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Phantom crane fly. Photo: Kristen Bell Travis © 2010

News from Hudsonia

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INSIDE HUDSONIA

You don't know what you've got 'til...

Dear Friends of Hudsonia,

If there was ever any doubt about the fragile and ephemeral nature of our wild and precious environment, the unfolding tragedy in the Gulf of Mexico makes it terrifyingly clear. The knowledge that what we have can so easily be lost lends greater urgency to our work.

This issue of *News from Hudsonia* brings to light things we still need to learn about our own landscape: the special habitats of the region, and the importance of forests in maintaining the quality and quantity of our water resources. Both stories highlight the intricate natural systems that can be upset not just by one massive environmental disaster but also by the creeping destruction caused by land use decisions made without the benefit of good science.

The accumulated knowledge from decades of work by Hudsonia biologists provides the scientific underpinnings for the conservation work of other organizations and agencies in the region.

As we go to press, we do not yet have all the funding we need to complete the habitat mapping of the towns of Dover and Woodstock. In these days of diminished state monies for conservation, it's more vital than ever that individuals and private entities carry on where public funding leaves off.

If you can help, please do. Preserving the best of what we have requires all of our best efforts.

Philippa Dunne
Chair, Board of Directors

Erik Kiviat
Executive Director

On the cover: Phantom crane fly (*Bittacomorpha clavipes*). This unusual insect has an aquatic larva and is associated with fens and other circumneutral wetlands in our region. The species can be locally common in suitable habitats, but little is known of its ecology. A phantom crane fly moves slowly through the air in a vertical position with legs outstretched like the spokes of a wheel, then seems to disappear as it lands on a sedge.

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COOL RAVINES AND OTHER BIODIVERSITY HOTSPOTS IN THE TOWN OF DOVER

By Gretchen Stevens*

Even in the middle of a hot summer day, the air is cool in these twilit depths where the rocky walls rise steeply on either side. Some parts of this netherworld never see direct sunlight, and the summer air temperatures always feel like early spring. There are only a few such cool ravines in southeastern New York, but this is just one of many rare habitats in the Town of Dover (Dutchess County) where Hudsonia is now identifying and mapping all the ecologically significant places that we can find.

Dover is one of the few towns we know of where you can find fens, calcareous wet meadows, and marble knolls all within a few hundred meters of acidic bogs, acidic ledges, and oak-heath barrens. These environments represent regional extremes of the pH spectrum and are home to unusual concentrations of rare plant and animal populations. They occur in surprising proximity to each other in Dover and nearby towns in the physiographic region that we loosely refer to as the Harlem Valley and Ridges (HVR)—a system of broad fertile valleys on the southeastern edge of the state, flanked by hills on the east and west.

Why this strange juxtaposition? The valleys in the HVR region are underlain by carbonate bedrock—marble, limestone,, and dolostone. These are the "soft," easily-weathered carbonate rocks formed from decayed marine plants and animals accumulated during the Cambrian and Ordovician geologic periods, when the land mass that is now North America was in the southern hemisphere and this part of it was under water.[2,3] Harder rocks—especially schist, gneiss, and quartzite—underlie the Taconic range to the east and the lower hills to the west. The proximity of these very different bedrock types helps to explain the great diversity of habitats, plants, and animals, and the presence of many rarities in the HVR. Another contributor is the large deposits of glacial outwash over the carbonate bedrock, yielding abundant groundwater discharge at springs, seeps, streams, and calcareous (calcium-rich) wetlands. Recognizing the concentration of important habitat complexes and known rare species occurrences, the New York State Department of Environmental Conservation has designated several Significant Biodiversity Areas in the HVR corridor.[6] Dover itself may have the highest known concentration of rare species of any town in southeastern New York.

One of Dover's greatest natural assets is the **large areas of forest** in the Taconic Ridge and West Mountain. The second article in this issue of *News from Hudsonia* explains the importance of forests for maintaining groundwater and surface water resources, stream

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* Director of Hudsonia's Biodiversity Resources Center

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habitat quality, and wildlife habitat. Fragmentation of these forests (e.g., by roads, driveways, house lots, utility corridors, etc.) threatens the native wildlife of Dover, and loss of forest cover can reduce carbon sequestration and lead to degraded stream habitats, reduced groundwater volumes, and poorer water quality for streams, ponds, and drinking-water wells.

The special habitat that we call a "**cool ravine**" differs from other ravines in having especially steep, high, rocky walls narrowly flanking a rocky stream. This configuration makes for a very shady, cool, moist microclimate, and we often find plants of more northern or high-elevation affinities—such as striped maple, mountain maple, fly honeysuckle, hobblebush, American yew, and red-berried elder. Northern slimy salamander and small-footed bat may use talus (loose rock) areas of the rocky ravine walls, and northern dusky salamander and perhaps even spring salamander may use the streams and associated seeps of cool ravine habitats. Rare and uncommon birds such as Acadian flycatcher and blackburnian warbler sometimes nest in the trees clinging to the steep walls and lips of cool ravines. The gorge below the "Stone Church," a small cavern on the eastern slope of West Mountain, is a beautiful example of a cool ravine in Dover. These places, where air temperatures are markedly cooler than those of the surrounding landscape, provide habitat for unusual biota, and may offer critical refuge for wildlife and plants stressed by the advance of global warming in the coming decades.

An **oak-heath barren** is a special kind of open rocky habitat that occurs on hilltops and slopes with exposed bedrock and shallow, acidic soils. You can recognize the habitat by the sparse and often stunted vegetation, and the distinctive plant community of pitch pine, scrub oak, other oaks, chokeberries, and heath (Ericaceae) shrubs such as lowbush blueberries, huckleberries, and deerberry. Oak-heath barrens appear to benefit from occasional wildfires which help the pitch pine regenerate, return nutrients to the soil, and prevent the overgrowth of large trees and other vegetation. The very shallow soils, fires, and exposure to extremes of air temperatures, wind, and ice also discourage other kinds of plants from colonizing these areas. Species of statewide and regional conservation concern sometimes found on oak-heath barrens include clustered sedge, bronze sedge, mountain spleenwort, northern hairstreak, Edward's hairstreak, Nashville warbler, and whip-poor-will. Snakes such as timber rattlesnake, northern copperhead, and black racer use these areas for basking and breeding, and may rest and overwinter in deep bedrock crevices associated with some barrens.

Marble knolls, the biodiversity jewels of the region, occur only here in the Harlem Valley where Stockbridge Marble bedrock forms low hills rising from the broad valley floor. Although they may look unprepossessing—most are now abandoned pasture or hayfield or young forest—marble knolls support an extraordinary array of rare and uncommon plants and animals. Side-oats grama, Bicknell's sedge, Carolina whitlow-grass, Virginia false-gromwell, mock-pennyroyal, Torrey's mountain-mint, yellow wild flax, large twayblade, green milkweed, and northern blazing-star[4] are just a few of the state-listed rare plants of these habitats. In some places the marble bedrock has weathered to produce a whitish-gray calcareous sand, sometimes referred to as the "white sands of Dover"—a unique feature of the Dover landscape. Eastern hognose snake is known to use this habitat, and this is one of two locations north of Long Island where the eastern spadefoot toad has been found in the state. We expect that the sandy soils also provide nesting sites for wood turtle, spotted turtle, and snapping turtle wherever these knolls are close to suitable streams and wetlands. The habitats of marble knolls are mostly dryish upland forests and meadows, but look for small fens on hillside seeps, and larger fens at the knoll bases.

With the decline of agriculture in the

Hobblebush (*Viburnum lantanoides*), a shrub of cool ravines. Photo: Nava Tabak © 2010

Round-leaved harebell (*Campanula rotundifolia*), a wildflower of dry, calcareous woods, meadows, and ledges. Photo: Erik Kiviat © 2010

region, **upland shrubland** is now a fairly common habitat, often occupying the brief successional stage between abandoned meadow and young forest. In Dover and other towns of the HVR, large areas of dense shrub thickets have caught the attention of biologists because of their apparent suitability for the rare New England cottontail—a native rabbit that has been largely replaced in our landscapes by the very common eastern cottontail, introduced to the Northeast in the early 1900s. Shrublands also may support uncommon and rare breeding birds such as golden-winged warbler, clay-colored sparrow, and yellow-breasted chat, and a host of other rare birds, reptiles, and invertebrates. Shrublands on calcareous soils sometimes have rare plants such as shrubby St. Johnswort. This serves as a reminder that even common habitats that the conservation community tends to ignore may have important biodiversity values deserving our attention.

A **fen** is a special kind of wet meadow fed by calcareous groundwater seepage. Fens occur mainly in areas underlain by carbonate bedrock, and are unusually concentrated in Dover and nearby towns in the HVR. They can be difficult to distinguish from other wet meadow habitats to those unfamiliar with the indicator plants of the fen community, such as shrubby cinquefoil, grass-of-Parnassus, porcupine sedge, and bog goldenrod. Indeed, because fens are difficult for non-biologists to identify, many landowners are entirely unaware that they have these habitats in their own meadows and forest openings. Fens are the core habitat for the endangered bog turtle in this part of New York, and support other rare species of animals and plants.

Intermittent woodland pools—those small, isolated wetlands that dry up in the summer but are teeming with frogs and salamanders in the spring—are important foraging and rehydrating sites for mammals, birds, and reptiles in the larger landscape. The abundant amphibians emerging from such pools each year are a prominent part of the forest food web, and play a critical role in Dover's forest ecology.

Circumneutral bog lake—the name is a mouthful that lives up to the biological complexity of these exceptional places. A circumneutral bog lake is a spring-fed, calcareous waterbody that typically has vegetation of both acidic bogs and calcareous wetlands and ponds. The lakes often have large areas of open water that in summer may be partially or entirely covered with pond-lilies, and large floating mats with abundant *Sphagnum* mosses and diverse woody and herbaceous plants, often in communities resembling those of acidic bogs. But the strangest feature of these lakes is the "peat rafts" that sometimes drift freely around the lake surface. The rafts are masses of pond-lily rhizomes and decayed organic material buoyed by the gases produced by biological processes in spring through early fall. As temperatures decline in the fall and biological activity slows down, the rafts sink slowly to the lake bottom; then they rise again to the surface with warming temperatures in the spring. The rafts often develop unusual plant communities, including species of regional and statewide rarity, and we have seen them used as perches and basking sites by shorebirds, waterfowl, and turtles. Circumneutral bog lakes are hotspots for rare and uncommon species of plants and animals, and seem to be very sensitive to water pollution and other human disturbances.

"Swamp" is a technical term applied to any wetland dominated by trees or shrubs, and "hardwood swamps" are the most common and extensive kind of wetland in the state. **"Calcareous" hardwood swamps**—those with calcium-rich soils and circumneutral or alkaline waters—are much less common in general, but are well represented in the Town of Dover due to the prevalence of carbonate bedrock in the lowland areas. Calcareous swamps have many plant species typical of other swamps (such as red maple, green ash, slippery elm, and silky dogwood), but also may have black ash, pin oak, swamp white oak, poison sumac, maleberry, and Pennsylvania saxifrage, and a variety of other calcicoles (plants with an affinity for calcium-rich environments). Rare plants of calcareous swamps in the region include dwarf huckleberry, southern dodder, and spotted pond-weed. The Great Swamp, associated with the Swamp River and the Tenmile River in Dover and extending south into Putnam County, contains fine examples of calcareous swamps. But calcareous or not, forested swamps of all kinds provide important wildlife habitats, particularly for amphibians, cavity-nesting and forest-interior songbirds, and bats.

This is just a small sample of the ecologically significant habitats in the Town of Dover. In fact, we have not yet confirmed circumneutral bog lakes in the town (although they occur in several nearby

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Forests: Unsung Defenders of our Waters

Condensed and adapted by Kristen Bell Travis, from Wilder and Kiviat (2008)*

A "watershed" is the entire land area that drains into a particular stream, pond, reservoir, or other waterbody. The watershed of a small woodland pool might be less than a hectare, but the watershed of the Croton Reservoir system spans large areas of Westchester, Putnam, and Dutchess counties, covering nearly 1000 km^2 (about 400 mi^2) of southeastern New York. The water quality, biodiversity, and ecological health of freshwater systems depend in large part on the condition of the many small streams that feed the larger streams and waterbodies, and all depend on the condition of the land throughout the watershed. Forests are important contributors to the water quality and habitat quality of freshwater systems, and to wildlife conservation and carbon sequestration, but there is little legal protection for forests in the northeastern United States, and they continue to yield to urban, suburban, and rural development. The loss of forests can have dramatic consequences for our water resources, causing streams to dry up, groundwater to be depleted, and water quality to be degraded.

Surface Runoff and Stream Flow

First, a brief primer on the fate of rainwater and snowmelt in the landscape. Precipitation travels to streams in two major forms: as surface flow (runoff) and subsurface flow (groundwater). Large volumes of runoff flowing quickly into streams leads to higher flood crests, greater soil erosion, and a suite of other physical disturbances. Vegetated land cover helps to slow runoff into streams by several mechanisms, and forested landscapes are perhaps the most effective at this task. Organic matter on the soil surface and within the soil, as well as pores formed by roots and soil fauna, makes the forest soils highly permeable,[13] allowing for high rates of water infiltration. Groundwater is replenished by infiltration of large volumes of rainwater and snowmelt in forested landscapes. Water uptake and transpiration by trees and other forest plants during the growing season further reduce water runoff. The main mechanism by which streamflow is sustained through dry periods is by slow subsurface flow of groundwater.[4] In an intact forested watershed, a large portion of precipitation recharges groundwater, and thence moves slowly into streams. The effect is to moderate flood crests and keep streams flowing during the drier times of year.

Deforestation or replacement of forest with impervious surfaces (e.g., pavement, roofs), on the other hand, can produce unnaturally large volumes of runoff which can radically alter stream flows. Many studies,[18] including a recent one examining runoff in the Croton Watershed,[2] have found that peak stream flows after storm events increase with increasing urbanization. Watersheds with large areas of impervious surfaces tend to produce high flood flows, little groundwater recharge, and (consequently) low base flows of streams during dry periods.[18] Hence, in many urbanizing watersheds, streams that once flowed year-round now have little or no flow by mid-summer."

Stone Church Brook, a forested stream in the Town of Dover, Dutchess County, NY. Photo: Nava Tabak © 2010

Soil Erosion

The accelerated rate of soil erosion has been of such concern in the United States since the 1930s that experts consider it to be an environmental crisis.[19] The cutting and carrying power of water is disproportionately associated with its velocity[13] and, in the landscape in general, the rate of erosion may increase dramatically with a small increase in runoff. The canopy and litter layer of an intact forest, however, provide significant protection from the erosive energy of falling raindrops. Furthermore, the roots of trees and associated vegetation not only increase soil permeability and thus reduce runoff, but also stabilize the soil itself. Stream banks, too, are stabilized by roots of riparian vegetation and shielded from erosion by leaf litter.[1,6] Mature northeastern forests are relatively erosion-resistant ecosystems due to slowed runoff and sheltered and stabilized soils.

Siltation and Eutrophication

An important consequence of deforestation in urbanizing watersheds is the diminution of water quality and habitat quality in streams from increased levels of sediment and nutrients. Siltation occurs when large amounts of sediment are deposited in the stream bed, disrupting the stream's ecology in many ways. The major causes of stream siltation are erosion and soil transport in storm runoff—processes that are tightly controlled in healthy forests[24] but are elevated in disturbed or developed landscapes. Increased siltation in streams may result in suffocation of aquatic wildlife, and smothering and abrasion of habitats.[15] In ponds, lakes, and reservoirs, sediment deposition reduces reservoir volume and duration of use, causes deterioration of water quality, reduces flood control capability, and even augments breeding areas for mosquitoes.[7]

"Eutrophication" is the hyper-enrichment of an aquatic system by dissolved nutrients, stimulating excessive growth of aquatic plants and usually resulting in the depletion of dissolved oxygen. The process of eutrophication changes both the chemical and biological characteristics of surface waterbodies and constitutes one of the most serious water quality problems affecting human uses and aquatic habitats in developed landscapes. Chemical nutrients, most importantly phosphorus and nitrogen, enter waterbodies in runoff from agricultural activities (fertilizers, animal wastes) and residential and urban areas (fertilizers, septic leachate, sewage, garbage, pet feces), particularly following periods of intense precipitation.[e.g.,12] Eutrophication can also result from deforestation in otherwise undeveloped watersheds.[14] Algae and cyanobacteria (blue-green algae) thrive in the high-nutrient environments of affected streams and ponds, forming dense blooms, reducing oxygen availability, and releasing toxins. These algal blooms can have harmful effects on the entire aquatic food web including submerged vascu-

* Kristen Bell Travis is a biologist with Hudsonia Ltd. This article was adapted from "The Functions and Importance of Forests, with Applications to the Croton and Catskill/Delaware Watersheds of New York" by Aryn Wilder, MS, and Erik Kiviat, PhD. Report to the Croton Watershed Clean Water Coalition, Hudsonia Ltd., October 2008.

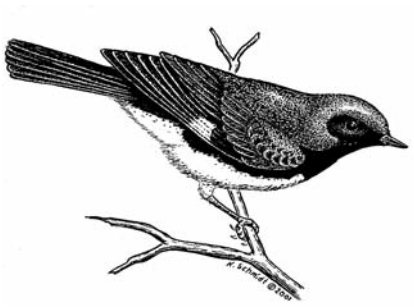
lar plants, macroinvertebrates, and fish, and also affect drinking water and other human water uses.[21]

Nutrient Cycling and Pollutant Buffering

Within the forest ecosystem, nutrients naturally cycle between soils, water, and living and dead organisms. The disruption of the nutrient cycle by the removal of forest vegetation can lead to large fluxes of nutrients into streams, affecting downstream water quality and ecosystem function.[8]

McHale et al.[16] documented the effects of logging on stream water chemistry in the Neversink Reservoir basin of the Catskill Watershed. Deforestation caused the release of significant quantities of nitrate from decaying organic matter, mobilizing inorganic aluminum from the soil, and leading to a large increase of nitrate and inorganic aluminum in stream water. The changes in water chemistry caused death in 100% of caged brook trout during the first year, and harmed macroinvertebrate communities for two years after the harvest. Nitrate did not increase in streams flowing from less-disturbed (selectively harvested) basins, however, suggesting that healthy, forested watersheds are able to buffer disturbances in nutrient cycling.

Forest soils are also highly effective at intercepting pollutants and excess nutrients that would otherwise end up in downstream waters. Interactions with the soil change the chemistry of soil water.[16] If water infiltrates into the soil and root zone, certain pollutants can become bound to soil particles and then be taken up by microbes and plants. One study found a loss of 80% of nitrate and 74% of phosphate from storm runoff after exposure to streamside soils.[3] Bacteria associated with the roots of birch (*Betula*) are capable of degrading polycyclic aromatic hydrocarbons (toxic, mutagenic, and carcinogenic substances produced by combustion) in the soil.[23] Other soil bacteria are able to completely change atrazine, a commonly used herbicide, into carbon dioxide.[17] For effective cleansing to occur, runoff must have extended contact with soil microbial communities. When impervious surfaces or loss of forest vegetation prevent precipitation and snowmelt from infiltrating the soil, however, more pollution ends up in streams, ponds, and reservoirs.



Black-throated blue warbler nests in forest-interior habitats. Kathleen A. Schmidt © 2001

In addition to their demonstrated value for maintaining and improving water quality, forests also play a critical role in the global carbon cycle. Indeed, deforestation may account for nearly 25% of the increase in global atmospheric carbon dioxide.[5] In northern hardwood forests, large pools of carbon are stored in above- and below-ground living biomass, dead woody matter and forest floor detritus, and soils. Moreover, forests of the northeastern United States, as a whole, are actively sequestering more carbon than they are releasing as forests mature from past major disturbance.[26] Deforestation results not only in the release of stored carbon into the atmosphere, but also in the loss of future stored carbon because those trees will no longer sequester additional carbon each year.

Ultraviolet Radiation and Temperature

Leafy forest canopies along streams and rivers help stabilize aquatic ecosystems by controlling the amount of sunlight that reaches the water. When forest canopies are altered or removed, streams are exposed to more sunlight and ultraviolet radiation, leading to increases in temperature and consequent changes in the composition of aquatic communities. Compared to heavily shaded sites, areas of streams with reduced canopy have more algae[14] and reduced macroinvertebrate biomass and diversity.[22] Spikes in temperature caused by exposure to sunlight can affect the solubility of gases, rates of decomposition, and rates of metabolism and growth in aquatic animals, and are associated with increases in fish mortality and prevalence of disease.[9]

Habitat Quality and Biodiversity

Healthy and biologically diverse aquatic and terrestrial habitats are intrinsic to the ability of a watershed to maintain water quality. Because each habitat supports a different kind of biological community, the combination of upland, riparian, and aquatic habitats within a watershed can accommodate significant species diversity.[20] Macroinvertebrates,[16,22] fish assemblages,[10] waterfowl and other birds,[11] river otter, and many other rare and common species of streams and ponds rely on healthy watersheds to maintain the quality of aquatic habitats.

Summer maternity colonies of the endangered Indiana bat are most often found on the underside of peeling bark of dead or living trees with certain bark characteristics,[25] and the abundance and distribution of the bats are affected by the density of such trees that provide roosting habitat. Other organisms that depend on forest trees and are likely to be negatively affected by forest loss in our region include several other species of bats as well as flying squirrels, porcupine, fisher, bobcat, wood duck, ruffed grouse, most of the hawks and owls, many songbirds, mole salamanders, dusky salamanders, spring salamander, brook trout, many other stream fishes, a large number of invertebrate species, and many forest wildflowers, sedges, mosses, liverworts, lichens, and fungi.

Both in remote rural areas, and in watersheds where streams and forests are severely threatened by human activities, intact forests actively work to moderate climate, take up pollutants, maintain groundwater volumes and stream flows, and prevent further degradation of water quality. Anyone concerned about the immediate and long-term future of our water resources, wildlife habitats, and carbon balance should concentrate on conserving intact forests wherever possible, and on designing region-wide, town-wide, and site-specific development plans with this end in mind. ■

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towns), and our field work may yet uncover much that is unexpected. With initial funding from the Millbrook Tribute Garden (through the Dutchess Land Conservancy) Hudsonia biologists Kristen Bell Travis and Nava Tabak have completed a preliminary habitat map for the entire town, and Nava is in the midst of the extensive field work necessary to verify, correct, and refine the map. We will need additional funding to complete the project, however, and are working hard to raise those funds.

The information contained in our final habitat map and report will help Dover landowners, developers, town agencies, and regional planners understand some of the extraordinary biodiversity of the Dover landscape, and effective ways to protect the habitats and species of greatest conservation concern. Other towns have used our habitat maps to revise their municipal comprehensive plans, open space plans, and zoning ordinances, and to review new development proposals with an eye to minimizing harm to sensitive resources.

Native biological diversity is fundamental to the ecosystems that support the natural world and the human community, but is often unwittingly harmed by us in our uses of the land. Although Dover may be uncommonly blessed with biodiversity, in fact all of southeastern New York is unusually rich compared with most other parts of the Northeast. To help protect these places and systems, we hope that landowners and everyone else involved in planning for development and conservation in the region will, wherever possible, follow some basic rules of land stewardship for biodiversity conservation:

- *Consider the larger landscape around any particular habitat unit of concern.*
- *Avoid or minimize habitat fragmentation.*
- *Maintain and restore links between habitat patches.*
- *Establish and protect broad buffer zones around sensitive areas.*
- *Maintain natural disturbance processes (e.g., flooding, wildfires, seasonal drawdowns).*
- *Minimize impervious surfaces, and prevent additional stormwater runoff during and after land development activities.* ■

[Many other habitats of the HVR region are described in the *Biodiversity Assessment Manual for the Hudson River Estuary Corridor,*[5] and in the *Harlem Valley and Ridges Supplement* (to the Biodiversity Assessment Manual).[1]]

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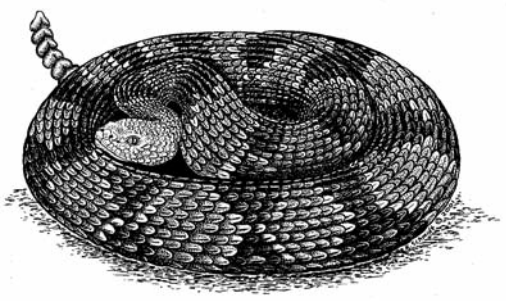

Timber rattlesnake and other snakes of conservation concern use oak-heath barrens and other open ledge habitats for basking and breeding. Kathleen A. Schmidt © 2001

NATURE AND ART

A nature-themed art show to benefit Hudsonia and Winnakee Land Trust will open at **Gazen Gallery in Rhinebeck July 17** with a 4-9pm reception and silent auction. The show will feature the work of approximately thirty Hudson Valley painters and photographers and will be open until September 6. The Gazen Gallery is at 6423 Montgomery Street (in Montgomery Row); gallery hours are Sun, Mon, Wed, Thu 11am-5pm, Fri, Sat 10am-9pm (telephone 845-876-4278). Please join us at the opening or visit the gallery another day!

SPECIAL THANKS TO

- Five Rivers Environmental Center, Norrie Point Environmental Center, Teatown Lake Reservation and the Environmental Leaders Learning Alliance for hosting Hudsonia's educational programs.
- Bard College for supporting Hudsonia at the Field Station.
- Carolyn Summers, David Brittenham, and Katy Brittenham for hosting a Hudsonia event in Hastings-on-Hudson.

Hudsonia is especially grateful to Katie Palmer House, Stancy Duhamel, Karen Finnerty, and Jill Way for organizing an event to benefit the Dover Habitat Mapping Project, and to Jim Muncey for hosting the event at the Inn at Dover Furnace.

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PROFESSIONAL WORKSHOPS

Stream Fish Identification and Natural History

6 August 2010

Laboratory and field instruction in identification and natural history of fishes of Hudson Valley streams, and assessment of stream habitats. The workshop emphasizes hands-on observation and practice with fishes in the field, specimens, and keys, and is designed for biologists, environmental professionals, and students. Course instructor is Robert E. Schmidt. Course fee of $275 includes lunch and snacks. Visit hudsonia.org for more information. Call or email Linda Spiciarich to register (845-758-0600; spiciari@bard.edu).

Biodiversity Assessment

22-27 August 2010

A five-day intensive course to introduce principles of biodiversity conservation, and techniques for recognizing biodiversity resources. The course will include hands-on exercises in remote sensing and field identification of habitats; discussions of ecology and conservation of rare species, and exercises in open space planning, and designing land development projects in ways that minimize harm to biologically sensitive areas. Course instructors are Erik Kiviat, Andrew Meyer, and Gretchen Stevens. Visit eomega.org for more information or to register.

Winter Identification of Woody Plants

5 November 2010

Hands-on laboratory and field instruction in identification and natural history of trees, shrubs, and woody vines in winter condition. The workshop is designed for biologists, environmental professionals, horticulturists, and students with some field experience with woody plants. Course instructors are Erik Kiviat and Gretchen Stevens. Course fee of $275 includes lunch and snacks. Visit hudsonia.org for more information. Call or email Linda Spiciarich to register (845-758-0600; spiciari@bard.edu).

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