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# TALE OF TWO TURTLES:

## Conservation of the Blanding's Turtle and Bog Turtle

by Erik Kiviat

A great challenge of the next century is the conservation of the multitudinous animals and plants that are in decline worldwide. Because so many species are in trouble, and economic resources are limited, society's scientific and planning skills must be focused on the habitats and ecology of declining species such that we may protect them where they occur, and not waste precious money and time in the wrong places. The bog turtle (*Clemmys muhlenbergii*) and the Blanding's turtle (*Emydoidea blandingii*) of North America are listed as endangered or threatened in many of the states and provinces where they occur,[4,6,8] and many turtle researchers believe these species are under severe stress. I will discuss the Blanding's and bog turtles, with examples from east of the Hudson River in New York, to show how conservation biology research can provide tools for environmental planning.

Fig. 1. Blanding's turtle. Photo by Esther Kiviat.

The bog turtle (Fig. 5, p. 7) occurs in 13 states from Georgia to Massachusetts. There is a gap between southern Virginia and northern Maryland; the population in western Pennsylvania may be extirpated and the range in western New York has contracted.[6] The Blanding's turtle is present in 16 states and Canadian provinces from Nebraska to Nova Scotia,[2,7] but is absent from large areas within this range. East of Ohio, there are Blanding's turtles in: 1. Dutchess County, New York; 2. The St. Lawrence River corridor - Ontario Lake Plain; 3. Eastern Massachusetts, the southeastern corner of New Hampshire, and the southern tip of Maine; and 4. A small area of southern Nova Scotia. The only states that currently have both species are New York and Massachusetts; only in New York are both known within a single county (Dutchess).

The Blanding's turtle (Figs. 1-2) reaches a maximum carapace (upper shell) length ca 255 mm and becomes sexually mature at about 190 mm. The carapace is elongated, high-domed, and blackish with faint light speckles that stand out when wet. The plastron (under shell) is dull yellow with 12 large black blotches, one on each scale; there is a plastral hinge but the Blanding's cannot close up tightly like box turtles. The head and very long neck are patterned rather like the shell, except that the chin and throat are solid lemon-yellow. Adult males are larger than females, and have a concavity in the posterior lobe of the plastron and a thickened tail base.

The bog turtle is one of the smallest North American turtles, with a maximum carapace length ca 110 mm. The carapace is usually dark gray or brown, but some individuals have a dull orange "sunburst" pattern. The bog turtle's plastron may be dull brown or dark yellow, or may show a black-and-yellow pattern less distinct than that of the Blanding's. The head and neck are brown, with a distinct, large, orange, red, or yellow blotch on each side behind the eye. Adult males have a more concave plastron and a thicker tail base than females.

Fig. 2. Blanding's turtle (underside). Drawn by Kathleen A. Schmidt.

Both turtles have a great need for solar heat in order to attain body temperatures optimal for foraging, digestion, social behavior, and escape from predators. Heat-seeking behavior is especially prominent in spring in New York. The bog turtle becomes active in April. In spring, it is more visible on warm sunny days in the open, low vegetation of wet meadows, but in summer the bog turtle may be more active in the shade or burrowing in cool, soft sediments. Bog turtles bask on sun-warmed soil, dead plant material, sedge tussocks, and in other fast-warming microhabitats. Much food, principally mollusks and other invertebrates, seems to be captured in the sediments, where the bog turtle burrows extensively.[6] During hot, dry periods of summer, bog turtles may remain beneath the surface for long periods. Nesting occurs in June, when a female lays a clutch of 3-5 eggs in a small excavation in the top of a sedge (*Carex*) tussock or a peat moss (*Sphagnum*) hummock in the wetland. Bog turtles enter hibernation in mid-fall; the hibernaculum may be in a spring hole, beneath the woody root crown of an alder or other robust woody plant, in a muskrat burrow, or under a muskrat lodge or stone wall.

The Blanding's turtle emerges from hibernation in late March or April. During the spring, individuals are active in warm weather and apparently sluggish during cold spells. The turtles bask perched on logs or muskrat lodges, but more often with part of the carapace emerging from the floating layer of living and dead plant material (the neuston) on the water surface. While basking thus, Blanding's turtles often hold their heads beneath the surface and slowly move their necks from side to side, apparently foraging. Snails, fingernail clams, aquatic insects, other large invertebrates, and tadpoles are probably the principal foods in Dutchess County. In late May and June, a female migrates overland from her springtime wetland habitat, sometimes travelling more than a kilometer, and lays a clutch of 5-18 eggs[8] in a nest dug in well-drained, loose, sunny soil. Nest sites are often in gardens, house yards, and other disturbed habitats[3] within ca 1000 m of suitable springtime habitats such as buttonbush pools. In summer, Blanding's turtles often move to ponds with deep, cool water. Hibernation begins in mid-fall, in some cases in the same wetlands used in springtime.

The two turtles have other aspects in common. Both species move through wetlands or overland, on short and long time scales, to optimize the use of their environment. Both are affected by predation by raccoons and other animals, as well as by road mortality. And both turtles seem to require calcareous (calcium carbonate charged) groundwater in at least portions of the habitat complex. Habitat chemistry has been studied but little in New York; however, the flora indicates that the rivulets, pools, and flats of the bog turtle habitat tend to be quite calcareous, and the moats and pools of many Blanding's turtle wetlands are probably more calcareous than the surrounding upland surface soils. (This does not necessarily apply to habitats in other regions; a species may have different habitat affinities and physical-chemical tolerances in different geographic areas.)

The habitats of the Blanding's turtle and bog turtle (Table 1) must be considered as "habitat complexes." Each species focuses critical activities on a certain habitat type, but other habitat types are used within a normal annual cycle, during infrequent events such as droughts, and over periods of longer-term hydrologic and vegetational change. The crucial habitat for the Blanding's turtle is the springtime foraging and basking habitat (Fig. 3). These deep, fluctuating pools are often dominated by buttonbush (*Cephalanthus occidentalis*) thickets alone or with other tall shrubs. Other prominent species may be red ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), beggar-ticks (*Bidens* spp.), certain grasses, yellow water crowfoot (*Ranunculus flabellaris*), water-lilies (*Nymphaea*, *Nuphar*), certain pondweeds (*Potamogeton* spp.), certain bladderworts (*Utricularia* spp.), duckweeds (*Lemna*, *Spirodela*, *Wolffia*), and floating liverworts. Sedges (*Carex*), cattail (*Typha*), common reed (*Phragmites australis*), and willows (*Salix*) may be present but rarely cover large areas. Indicators of Blanding's turtle habitat include: Buttonbush in abundance, short-awn foxtail grass (*Alopecurus aequalis*), pale mannagrass (*Torreyochloa pallida*), and the aquatic liverworts *Ricciocarpus natans* and *Riccia fluitans*. The rare coontail *Ceratophyllum echinatum* has been found in a few habitats. Some springtime habitats are flooded swamps with dead trees. Blanding's turtles also use intermittent woodland pools and acidic bogs lacking most of the above-mentioned indicators, if those habitats are within several hundred meters of buttonbush pools.

Springtime foraging and basking habitat is also crucial for the bog turtle, and the best units may also serve as nesting and nursery areas. These "harsh fen" habitats are meadows with low tussocks interspersed with bare soil; shrubby cinquefoil (*Potentilla fruticosa*) and low, narrow-leaved sedges (*Carex* spp.) dominate; many other plants of wet, sunny, calcareous habitats are present, but grasses and tussock sedge (*Carex stricta*) generally are not common. The habitats have elements of the "rich sloping fen," "rich graminoid fen," and "rich shrub fen" described by Reschke.[9] Indicators of bog turtle habitat include: shrubby cinquefoil in abundance, grass-of-Parnassus (*Parnassia glauca*), the sedges *Carex flava, C. lasiocarpa, C. sterilis, and C. hystericina*, the spike-rushes *Eleocharis elliptica* and *E. erythropoda*, beak-rush (*Rhynchospora alba*), muhly grass (*Muhlenbergia glomerata*), *Juncus nodosus* and certain other rushes, mountain-mint (*Pycnanthemum virginianum*), brook lobelia (*Lobelia kalmii*), the goldenrods *Solidago patula* and *S. uliginosa*, autumn willow (*Salix serissima*), alderleaf buckthorn (*Rhamnus alnifolia*), red-osier dogwood (*Cornus sericea*) especially when in dense low patches, and selaginella (*Selaginella apoda*). Many of the indicators listed are also found in habitats not suitable for the bog turtle, and any given suitable habitat is unlikely to have all the indicators. Thus a few tufts of indicator plants do not make a habitat, but the species composition, abundance, and vigor of the flora provide the knowledgeable biologist with a wealth of information. Southeastern New York bog turtles sometimes occur in tussock sedge meadows and other wetlands quite unlike the habitat just described. It is unclear if these are degraded habitats, ancillary habitats within ca 400 m of focal harsh fen habitats, or suitable habitats having as-yet unidentified special features.

The habitats (Table 1) of the bog turtle and Blanding's turtle are at opposite ends of the wetland depth spectrum, yet both habitats are characterized by shrubs that are otherwise uncommon, both are apparently conditioned by groundwater discharge, and both function as temperature regulators and refuges from competition and predation. Despite the differences in the geographic ranges, habitats, and other aspects of the bog turtle and Blanding's turtle, the threats to both species are similar: human alteration of habitats, vegetation change, predation by raccoons and other animals, road mortality, and collecting.

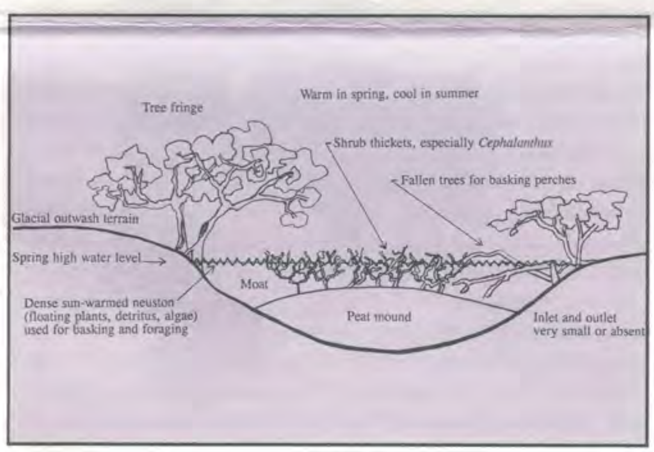


Fig. 3. Focal springtime habitat of the Blanding's turtle in Dutchess County, New York (schematic), showing thermal characteristics. Drawn by Erik Kiviat.

In the environmental planning arena, consultants, staff of public agencies and private groups, land owners, and other involved persons must make decisions about the selection and configuration of development sites, and the conservation and management of special habitats on and around development sites or in nature reserves. Of necessity, these decisions are ordinarily made with incomplete information about the relationships between the impacts of proposed land use and rare species. This imperfect world, however, does not mean that decision makers need act blindly or be swayed by inaccurate or distorted information. Experienced conservation biologists implicitly or explicitly use a procedure that might be called "ABCD." This is species- or habitat-specific, and comprises four steps: A. The prediction of *potential* habitat from topographic maps, soil maps, wetland maps, and aerial photographs, within the historic and potential geographic range of the species; B. The assessment of habitat *suitability* in the field, interpreting soil and water conditions, indicator flora, and cultural influences; C. Searching for the rare species or plant community in the appropriate season, time of day, microhabitat, and with a standardized minimum effort; and D. Conservation of habitat and species (or community). Steps B-D each follow the previous step only if an acceptable threshold is attained.

For the Blanding's turtle in Dutchess County, the ABCD procedure works like this.

A. Soil maps, U.S. Geological Survey topographic maps, National Wetland Inventory maps, and airphotos used to locate wetlands of any size within 500-1000 m of gravelly or sandy upland soils (usually glacial outwash, most often Hoosic soil series), within Dutchess County excepting the four easternmost towns;

B. Wetland soils with organic surface layers, water 25-120 cm deep in springtime, minor or no inlet and outlet, tree fringe but not a closed tree canopy, and a major component of tall shrubs (commonly buttonbush), or wetlands with 25-120 cm deep water in spring and within ca 500 m of wetlands having the other characteristics;

C. Live-trapping and visual observation with binoculars, for 5 continuous 24-hour periods during mild weather (water surface or neuston 25-36 C) 1 May to 16 June, using at least 20 (preferably 25) traps, covering all suitable habitat within at least 1000 m radius of the site of concern;

D. Maintenance of suitable hydrologic, chemical, and vegetational conditions in wetlands; no new construction of public roads, and management of vehicles, farm equipment, and construction equipment to prevent turtle mortality within at least 1000 m of wetland habitats or within more limited Blanding's turtle terrestrial movement areas if these are known ("Turtle Crossing" signs, speed bumps, speed limits, seasonal restrictions, and other techniques might be used); elimination of hazards such as swimming pools lacking turtle guards, or abandoned soil test pits, within 1000 m; and provision of passages through potential movement barriers such as partly-buried fences or stone walls (potential off-site impacts of development on the Blanding's turtle must be evaluated if suitable Blanding's turtle springtime habitat exists within 1000 m of the development site and the locations of any nesting areas and drought refuge ponds are not known).

The comparable procedure for the bog turtle in Columbia, Dutchess, Putnam, and Westchester counties follows.

A. Soil surveys used to identify any soil that is Somewhat Poorly Drained, Poorly Drained, or Very Poorly Drained *and* has a described pH range of the surface soil or subsoil that includes or exceeds 7.0, within the "bog turtle geographic areas of concern" (Fig. 4);

B. At least one occurrence of a fen or wet meadow 15 m or more long, within 400 m of the wetland or development site of concern, with these characteristics: vegetation predominantly 1 m or less in height at peak summer growth, areas of soft organic or loamy surface soil readily penetrable to a depth of 30 cm or greater, with calcicolous (lime-indicating) plants normally including shrubby cinquefoil, grass-of-Parnassus, and certain *Carex* sedges;

C. Visual and tactual search of fen habitat, 4 visits 1 week apart, 5 person-hours searching per hectare of habitat per visit, 15 April to 15 June, in suitable weather;

D. Maintenance of suitable hydrological, chemical, and vegetational conditions in wetlands, notably perennial, cool, mineral-rich but nutrient-poor groundwater seepage, low and open vegetation, suitable nesting substrates (sedge tussocks, *Sphagnum* hummocks, etc.) and hibernacula; light cattle, horse, or sheep grazing is permissible; siltation or nutrient input must be minimized such that nutrient levels in the fen do not increase; maintenance of extensive matrix of contiguous wetlands; road, vehicle, equipment, hazard, and barrier recommendations analogous to those for the Blanding's turtle (above) except that bog turtles do not leave the wetlands to nest and the activity range of concern is probably 400 m rather than 1000 m.

In practice, ABCD procedures are more complex than outlined. The effectiveness of the procedures depend on appropriate experience and training of the practitioners. The procedures may be used to examine the vicinity of a development site, or to identify resources for a whole town; for example, Step A could produce maps of potential rare turtle habitat that could be considered along with currently available factor maps of steep slopes and soils suitable for septic systems when selecting sites for residential or infrastructure development. My recommendations may seem strict, but must be viewed in the ecological context. The remaining populations of Blanding's turtle and bog turtle east of the Hudson are small (e.g. perhaps as few as 200 adult Blanding's turtles[5]), and turtle populations are vulnerable to increased mortality of juveniles and adults.[1]

There is a risk implicit in the dissemination of effective ABCD procedures for endangered species: illegal collectors can learn to better locate sites and acquire specimens, and unethical developers can destroy habitats to prevent planning controversies. Several years ago a land owner in Dutchess County, for example, bulldozed a fen supporting a rare plant. These ever-present possibilities must be balanced by elements of confidentiality, and vigilance by citizens and groups. (*Note that step C, searching for and handling a threatened or endangered animal, requires an Endangered Species Permit from the DEC, and it is desirable that all stages be conducted in consultation with the DEC.*)

A 1993 survey of springtime Blanding's turtle habitats in Dutchess indicated alteration by drainage, filling, dumping, damming, road crossings, or other means in nearly all the habitat units. Although some Blanding's turtle wetlands have undergone alterations that did not harm, or even improved, habitat suitability, many alterations have had negative impacts. The drainage, filling, damming, or excavating of wetlands, their use for treating storm water or polishing sewage effluent, or any other activities with the potential to affect the quality, timing, or quantity of wetland water, must be considered on a case-by-case basis. If information is insufficient to demonstrate a neutral or beneficial impact, the wetland should not be altered. Nonetheless, notable examples of the inadvertent creation of Blanding's turtle habitat in the past could guide experimental habitat creation. Any such experiments must include scientifically rigorous "before" and "after" studies of sufficient duration to judge success and guide future efforts at restoration, creation, and management. Bog turtle habitat ecology is quite different; other than light grazing by livestock and possibly the cutting of taller vegetation, there is no evidence that unintentional or intentional habitat alterations can be beneficial. The groundwater hydrology and apparently low nutrient levels of bog turtle fens suggest it would be difficult or impossible to create habitat or restore severely damaged habitat.

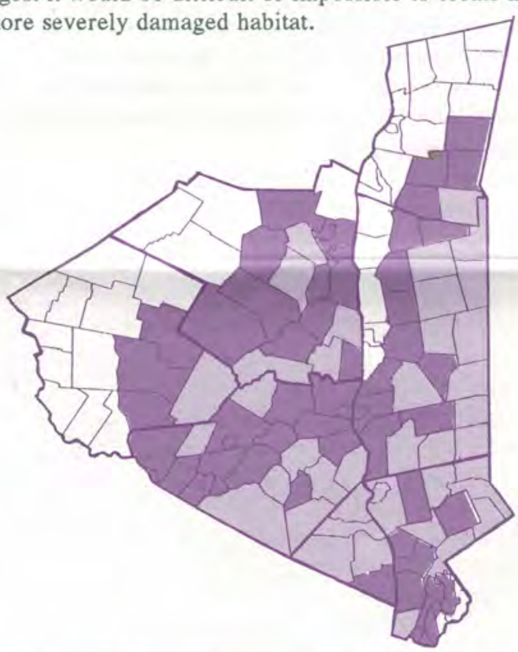

Fig. 4. Map of Hudson Valley towns in which bog turtles have been found, and adjoining towns, together comprising the "bog turtle geographic areas of concern." (Unpublished distribution data, New York State Department of Environmental Conservation Endangered Species Unit.)

Table 1. Comparison of principal features of the springtime habitats of bog turtle and Blanding's turtle in eastern New York. Descriptions pertain to typical conditions and may not apply to altered habitats or habitats used outside the springtime; furthermore, there are occasional exceptions to these features in eastern New York, and habitats in other regions may differ.

| Habitat feature | Bog turtle | Blanding's turtle |
|---|---|---|
| Bedrock geology | Marble, limestone | Sandstone, shale, slate, carbonates |
| Surficial geology | Till, outwash | Outwash, till |
| Groundwater | Perennial seepage through vegetation | Discharge at pool margins |
| Surface water | Rivulets, tiny pools several cm deep | Large pools & channels 0.3-1.2 m deep (a) |
| Water clarity | Clear | Stained (occasionally clear) |
| pH (b) | Neutral to alkaline (hummocks may be acidic) | Acidic to alkaline |
| Nutrient status (b) | Low | Low to moderate? |
| Microtopography | Small tussocks, rivulets | Banks abrupt; central peat mound or woody hummocks may be present |
| Wetland soil texture (c) | Organic or loamy | Organic |
| Wetland soil type | Palms, Sun, Carlisle, Wayland, etc. | "Muck," etc. |
| Upland soil series | Stockbridge, etc. | Hoosic, etc. |
| Marginal vegetation | Some woods present | Wooded or tree fringe |
| Tree canopy | Absent or very open | Absent or open |
| Shrub layer | Low shrubs prominent, tall shrubs sparse | Tall shrubs in patches or extensive |
| Herbaceous layer | Low, sedge-dominated | Forb-dominated |
| Mosses & liverworts (d) | *Sphagnum*, others often common on soil | Mostly on woody substrates; *Sphagnum* uncommon |
| Dead wood (e) | Generally rare | Often prominent |
| Neuston | Minor | Major; often thick |

a. Springtime depths.
b. pH and nutrient status are inferred from the vegetation and for bog turtle habitats from studies in other regions.[10,12]
c. Surface layer.
d. Other than "floating" liverworts.
e. Greater than 15 cm in diameter.

Errors in wetland mapping and wetland boundary delineation[11] can pose a major problem for the conservation of rare turtle habitats. Bog turtle fens often occur at wetland-upland edges where groundwater seepage enters a large wetland; on airphotos, these peripheral wet meadows may appear to be oldfields, therefore some habitats were omitted from New York State Freshwater Wetlands Maps. Most Blanding's turtle wetland habitats are smaller than the automatic regulatory threshold of 5 ha (12.4 ac) and were not mapped, although the DEC upgrades these wetlands to Class I protected status once a Blanding's turtle is found in the wetland. One over-5 ha unmapped bog turtle wetland was partly ditched and filled before the bog turtles were discovered, and at least three under-5 ha Blanding's turtle wetlands were damaged before or after discovery of the turtles. Wetlands are often under-delineated in the field (i.e. delineated as smaller than their actual size); because the delineation of the wetland boundary has important impacts on habitat conservation, all boundary delineations should be inspected by an independent expert so that errors may be corrected and legitimate differences of opinion can be aired. Although the 30 m (100 ft) regulatory "adjacent area" outside the delineated wetland boundary may protect an under-delineated wetland, the actual ecological buffer zone is narrowed, potentially allowing removal of the woodland that protects the wetland from wind, siltation, nutrient loading, and human intrusion. These cases demonstrate the need to apply the ABCD procedures consistently throughout the ranges of Blanding's turtle and bog turtle in the Hudson Valley.

Cumulative impact assessment is another difficult issue. For example, each residential development project within the watershed of a bog turtle wetland contributes nutrients, silt, and other pollutants. The pollution from each project may be minor, but cumulatively pollution may exceed the levels that cause habitat deterioration such as overgrowth by tall vegetation. The State Environmental Quality Review Act (SEQRA) mandates consideration of cumulative impacts. Yet which regulatory jurisdictions are responsible and to what extent individual developers can be required to fund the analysis of cumulative impact are unclear (this analysis may also require studies on other people's land). When development requires a DEC permit (e.g. a Freshwater Wetlands Permit) and the DEC is Lead Agency under SEQRA instead of a Town agency, cumulative assessment is easier. The DEC does not always assume the role of Lead Agency when a DEC permit is required, and this would be helpful in situations likely to involve the conservation of habitat quality for the bog turtle or Blanding's turtle. Nonetheless, a Town agency should be able to require cumulative impact assessment within the boundaries of the town. The towns of Ancram and Northeast, for example, both have high quality, extant, bog turtle sites, and the towns of La Grange and Hyde Park both have multiple Blanding's turtle sites. The town planning boards could begin conducting cumulative assessments of impacts on these habitats, so that residential and commercial developments, soil mines, and other projects on the docket now or proposed in the next 5-10 years, can be dealt with proactively, sensitively, fairly, and economically. The mechanics of off-site and cumulative impacts such as water pollution, together with habitat dynamics and turtle mobility, also emphasize the need for large working reserves to protect the matrix of which the turtle habitats are part.

We have many of the tools needed to meet the challenge of bog turtle and Blanding's turtle conservation, and these species are known better than many other endangered and threatened species. But do we have the institutional and political will to put these tools to good use - and the economic ingenuity to fund the research, planning, land preservation, and monitoring? The large reserves that will be necessary for long term protection of the landscapes supporting these two rare turtles may need to include working agriculture, residences, recreation areas, and other economic activities, all compatible with turtle habitats, to facilitate the preservation of the landscape elements critical to the turtles. Preliminary estimates suggest a Blanding's turtle reserve, including drought refuge, nesting area, and buffer zone, might require one to several square kilometers. A bog turtle reserve, including future habitats, dispersal corridors, the wetland matrix, and buffer zone might require a larger area, perhaps 10-20 or more square kilometers.

The problem of designing and establishing turtle reserves is complicated by not knowing the full extent of habitats supporting the local enclaves of individuals that collectively comprise a "metapopulation," and also because most habitat complexes are already fragmented by paved public roads. Yet large turtle reserves comprising wetlands, forests, and farmlands could provide services to society in the form of amelioration of water quality, recreational opportunities (depending on the sites, fishing, hunting, hiking, and nature study), protection of agricultural soils and farming opportunities, carefully planned and monitored extractive activities such as mining and logging, and the conservation of many other rare, declining, or development-sensitive animals such as American black duck, red-shouldered hawk, northern harrier, bobolink, spotted turtle, wood turtle, ribbon snake, and blue-spotted salamander. The real test of turtle conservation may prove to be land use planning and reserve design that accomodate the needs of rural land owners. If society values rare species and wants to conserve native biological diversity, all of us as users of the landscape will have to do more to contribute to conservation of the bog turtle, the Blanding's turtle, and their habitats.

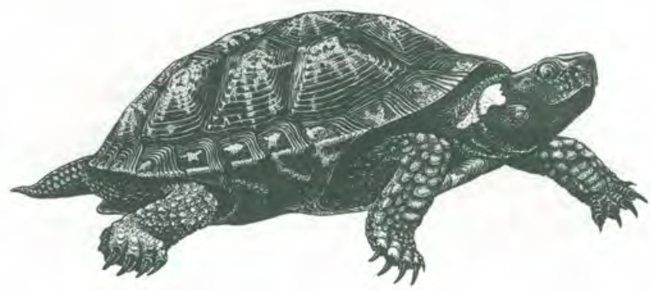

Fig. 5. Bog turtle. Drawn by Kathleen A. Schmidt.

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Copyright © Kathleen A. Schmidt 1993. Flora of turtle habitats identified or verified by Gretchen Stevens and Jerry C. Jenkins. This article is based in part on research conducted in collaboration with Michael W. Klemens (Center for Biodiversity and Conservation - American Museum of Natural History, and IUCN/SSC Tortoise and Freshwater Turtle Specialist Group), John L. Behler (Department of Herpetology, NYZS - The Wildlife Conservation Society), Marla Emrich Briggs (formerly Bard College Graduate School of Environmental Studies), Hank Gruner (Science Museum of Connecticut), and Al Breisch and Jim Eckler (New York State Department of Environmental Conservation Endangered Species Unit). Thanks also to Judy Landry, Joel Hermes (deceased), and Patricia Riexinger (DEC), Paul Novak (New York Natural Heritage Program), Dave Hayes (National Park Service), Jim Curatolo and Chris Harmon (Nature Conservancy), several field assistants, and many landowners and citizens. Financial support for Blanding's and bog turtle work was provided by: Return a Gift to Wildlife (Southeastern New York Bog Turtle Survey), Cary Arboretum Institute of Ecosystem Studies (Cary Summer Research Fellowship to EK), Nature Conservancy Lower Hudson Chapter, Norcross Wildlife Foundation, Conservation Resources Group, New York State Office of Parks, Recreation, and Historic Preservation, U.S. National Park Service, Chauncey Stillman and other Millbrook Marsh Watershed Fund donors, International Business Machines, Serls Realty, East Coast Land Partners, Guercio Construction, Lee Archer, Ernest Rivellino, Edward Shelley (deceased), Taconic Valley Preservation Alliance, New York State Department of Transportation, Simon's Rock College of Bard (Junior Fellowship to Tanja Pyles), and individual donors to Hudsonia. Michael W. Klemens, Gretchen Stevens, Drayton Grant, and an anonymous reviewer commented on a draft of the article. Grantors, agencies, and individuals acknowledged do not necessarily agree with the concepts and opinions expressed in *News from Hudsonia*; final interpretations are those of the author.

Dear Friend of Hudsonia,

Hudsonia was founded in October 1981. Besides research and technical assistance for the conservation of rare turtles, Hudsonia has conducted many other activities. Our studies of wetlands, streams, and development sites are well known. We have tested new techniques for sampling, identifying, and curating specimens for Hudson River fisheries research. We have studied the winged monkeyflower, osprey, timber rattlesnake, pine barrens treefrog, and other threatened or endangered species. We offer courses, by experts, on natural history subjects otherwise unavailable in the region. Agency staff, consultants, and land owners contact us for current information.

This unique institute needs your support to continue its work in the Northeast.

Why not give Hudsonia a birthday gift? Your $25, $50, $100, or another amount will help us work for the conservation of rare turtles, special habitats, and native biological diversity. You could make a sponsorship donation ($200-$2500) on behalf of your business or a nonprofit organization. IBM and many other corporations match employees' donations. Other ways to help Hudsonia include a gift of goods or services, a referral for a grant or a contract, or a bequest - please contact us for more information.

Erik Kiviat, Executive Director

## * Two Hudsonia Projects *

We have just completed a demonstration project in stream restoration, on the Saw Kill in Annandale, New York. Retaining walls and a septic system were removed, slopes regraded, soil stabilized with natural fiber matting, and six species of native sedges planted to create a "natural" stream bank habitat. The grading was done by John Hardeman Excavating, and the stabilizing and planting designed and carried out by Creative Habitat. The project was supported by the J.M. Kaplan Fund.

This fall we begin work on a *Manual for the Identification of Biodiversity Resources in the Hudson River Greenway Corridor*. In this two-year project, Hudsonia will synthesize existing information and methods to provide a tool for land trusts, municipal agencies, citizens' groups, land owners, and consultants who want to identify significant habitats for planning purposes. We will be polling potential users about information needs, and offering training workshops in 1994. Potential users can contact our office to be on the mailing list for this project. The *Manual* will be supported by the Sweet Water Trust, the Hudson River Foundation, and as-yet unidentified funding sources.

### Micro-review

Middleton, R.L., D. Dreishpoon & R.E. Lawton. 1993. Lewis Rubenstein; A Hudson Valley painter. Dutchess County Art Association and Overlook Press, Woodstock, NY. 80 p. -Watercolors of the river, landscapes, and other subjects.

### Bard GSES

The 1994 catalog of the Bard College Graduate School of Environmental Studies will be available soon (call 914-758-7483).

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