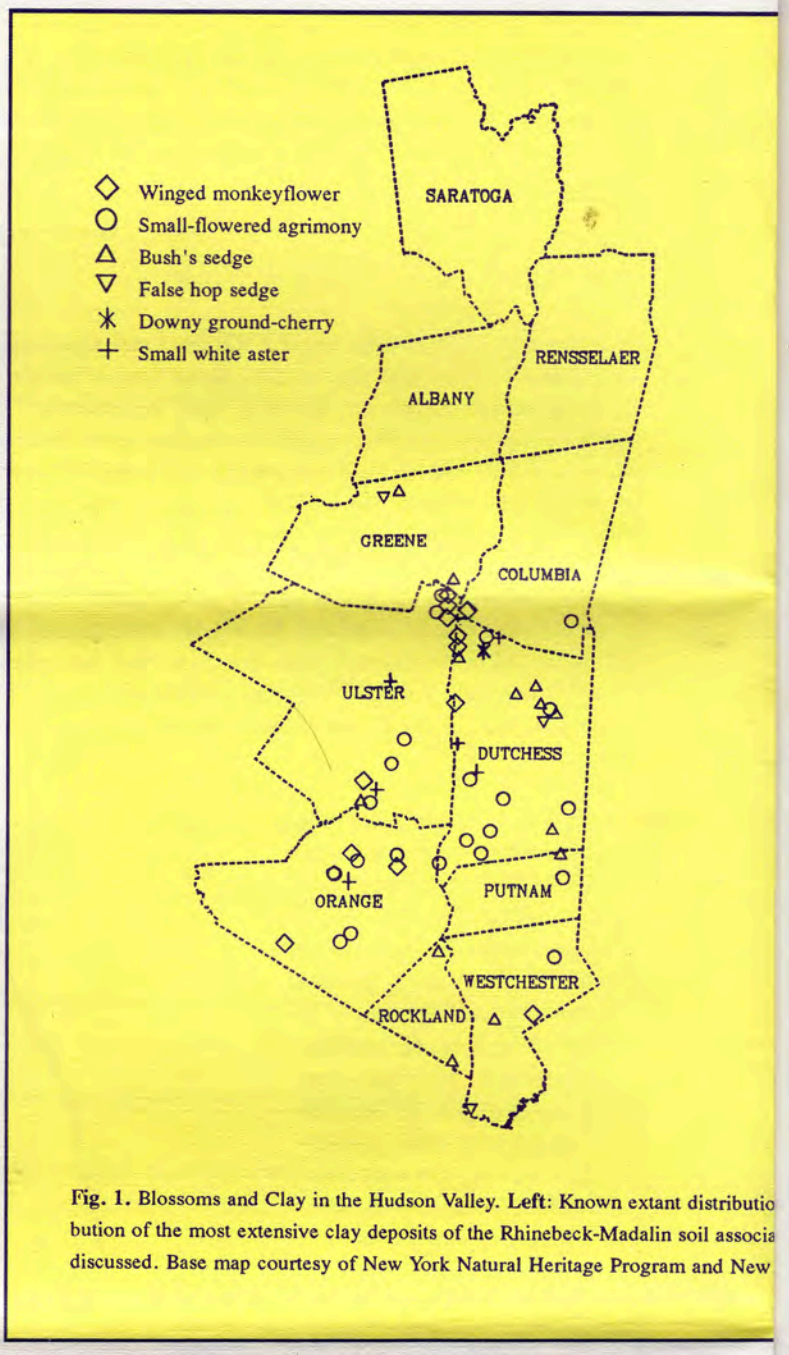
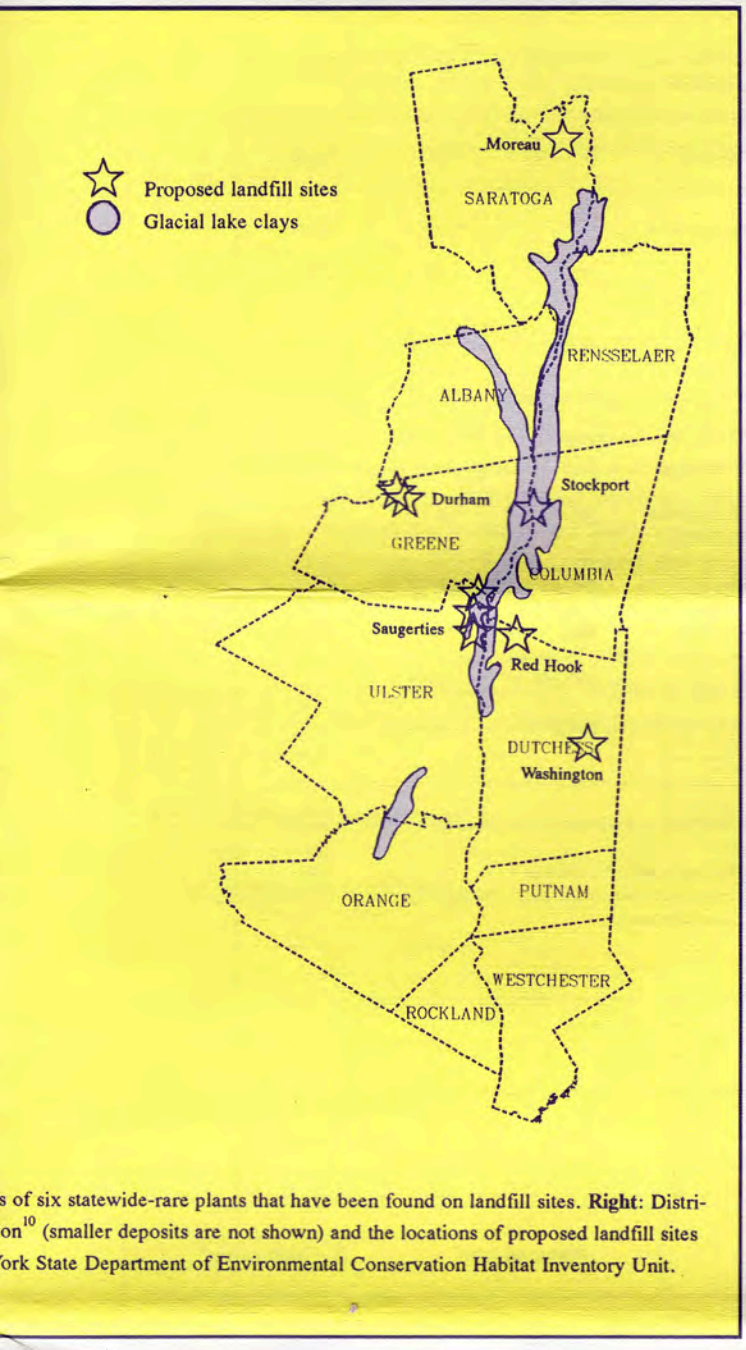


Fig. 1. Blossoms and Clay in the Hudson Valley. **Left**: Known extant distributio
bution of the most extensive clay deposits of the Rhinebeck-Madalin soil associa
discussed. Base map courtesy of New York Natural Heritage Program and New

attempt to site a landfill, a Dutchess County official asked Kiviat to review maps of three proposed sites. These sites were all on carbonate (limestone, etc.) bedrock but were not clay meadows. Without seeing the sites, he suggested that they were likely to contain habitat for the endangered bog turtle; one of these sites subsequently yielded a bog turtle record. Evidently that landfill siting experience was not applied by the County to the most recent siting process.

Contrary to our opinions, resource economists[25] have suggested that biological considerations should wait until the middle stage of screening potential sites, rather than being included with "constraints" in the early stage; the cultural and ecological importance of biological diversity was not men-



s of six statewide-rare plants that have been found on landfill sites. **Right**: Distri-on[10] (smaller deposits are not shown) and the locations of proposed landfill sites ork State Department of Environmental Conservation Habitat Inventory Unit.

tioned. The growing public consciousness of biological conservation requires that biodiversity be addressed before money and institutional inertia have been invested in a biologically unsuitable site. The landfill site selection process needs more biological and ecological accountability. Habitat assessments and rare species surveys are critical at an early stage of site selection for any major land use project, and should not be initiated just as a response to criticism later in the process. Independent scientists with experience in the native biological diversity of a region should be involved throughout the site selection process.

Possible landfill sites should pass a biological filter of map signatures designed to detect the physiographic niches of potential habitats for regionally or statewide rare flora and fauna. For example, the rare plants listed in Table 1 are associated with wet calcareous clays and other moist-to-wet calcareous habitats; bog turtles are associated with groundwater-fed, non-clay, non-wooded, calcareous wetlands especially on Wayland, Sun, Palms, and Carlisle soils;[13,19] northern cricket frogs occur in peaty or silty wetland lakes many of which have Carlisle or Canandaigua soils;[11] Blanding's turtles live in wetlands adjoining Hoosic and other coarse-textured upland soils;[14] and the eastern hognose snake and worm snake are associated with sandy soils.[20] Soil maps should be used in the habitat prediction process, with the understanding that soil maps are generalized and indicative, but not conclusive for either positive or negative predictions. Sites that pass such filters in a map analysis, and which are acceptable for engineering reasons, should be reconnoitered by experienced biologists to recognize significant habitats which may not be detectable on maps. Any significant habitats present should be surveyed for particular rare biota during the appropriate seasons.[18] Blossoms and Clay are part of our rural biological heritage: wetlands on calcareous clays, including sedge meadows and low floodplain deciduous woods, should be considered as potential habitats for rare plants throughout New York and elsewhere in the Northeast.

All New York counties planning to establish landfills should share information. Environmental errors in one county could be used to improve future efforts, conserve biodiversity, and save money in the same or other counties. More consideration is needed of the potential to establish environmentally safe landfills in previously damaged areas like mines, disused industrial sites, and military installations, using imported clay, plastic, or recycled materials for liners. Although damaged areas may still support rare biota, the potential is less. Much Town and County money was spent on legal actions over wetlands at the Red Hook site; the litigation was partly responsible for the County Resource Recovery Agency's bonds being downgraded, and ultimately resulted in the site being rejected by the County. Would it have been better to spend some of that money selecting a site that reasonably met all requirements (engineering, economic, biological, and social)? Lawrence Susskind has developed methods to improve the efficiency and social acceptability of the process of siting noxious facilities.[1]

Although Hudsonia's landfill site studies were all conducted for groups and agencies opposing proposed landfills, we have conducted comparable site studies for proponents of other major projects including a highway, a mine, a golf course, and numerous residential subdivisions. Hudsonia's early offers of county-wide biological screening of potential landfill sites to two of the counties were rejected. From our perspective as a "non-aligned" party in development controversies, we see opposition to high-impact facilities as a force for the improvement of environmental knowledge, site selection processes, and facilities design. We would much rather see, however, field scientists with experience in the rare habitats

and biota of the region participate in all stages of site selection and planning, to ensure that biodiversity issues are addressed. Future establishment of landfills and other needed facilities need not be delayed or derailed if biodiversity is considered early and thoroughly in the site selection process.

Landfills are necessary, but even with an ideal site selection process they destroy habitat, and there is a risk of polluting adjoining lands and waters. Many landfills preempt agricultural lands, or disproportionately affect low-income communities. We need to program "source reduction" into our economy, to both reduce waste generation and conserve more of the materials and energy used to produce unneeded packaging and consumer goods. There is also much to learn about reusing and recycling difficult materials like construction and demolition debris. The field of solid waste management offers special opportunities for collaboration among engineers, economists, and ecologists.

Table 2. Major soil types mapped for the landfill sites. Soil data adapted from Tornes[26] and unpublished U.S.D.A. Soil Conservation Service data for Dutchess and Greene counties.

Soil type	Parent material	Drainage[a]	pH[b]	Remarks	Sites[c]
Hudson silt loam	lacustrine clay & silt	MWD	5.1-7.3	calcareous	S
Lackawanna channery loam	till[d]	WD	4.5-5.5	hardpan at 43-91 cm	D
Madalin silty clay loam	lacustrine clay & silt	PD-VPD	5.7-7.8	calcareous	R,S
Middlebury silt loam	alluvium[d]	MWD-SPD	5.1-7.3		S
Morris channery silt loam	till	SPD	4.5-6.5	hardpan at 30-56 cm	D
Raynham silt loam	alluvial & lacustrine silt & fine sand	SPD	5.1-7.3		R
Rhinebeck silt loam	lacustrine clay & silt	SPD	5.1-7.8	calcareous	R,S,M
Saprist (muck)	organic material	VPD	(4.7-7.3)		M
Wareham loam	outwash	SPD-PD	3.6-6.5		M
Wellsboro channery silt loam	till	MWD	4.5-6.0	hardpan at 38-64 cm	D

[a] Drainage: MWD = Moderately well drained; SPD = Somewhat poorly drained; PD = Poorly drained; VPD = Very poorly drained.
[b] pH range at 0-50+ cm depth; pH under 7 is acidic, over 7 is alkaline.
[c] Sites: D = Town of Durham (Greene County); R = Town of Red Hook (Dutchess County); S = Town of Saugerties (Ulster County); M = Town of Moreau (Saratoga County).
[d] Parent material includes limestone.

Table 3. Characteristics of three types of calcareous wetland habitats for rare plants in southeastern New York.

Wetland type	Geology[a]	Soils[b]	Water source[c]	Trophic status[d]
Clay meadow	Shale, sandstone, carbonates	Madalin, Rhinebeck	Runoff	Medium?
Fen	Carbonates	Wayland, Sun, Palms, Carlisle	Groundwater, runoff	Low to medium
Fresh-tidal	Sandstone, shale	Hudson, Wayland, "Freshwater marsh"	Tides, runoff	High

[a] Bedrock or surficial deposits in Dutchess, Greene, Ulster counties; some of the sandstones are calcareous; carbonates include marble, limestone, and possibly dolostone.
[b] Predominant mapped soil types.
[c] Predominant hydrology; clay meadows may have secondary groundwater influence.
[d] Nitrogen and phosphorus levels (hypothetical).

References Cited

1. Anonymous. 1992. Susskind on siting: There is a better way. Examiner; The Legislative Commission on Solid Waste Management. 7(1), not paginated.

2. Barbour, S. 1991a. Preliminary wetlands reconnaissance of Ulster County Landfill Candidate Site 2. Unpublished report to Winston Farm Alliance. Hudsonia Ltd., Annandale, NY. 4 p.

3. Barbour, S. 1991b. Preliminary wetlands reconnaissance of Ulster County Landfill Candidate Site 3. Unpublished report to Town of Saugerties. Hudsonia Ltd., Annandale, NY. 8 p.

4. Barbour, S. 1991c. Preliminary wetlands reconnaissance of Ulster County Landfill Candidate Site 6. Unpublished report to Town of Saugerties. Hudsonia Ltd., Annandale, NY. 5 p.

5. Barbour, S. 1991d. Rare plants and significant habitats survey on the Ulster County Alternative Landfill Site 2 (Winston Farm), Town of Saugerties, Ulster County, New York. Unpublished report to Town of Saugerties. Hudsonia Ltd., Annandale, NY. 24 p.

6. Barbour, S. 1991e. Rare plants and significant habitats survey on the Ulster County Alternative Landfill Site 3 (Mount Marion), Town of Saugerties, Ulster County, New York. Unpublished report to Town of Saugerties. Hudsonia Ltd., Annandale, NY. 22 p.

7. Barbour, S. 1991f. Rare plants and significant habitats survey on the Ulster County Alternative Landfill Site 6 (Asbury), Town of Saugerties, Ulster County, New York. Unpublished report to Town of Saugerties. Hudsonia Ltd., Annandale, NY. 24 p.

8. Barbour, S. & E. Kiviat. 1990. Greene County proposed landfill sites at Cornwallville, New York: Biological assessment. Unpublished report to the Town of Durham and the Association for the Preservation of Durham Valley. Hudsonia Ltd., Annandale, NY. 37 p.

9. Broughton, J.G., J.F. Davis & J.H. Johnsen. [1966?] The Hudson; Mineral resources. Geology and mineral resources of the middle and lower Hudson River valley. State of New York, Hudson River Valley Commission, Bear Mountain, NY. 103 p. + folded map.

10. Cline, M. 1955. Soils and soil associations of New York. Cornell Extension Bulletin 930, 72 p. + folded "Soil association map of New York State."

11. Dickinson, R. 1993. Northern cricket frog (*Acris crepitans*) survey in Ulster County, New York, 1992. Unpublished M.S. thesis, Bard College, Annandale, NY.

12. Grainge, M. & S. Ahmed. 1988. Handbook of plants with pest-control properties. John Wiley & Sons, New York. 470 p.

13. Kiviat, E. 1978. Bog turtle habitat ecology. Bulletin of the Chicago Herpetological Society 13(2):29-42.

14. Kiviat, E. 1988a. Time and the Blanding's turtle. News from Hudsonia (summer):1-6.

15. Kiviat, E. 1988b. Preliminary ecological survey of the proposed county landfill site at and around the Town of Washington landfill. Unpublished report to Preservation of Washington. Hudsonia Ltd., Annandale, NY. 4 p.

16. Kiviat, E. & S. Barbour. 1990. Proposed Dutchess County landfill site wetlands, Red Hook, New York. Unpublished report to the Town of Red Hook. Hudsonia Ltd., Annandale, NY. 33 p.

17. Kiviat, E. & G. Stevens. 1990. Biological reconnaissance of the proposed Saratoga County landfill site at Moreau, New York. Unpublished report to Save It For Tomorrow. Hudsonia Ltd., Annandale, NY. 9 p.

18. Kiviat, E. & G. Stevens. 1991. How biologists assess special resources: All about Eve's Point. News from Hudsonia (July):1-6.

19. Kiviat, E. et al. 1993. Southeastern New York bog turtle survey. Unpublished report to Return a Gift to Wildlife, New York State Department of Environmental Conservation, Albany, NY. 68 p.

20. Klemens, M.W. In press. Amphibians and reptiles of Connecticut and adjacent regions. State Geological and Natural History Survey of Connecticut, Bulletin 112. 305 p.

21. Phaneuf, R.J. 1992. New York State regulatory perspective on landfills. Northeastern Geology 14(4):233-243.

22. Reschke, C. 1990. Ecological communities of New York State. New York Natural Heritage Program, Latham, NY. 96 p.

23. Sharma, V. 1993. Habitats of the monkeyflowers *Mimulus alatus* and *Mimulus ringens* on the Hudson River. Unpublished M.S. thesis, Bard College, Annandale, NY.

24. Stevens, G. 1990. Wetland delineation at the proposed county landfill site. Unpublished report to the Town of Red Hook. Hudsonia Ltd., Annandale, NY. 5 p.

25. Swallow, S.K., J.J. Opaluch & T.F. Weaver. 1992. Siting noxious facilities: An approach that integrates technical, economic, and political considerations. Land Economics 68(3):283-301.

26. Tornes, L.A. 1979. Soil survey of Ulster County, New York. U.S.D.A. Soil Conservation Service. 273 p. + maps.

27. Young, S.M., ed. 1992. New York rare plant status list. New York Natural Heritage Program, Latham, NY. 82 p. (and unpublished data.)

Design and production, Kathy Anne Schmidt. Drawings Copyright© Kathleen A. Schmidt 1993. Flora identified or verified by Jerry C. Jenkins. Stephen M. Young reviewed a draft. Studies reported here were funded by: Association for the Protection of Durham Valley, Preservation of Washington, Save It For Tomorrow, SCRAP, Town of Durham, Town of Red Hook, Town of Saugerties, U.S. Department of the Army, Winston Farm Alliance; thanks also to the New York Natural Heritage Program of the NYS DEC and the Nature Conservancy, and the New York State Museum. Financial support for *News from Hudsonia* was provided by the Norcross Wildlife Foundation, Inc. Printed on recycled paper.

Thanks to: Sally G. Hornor and John Johnson for journals and books; Heinz Meng for identifying specimens; Bill Sherrod for preparing a bobcat study skin; Forest Mate of Antigo, Wisconsin, for donating Tick Chaps (spelled the town wrong in our last issue!)

As the Bard College Graduate School of Environmental Studies enters its sixth summer session, 7 students are graduating with Master of Science degrees. Thesis research has ranged from solid waste to fisheries to multinational corporations. Hudsonia assisted two graduates, Rosalind Dickinson and Valerie Sharma, who studied the northern cricket frog and the winged monkeyflower, respectively, in the Hudson Valley. The 1994 Bard GSES catalog will be available in August; call 914-758-7483.

recycled paper

Remaining Hudsonia Natural History Courses:

TICKS, MOSQUITOES, AND VECTOR-BORNE DISEASES,
26 June, Durland Fish
HUDSON RIVER FISHES, 10 July, C. Lavett Smith
WETLAND DELINEATION, 17 July, Gretchen Stevens
SEDGES, 24 July, Jerry C. Jenkins
ARCHEOLOGICAL METHODS, 7 August, Chris Lindner
AQUATIC MOLLUSKS, 21 August, David Strayer
GRASSES, 11 September, Jerry C. Jenkins

Dear Friend of Hudsonia,

This is a challenging year for Hudsonia. Many of our grantors and consulting clients are delaying longer, giving less, and asking for more in return. Yet we have not compromised the depth and thoroughness of our work.

Hudsonia still leads the way with innovative field science, technical assistance to planners and conservationists, analysis of endangered species habitats, identification of special resources for open space planning, and studies of streams, wetlands, and estuaries. But we need your help in order to continue.

Because conservation biology in general is underfunded, small contributions can have a large impact. If *every* reader of this newsletter sent us $25, it would triple our budget - think how much science that would buy! IBM and many other corporations match employees' donations.

Erik Kiviat, Executive Director

Hudsonia Ltd. is a non-advocacy, public interest organization, and does not support or oppose development projects. Our annual financial report is available from our office or the New York Department of State Office of Charities Registration, Albany, NY 12231. Donations to Hudsonia are tax-deductible as allowed by law, and are used only for Hudsonia's research and education programs as a 501(c)(3) organization under the rules of the Internal Revenue Service.

Winged monkeyflower, 25-100 cm tall

Special thanks to the following:

PATRONS

Norcross Wildlife Foundation, Inc.

SUPPORTERS

Anchorage Romney Sheep
Hudson River Foundation

FRIENDS

Bill Coleman
Henriette Granville Suhr

SPONSORS

Kent D. Anderson, Law Offices
Heinz and Elizabeth Bertelsmann
Joseph Calia, Financial Advisor, Prudential Securities
Canal Press
Elaine Colandrea, Muscular Therapist
Mrs. Beatrice A. Duggan
Dutchess Land Conservancy
Dutchess Quarry and Supply Company, Inc.
Fairfax Biological Laboratory
Drayton Grant, Esq.
GREENPLAN, Inc.
Kellar & Kellar, Attorneys at Law
Kingston School of Art
Esther Kiviat, Photographer and Writer
Marilyn Marinaccio
Meta Nature Products
George and Cathy Michael
Millbrook School
Rhinebeck Health Food Store
Rudikoff and Rohde, Inc.
Ms. Kathryn Salomon
Shawangunk Valley Conservancy
Sipos Insurance and Financial Services
Billy Steinberg Music
Anton Wilson
Winter Sun
Woodstock Percussion Inc.

DONORS (since the April 1992 *News From Hudsonia*)

Ruth D. Adams
Diane Alexander, Esq.
Dr. Matthew Asbornsen
Kerttu and Irving Barnett
Edward and Wendy Bedrosian
John Bierhorst
Kay Blumberg
Joe Bridges
Burt Brody
Edward J. Brophy
Mary Gregorie Burns
Barbara Butler
Sherret S. Chase
David A. Chittick
David and Constance Clapp
Richard and Norene Coller
Edward A. Cope
Anne Cridler
Frances F. Davis
Gerald A. Davison
James DeNitto
Joe Deschenes
Susan G. Dillon
Dr. Michele D. Dominy
Deborah Dows
Brian Doyle
Mrs. Allen K. Eastman
Walter H. Effron
Kip Eggert
Charles R. Eickhorn, Jr.
Carol Ethan
William M. Evarts, Jr.
Mark E. Feinberg and Pamela Jane Jenkins
Lee Felshin
Margay Ferguson
Foresight Land Services
Douglas F. Fraser
Jeanne French
Knowlton Foote
Barry H. Garfinkel
Marti Gearhart
Jean C. George
Ken and Jeanne Goldberg
Regina Gonyea
David and Maggie Gordon
Barbara Gray-Black
Patricia A. Green
Mr. J. Ken and Mrs. Elizabeth Greenburg
John and Jane Geisler
James J. Grefig
Susan Gromkowski
Edward J. Hogan
John C. Honey
Robert E. Henshaw
Historic Hudson Valley
Adrienne Hollander
Joan Howe
Judy Humphrey
Steve Hutkins
Stanley S. Jacobs
Henry Johnson
Stephen Kaye
Robert J. Kennedy, Jr.
Carol Kerbin
Mrs. Jean L. Klaiss
William Koff
Gilbert R. Kortz, Jr.
Mike Levandowsky
Ann Lezberg
Mary Lunt
Maeve Maurer
Sandro Mayer
Donald McKinney
Beth Mead
Rosalind Michahelles
Renee Miller
Mr. George W. Newcombe
Richard Oestrike
Richard Ostfeld
Jim Ottaway, Jr.
Cynthia Phillips
Melvin Pomerantz
Lois Quillinan
Mrs. Frances S. Reese
Mr. and Mrs. Robert Rifenburg
Robert Rippstein
Thomas Ronan
Curtis Rose
Mr. and Mrs. Albert Rosenblatt
Mrs. Routledge
Dr. John J. Ryan
Mrs. Kathryn Salomon
Margaret Shafer
Norman Shapiro
Steven Shaw
Barbara R. Shultz
Olga Smyth
Dr. Seldon S. Spencer
Star Travel
Andre and Lise Starrett
Ira Stern and Francine Hertz
Eric Sullivan
Paul Sutera
Mario and Donna Verna
Kay Verrilli
Teresa Vilardi
Alvin D. Wanzer
Karen West
Mrs. Maurice A. Williamson
Jay E. Wilmarth
Phyllis Witner
Anne P. Wood
Mrs. Mary W. Yegella

Inquire about sponsorship or advertisement for your business, or on behalf of a nonprofit organization of your choice. *News from Hudsonia* Sponsorship is $200 per year or $75 per issue. We also offer higher levels of sponsorship ($500-2500+ per year) which entitle a Sponsor to an inscribed copy of Wild Flora of the Northeast by Anita and Spider Barbour, invitations to special field trips, and assisted use of Hudsonia's library.