VEGETATION RESPONSE FOLLOWING RESTORATION OF A FRESH TIDAL WETLAND, WOOLWICH, ME

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Data for restoration of fresh tidal marshes are scarce, particularly in the northeastern US. This project describes the response of vegetation to reintroduction of tidal flows after more than 100 years of restricted or no flow. As partial compensation for filling 6 ha in the Kennebec River, Bath Iron Works restored near-fresh tidal flows to 36 ha of wet meadow and forested wetland on Back River Creek, Woolwich, ME. Restoration efforts included removing twin tide gates on a secondary road, installing an additional culvert under US Route 1, and ditching over 1 km to restore a former tidal creek. Partial tidal flow was restored in June 1999, producing a mean tidal amplitude of 0.75 m at the culverts and 0.6 m at the site's north end. Salinities were typically near 0, with a high of 4 ppt. Most of the wet meadow and approximately 50% of the forested wetland experienced regular or irregular tidal flooding. Vegetation was monitored at 106 1-m^2 permanent plots on 14 transects for 1 year before restoration, and 5 years following restoration. The wet meadow converted to either submerged aquatic vegetation or shallow marsh, depending on its elevation. After 5 years, approximately two-thirds of the forested wetland was converting to shallow marsh. The death of wet meadow vegetation was most pronounced in the first two years. As a result, bare ground was most abundant in the wet meadow zones in the early years, followed by rapid recolonization by cattail (*Typha* spp), wild rice (*Zizania aquatica*), variable milfoil (*Myriophyllum verticillatum*) and pondweeds (*Potamogeton* spp). Purple loosestrife (*Lythrum salicaria*) occurred sporadically, but appeared unable to compete with cattail. In the forested wetland, the rate of mortality depended on the size of the vegetation, with the emergent and shrub layers dying within two years, the smaller trees taking 2 to 3 years, and the larger trees, some of which exceeded 2 feet in diameter, taking 4 to 5 years or longer. Additional monitoring for at least another 5 years would provide useful data on the long-term dynamics of the emergent vegetation, particularly wild rice, cattail and purple loosestrife.

BAT ACTIVITY AT WETLANDS IN CENTRAL MASSACHUSETTS

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The ecology of bats in the northeastern United States and adjacent Canada is poorly understood. Published studies from both the White Mountain National Forest in New Hampshire and from Maine's Acadia National Park agree that bat activity is greatest at still-water habitats such as lakes, ponds, and wetlands. The abundance of these habitats on the Quabbin Reservoir watershed in central Massachusetts, due to the flat terrain, abundant streams, and beaver activity, led me to suspect that bats may be abundant there.

The development and widespread use of acoustical monitoring systems has provided for the rapid characterization and assessment of bat assemblages and of generalized foraging-habitat use. I used Anabat II detectors to assess bat species composition and relative levels of activity at six major habitat types on the Quabbin Reservoir watershed in central Massachusetts. Still-water habitats included the Reservoir, large ponds, beaver meadows, and woodland vernal pools. Other surveyed habitats include streams, and herbaceous and shrubby openings.

Bat activity, as measured by numbers echolocation call sequences was high, with an average 22 search-phase and 5 feeding-buzz call sequences per 20-minute survey period, over all surveys and all habitats. The little brown bat (*Myotis lucifugus*) was the most commonly recorded species; the eastern red (*Lasiurus borealis*) and big brown bats (*Eptesicus fuscus*) were also abundant, especially in open habitats. Bat activity was high at all still-water habitats, but greatest at large-pond habitats. Large-bodied bats, principally the big brown bat, were recorded more often in open, structurally uncluttered [open] habitats. Of the more mobile, small-bodied bats, little brown bats were ubiquitous, while northern myotis (*M. septentrionalis*) were most common in structurally cluttered habitats found at woodland vernal pools and along forest streams. Generalized habitat associations among the bat species were similar to those reported for other eastern landscapes. However the abundance of aquatic habitats and of both open and cluttered settings results in a rich and populous bat community and makes the Quabbin Reservoir watershed an excellent site to continue examining bat-habitat relationships.

RAILROAD CROSSING STRUCTURE FOR SPOTTED TURTLES

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Loss of access to critical habitats is a key wildlife concern, particularly those listed for protection by state and federal agencies. Rail corridors pose unique design challenges by virtue of the need to avoid abrupt changes in track curves and grade in the right-of-way (ROW). Spotted turtles (*Clemmys guttata*) are particularly vulnerable to habitat fragmentation due to their limited mobility and dependence on a diversity of specific foraging, nesting, and aestivation habitats. Spotted turtles also display an apparent reluctance to enter or cross through narrow and confined culverts typically found under road and rail line ROWs. The Massachusetts Bay Transportation Authority initiated a demonstration project in spring of 2003 to determine the effectiveness of a proposed railroad crossing structure in an urbanized landscape. Three identical, open-air prototypes were positioned in the ROW of a former railroad bed between adjacent wetlands known to support spotted turtles. Each structure was linked with temporary funneling barriers along the track edges. Structure placement was in accordance with microhabitat survey assessments, radio telemetry data, and direct movement observations. To evaluate the effectiveness of the structures, remote photographic stations were established at each crossing and radio telemetry was used to track turtle movements. Monitoring was conducted from April 2, 2003 until July 8, 2003. Study results demonstrated spotted turtle crossing patterns and frequency through the ROW during the monitoring period similar to that prior to barrier development. Crossings also were shown to be utilized by 17 other wildlife species, including reptiles, amphibians, birds, and mammals. It was concluded that location and design of the crossing structures provided an effective means of maintaining habitat connectivity for a variety of wildlife species, as well as spotted turtles.

WETLANDS IN URBAN AND SUBURBAN REGIONS: A CHALLENGE FOR SCIENCE, CONSERVATION AND MANAGEMENT

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Wetlands in developed landscapes are subject to numerous influences emanating from the presence of people in them , adjacent to them and in their landscape surroundings. The effects of these influences pose many challenges for both the scientific understanding of how these wetlands work and the management of the sites. There is high variability among and within wetlands, both in the specifics of the disturbance factors and in the ecological responses, unexpected sources of ecosystem resilience, and multiple types of direct human presence in the wetlands, all contribute to the unique challenges of these wetlands. Moreover, conflicting perspectives of neighboring human communities, and trade-offs among the impacts of differing patterns of human use contribute to the difficulties of both understanding and managing these wetlands. I will discuss the patterns of variability and conflict that we have observed in wetlands in the metropolitan region of northeastern New Jersey, and suggested lines of research that would enhance our understanding of the function and management of these wetland systems.

SPATIAL AND TEMPORAL PATTERNS OF AMPHIBIAN DISEASES IN ACADIA NATIONAL PARK WETLANDS: PRELIMINARY RESULTS

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Abstract.
In Acadia National Park (ANP) from 1999-2002, tadpole die-off events occurred in various small wetlands. The disease events in ANP were unique in temporal and spatial variability, the diversity of pathogens (*Iridovirus, Ichthyophonus*, chytridiomycosis) and the multiple amphibian species affected: wood frogs (*Rana sylvatica*), green frogs (*Rana clamitans*), bullfrogs (*Rana catesbeiana*), and spring peepers (*Pseudacris crucifer*). The first objective for this study is to determine amphibian disease prevalence and presence in ANP wetlands, using historical disease records (1999-2002) and our current health screenings (2003-2005). The second objective is to potentially resolve why some ANP wetlands are more susceptible to amphibian die-off events and disease than similar unaffected wetlands. In the breeding seasons of 2003-2004, we screened 25 wetlands of varying hydrology, amphibian diversity and density 3 times per week for amphibian health and disease presence. Adult and larval amphibians from six wetlands with similar hydroperiod (temporary-long duration, drying by mid-August), amphibian species diversity (wood frogs, green frogs, spring peepers, and spotted salamanders, *Ambystoma maculatum*) were pathologically examined at the National Wildlife Health Center (Madison, Wisconsin). Additionally, we measured a suite of possible causal factors (pH, water quality, heavy metals, UV radiance, water temperature) and biological indicators (microhabitat, wetland hydroperiod, relative abundance of amphibian species and invertebrate predators) at different scales. Pathological and field health screening results indicate more widespread amphibian disease in ANP wetlands than previously recorded. Furthermore, new diseases (*Anuraperkinsus, Saprolegnia*) were confirmed in a number of wetland sites. Preliminary results from the first year of this 3 year study have also illuminated potential stressors for amphibians that may make them more susceptible to amphibian disease in some ANP wetlands. For example, average seasonal water temperature differences of 2°C were found between non-disease wetlands and wetlands with at least one die-off event. Water depth and canopy density were correlated with water temperature. Additionally, shorter hydroperiod wetlands (drying in June and early July) and those with low larval density appear to be unaffected by amphibian disease. Further work will address the role of water temperature and hydroperiod more specifically as well as continue to focus on field health screening techniques.

PHASE 1 RESTORATION OF BRIDGE CREEK, BARNSTABLE MA.

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In 1996, the U.S. Army Corps of Engineers ranked the tidal restriction at Bridge Creek, Barnstable, MA as one of two most in need of correction on Cape Cod. However, the envisioned project would be daunting: replacing and upgrading undersized culverts beneath an active RR line (Phase 1) and a busy 2-lane highway (Phase 2), both located on narrow, elevated causeways with salt marsh at close margins. The goal was to return tidal flow to 40 acres of brackish and fresh marsh increasingly dominated by Phragmites australis, where decades ago Spartina patens thrived. Achieving Phase 1 would require a break in service on the RR line, and in summer 2001 the Town received word of an upcoming and rare 3-month maintenance closure of the Cape Cod Canal RR Bridge, scheduled for winter 2003. Thus an opening perhaps large enough to drive a project through emerged, setting into motion a dash to enlist project support, raise needed funds ($750,000), obtain necessary permits and engage a contractor. Help arrived in spades from an impressive array of federal, state and local sources, both public and private. This talk will detail how a project moved at pace from pipe dream to Phase 1 completion, amidst a treacherous timeline and ample opportunities to fail. A glimpse at progress toward Phase 2 will also be offered.

FACTORS ASSOCIATED WITH ATLANTIC WHITE-CEDAR SEEDLING RECRUITMENT AT BROWN MILL POND, NEW HAMPSHIRE

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The decline of Atlantic white-cedar throughout its range has motivated researchers to investigate cedar seedling recruitment. In this study, conducted at Brown Mill Pond in Rye, New Hampshire, the distribution pattern of cedar seedlings was studied in order to identify which, if any, biological or physical factors were associated with seedling presence. According to a field survey, cedar seedlings were absent from hummocks with tussock sedge substrate and present on hummocks with some alternative substrate (e.g., moss or litter). Furthermore, cedar seedlings were most common 10-25 cm above the July water table, occurring at an "intermediate" elevation, and were less common at higher elevations of these hummocks which were as much as 60 cm above the water table. Several multi-factor field experiments were initiated in order to determine the underlying factors explaining cedar recruitment in this wetland. The experiments tested whether factors identified in the survey, specifically substrate type and elevation relative to the water table, influenced cedar seedling emergence, growth, or survival. In contrast to expectations based on cedar seedling's differential distribution among substrate types, the field experiments indicated substrate type did not influence seedling emergence, growth, or survival. The lack of cedar seedlings on tussock sedge hummocks may be explained by hummock area rather than substrate quality, as tussock sedge hummocks were generally smaller than the moss-litter hummocks. The experiments showed that elevation relative to the water table, however, influenced cedar seedling emergence and performance, indicating that moisture was the primary limiting factor in the natural regeneration of cedar at this site.

MEASURING REDOX IN NEW ENGLAND SOILS

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The use of redox potential measurement has been used to evaluate oxidation reduction status of soils, but its value as a field tool is unclear. Few methods are accepted for measuring redox, and, combined with the variable results of redox potential measurements, make the use of redox measurement as a field tool questionable. The authors have been experimenting with field observations and will discuss several methodologies and their findings, as well as compare their data to published information. The use of redox potential as a predictive tool in measuring the success of recently constructed or restored wetlands may be valuable, and is, for example, a recommended monitoring criterion in the MA Inland Wetland Replication Guidelines. In addition, redox potential measurement may be useful in evaluating difficult soils.

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USING LANDSCAPE LEVEL ASSESSMENT TO EVALUATE WETLANDS AND INDIRECT IMPACTS OF PROJECTS ON HABITAT AND BIODIVERSITY VALUE

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Wetlands ecosystems are often distributed as patch communities within larger landscapes. As such, dispersal and metapopulation dynamics are critical factors for long-term maintenance of wetlands-dependent wildlife populations. As a result, wetland communities are particularly vulnerable to land use change and landscape fragmentation. The Conservation Assessment and Prioritization System (CAPS) is a computer software program and an approach to prioritizing land for conservation based on the assessment of habitat and biodiversity value for various natural communities within a particular target area. Beginning with a computer base map depicting various classes of developed and undeveloped land, we evaluate a variety of landscape-based variables ("filters") to calculate habitat and biodiversity value for every point in the landscape. Because CAPS provides a quantitative assessment of habitat and biodiversity value it can be used for testing various scenarios. This scenario testing capability provides opportunities to evaluate and compare the impacts of development projects on habitat conditions as well as the potential benefits of habitat management or environmental restoration.

A simplified CAPS analysis of the proposed Route 11 Extension in Connecticut was conducted using six filters sufficient to characterize and quantify indirect impacts of the proposed highway on habitat and biodiversity value. Using existing GIS data we compiled a land cover map for developed areas and the undeveloped portion of the landscape using a simplified natural community classification. Terrestrial communities were classified generally as deciduous forest, coniferous forest and powerline shrubland. The quality of existing wetlands data allowed us to compile a more detailed map of wetland and aquatic communities. For purposes of quantifying the predicted loss of value we calculated that total impacts (direct and indirect) of the highway project would be roughly equivalent to 686 acres of high quality habitat. Taken alone, the indirect impacts of the highway on habitat and biodiversity value would be equivalent to 539 acres. Our analyses predicted that the loss of value in wetland and aquatic habitats would be approximately equivalent to 139 acres of high quality wetland/aquatic habitat within the compensation area (with indirect impacts equivalent to 112 acres).

IMPACTS OF SMALL AMOUNTS OF SANDY SEDIMENT ON WETLAND SOILS AND VEGETATION: RESULTS FROM FIELD AND GREENHOUSE STUDIES

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This project used three different experiments to test the hypothesis that deposition of small amounts of sediment in wetlands alters plant diversity and soil properties. Greenhouse experiments using potting soil and *Sagittaria latifolia* were used with 0.5-2 cm sediment treatments and controls. Thirty 2 m X 2 m plots were established in a freshwater palustrine marsh, and the plots were monitored before and after the addition of 1, 2, or 4 cm of sediment to half the plots. Large vegetated cores of native soil were removed from the wetland and monitored in the greenhouse before and after the addition of 2 cm of sediment. Greenhouse experiments showed that less than 2 cm of sediment had no effects on the growth of *S. latifolia*, while 2 cm of sediment significantly increased aboveground biomass but had no effect on matrix potential or oxidation-reduction potential. Field plots showed significant differences in bulk density, organic matter, and phosphorus resulting from addition of sediment, but did not show differences in water levels, temperature, plant diversity, biomass or stem density under any amount of added sediment. Soil cores showed a significant difference in bulk density and in matrix potential near the soil surface under wetter conditions, but showed no significant differences in temperature, evapotranspiration, oxidation-reduction potential, or aboveground biomass. The lack of effect seen in the field plots is likely the result of a low effective loading rate relative to the greenhouse experiments, and the dense plant cover and thick debris layer of the wetland. Observed changes in bulk density would alter the hydrologic functions of the wetland if these depths of sediment occurred over a larger area. The tolerable level of sediment for a wetland depends on the structure and function of the individual wetland.

VERSION 3 of the FIELD INDICATORS FOR IDENTIFYING HYDRIC SOILS IN NEW ENGLAND

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In the mid-1980s, the New England District Corps of Engineers and the Environmental Protection Agency Region 1 developed regional criteria for soil drainage classes and, in combination with Soil Taxonomy, used this as an approach to identifying hydric soils within New England. In the early 1990s, this evolved into regional field indicators that were disseminated for testing to a wide range of wetland science practitioners. The first *Field Indicators for Identifying Hydric Soils in New England* was issued in 1995. Realizing that this was a dynamic document that needed to be updated periodically to reflect current science, the New England Hydric Soils Technical Committee (NEHSTC) was established to maintain the technical integrity of the document. The NEHSTC has now completed Version 3 of the *Field Indicators for Identifying Hydric Soils in New England* which was completed Spring 2004. This regional effort has involved experts from EPA, NRCS, Corps of Engineers, state agencies, state universities, professional associations, and private consulting. The Technical Committee functions under the oversight of the New England Interstate Water Pollution Control Commission's Wetland Workgroup.

In Version 3, members of NEHSTC have begun to focus their efforts toward developing criteria for problem soil areas: disturbed soils, folists and soils with folistic epipedons (formed in cold temperature regimes), soils formed in dark parent material, and soils formed in red parent material. Subcommittees have been formed to conduct field testing in these soils and develop criteria and/or guidance.

Two new hydric soil indicators have been added for soils that have formed in parent materials that have dark colors due to their mineralogy. Problem Soil Areas has been expanded. A *Supplement to the Field Indicators of Hydric Soils in New England* has also been added. This document walks a practitioner through the steps of performing a determination of whether a soil is hydric or non-hydric, particularly those which are difficult to interpret and require looking at landscape position, time of year, vegetation, possible disturbance, and signs of hydrology. It "was developed for less experienced individuals to explain some of these nuances."

The modifications made to Version 3 have made for greater consistency when delineating wetlands using either the *Field Indicators for Identifying Hydric Soils in New England* or the *Field Indicators of Hydric Soils in the United States* (version 5).

ALTERATION OF WATER LEVELS IN A MASSACHUSETTS COASTAL PLAIN POND SUBJECT TO MUNICIPAL GROUNDWATER WITHDRAWALS

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Coastal plain ponds are unique ecosystems in which water level fluctuations are the primary abiotic control on pondshore plant community dynamics. Where pond levels are controlled by aquifer water levels, groundwater extraction for municipal supply has the potential to alter pond hydroperiod and plant community structure. We assessed the influence of groundwater pumping on pond levels at the Hyannis Ponds Complex in Barnstable, MA at short and long-term time scales. Pumping tests were conducted in 1995 and 1997, to assess short-term effects of pumping seasonally and at different distances from the pond. Pond levels were affected by pumping in all four tests. Water level, seepage rate, and water temperature data all provided unequivocal evidence of an intimate surface/groundwater connection. To evaluate effects at longer time scales, we produced a regression model relating pond levels to pumping and natural background water level variation. The model indicates ecologically significant pond level changes between 1983 and 1991 under high pumping intensity. The natural hydrologic regime is more closely approximated under the current, less intense, pumping regime.

THE RETURN OF COMMON LOONS TO MASSACHUSETTS

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The Massachusetts Aquatic Conservation Society surveys and monitors common loons (Gavia immer) throughout Massachusetts on lakes not managed by Department of Conservation and Recreation (DCR). From May to October lakes with known loons pairs are monitored for particular activities and behaviors. These include nesting, egg production, and chick hatching and survivorship. Data is collected by observing loons from shore or boats. Other lakes throughout Massachusetts are also surveyed and investigated for loon presence and activity during this time.

In 2004 eleven lakes were monitored. Six had breeding pairs of common loons and five lakes had between 1-3 common loons at any given time. The study area is located in north central Massachusetts and the lakes monitored are:
Bickford Pond, Westminster, MA) one breeding pair with two chicks, both chicks lost)
Fitchburg Reservoir, Fitchburg, MA (one to three loons)
Haynes Reservoir, Leominster, MA (one pair of loon's one egg in nest, was lost)
Mere Meadow Reservoir Westminster, MA (one loon)
Notown Reservoir, Leominster, MA (one pair of loons with two chicks)
Paradise Pond, Princeton, MA (one pair of breeding loons with two chicks)
Pine Hill Reservoir, Paxton, MA (one to three loons)
Wachusett Lake, Westminster, MA (one loon)
Lake Wampanoag, Gardner, MA (one pair of loons with one chick)
West Waushacum Pond, Sterling, MA (one loon)
Upper Naukeag Reservoir, Ashburnham, MA (one breeding loons with two chicks)

Prior to the foundation of MACS in 2002, summering common loons had only been documented on a few lakes in Massachusetts. MACS surveys have added 18 more individual loons appear to show an upward trend of the number of individuals in Massachusetts during the breeding season. We have also observed an increase in territorial and breeding pairs off DCR water bodies in 2004. A total of six pairs were observed and seven chicks have survived to date.

FIELD VERIFICATION AND EVALUATION OF STREAM FLOW PREDICTIVE DATA GENERATED WITH THE USGS STREAMSTATS PROGRAM

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In 1996, the Massachusetts Wetlands Protection Act (MGL Chapter 131, Section 40) was amended to regulate Riverfront Area which (in most municipalities) is defined as the land area within 200 feet of a perennial stream. Since the amendment of the Act, the Department of Environmental Protection has promulgated several versions of regulations that included criteria to determine if a stream is perennial. The most current version allows the use of a statistical method (Streamstats) developed by the U.S. Geological Survey to determine stream flow characteristics in certain settings.

The Streamstats program was used to predict low flow characteristics of two adjacent streams located in Belchertown, Massachusetts. Both streams are first order and occupy relatively undeveloped watersheds that are predominantly comprised of glacial till uplands. The larger of the two streams has a relatively low gradient (0.7 percent) and is situated within a broad valley. The higher-gradient (2.0 percent) stream is smaller, more linear and is located within a narrow steep-sided valley. The Streamstats program indicates both watercourses do not flow during one percent of the year (approximately four days) up to the point where they merge with other streams.

Based on eight consecutive months of regular field observations, the predictive data generated by the Streamstats model are accurate for the larger stream. However, field observations of the smaller stream are not consistent with the Streamstats-derived results. Even though this stream has a significantly smaller watershed than the larger watercourse, it has continued to flow throughout the monitoring period. The reason for this discrepancy may be attributed to the hydrogeolgic/hydrogeopmorphic setting of the smaller stream. A fracture-trace analysis of the watershed and surrounding area was performed through the inspection of aerial photographs. The results of this analysis suggest that the smaller stream is aligned with a sizeable fracture in the underlying bedrock and may be fed by continual groundwater discharge.

The findings of this investigation suggest that Streamstats may have limitations in certain hydrogeologic settings such as groundwater fed, high gradient streams and that results generated by predictive models should not preclude actual field observations, especially when establishing regulatory jurisdiction.

SEASONAL PATTERNS IN HYDROGEOCHEMISTRY IN A CALCAREOUS SLOPING WETLAND OF WESTERN MASSACHUSETTS

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Calcareous wetlands are uncommon in New England due to the limited distribution of limestone bedrock in the region. These habitats contain many rare plant species and are regionally targeted for conservation. There is only limited understanding of the seasonal hydrogeochemistry within these systems. A three-year field study was initiated in May 1996 to document the hydrogeochemical patterns within one such sloping wetland system. Eight instrumentation stations were established along a 250-m long transect. Each station included triplicate instrumentation clusters, each with a shallow PVC well (to 60 cm); tensiometers (at 15 and 30 cm depths); Pt-redox probes (at 15 and 30 cm depths) with associated salt bridge; and a suction lysimeter (at 30 cm). Nested piezometers (at 75 and 150 cm) monitored the presence of vertical groundwater gradients. Field monitoring and water sampling were conducted on a bi-weekly basis across three growing seasons. Standard water analyses included pH, EC, and total iron. Monthly measurements were made for alkalinity and several dissolved metals including calcium, magnesium, manganese and phosphorus. Tensiometers were found to be more useful for monitoring hydrology in these systems than were groundwater wells. Although well levels fell below 50 cm during summer months, the surface horizon remained effectively saturated and chemically reducing. A textural discontinuity between the mucky solum and the coarse glacio-fluvial substratum created epiaquic conditions by perching precipitation inputs. Although surface horizon saturation remained nearly constant, this hydrologic disconnect resulted in significantly different soil-water chemistry during summer months than that present in the early portion of the growing season. Significant seasonal differences were measured for soil-water iron and calcium, and vertical groundwater gradients and thermodynamic model analyses are used to explain these hydrogeochemical differences. These results strongly suggest that repeated seasonal sampling is needed to adequately characterize the geochemistry of calcareous sloping wetland systems in southern New England.

BODY SIZE VARIABILITY OF SPOTTED SALAMANDERS, *AMBYSTOMA MACULATUM*: QUANTIFYING ENVIRONMENTAL PRESSURE ON DIFFERENT LIFE HISTORY STAGES AMONG POPULATIONS FROM ACROSS MASSACHUSETTS

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Body size is a life history trait that has been demonstrated to be variable among populations of vertebrates. Mean body size of adults among populations of spotted salamanders (*Ambystoma maculatum*) has been previously demonstrated to be significantly different among some populations in separate geographic regions and at different elevations of Massachusetts. In the spring of 2004 we conducted a field study investigating mean adult body size of males from ten sites across Massachusetts. Within a subset of these sites we investigated physical and chemical characteristics of each breeding pond and differences in total length of larvae as well as quantification of potential competition and predation. We also report the preliminary results of age structure of breeding males collected previously from three populations as determined through skeletochronology. Our results indicate that the average body size of adult male spotted salamanders among ten breeding populations all sampled in the same year was significantly different between three subgroups of populations, not necessarily associated with geography or elevation. Within six of the study sites, we found that competition, predation, and hydroperiod were all important variables (each with varying degrees of affect per site) likely influencing body size of larvae at each site in the same year. Our age analysis between two populations indicates significant differences in both age and size and demonstrates that skeletochronology is useful for comparisons of estimated age among populations of spotted salamanders. Based on our results, we suggest terrestrial habitat and juvenile recruitment are important variables determining mean body size of breeding adults during a given year and we propose alternative hypotheses to explain body size variability among populations of adult spotted salamanders at each of our study sites.

COMPARISON OF ARTIFICIAL WETLAND TREATMENT SYSTEMS FOR DOMESTIC SEWAGE, SLAUGHTERHOUSE WASTE AND COMPOST LEACHATE

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Artificial wetlands are designed to emulate the processes that occur in natural wetland systems that have historically been the "dumping place" of many pollutants. The development of artificial wetlands systems, typically free water surface, or end-loading submerged bed systems has been primarily to polish treated wastes received as a continuous flow. The current study compares two top loading vertical flow submerged bed wetlands with the Tillson Farm Compost Leachate system, located in Western Massachusetts. The existing systems chosen for this study, the Zumtobel Staff Wetland, in Highland, NY and the Shushufindi slaughterhouse wetland, Shushufindi, Ecuador. Both systems receive high-strength waste in doses rather than continuous flow, undiluted (no laundry or showers) sanitary waste with average influent concentration of BOD and NH_4^+ of 350 and 126 mg l^{-1}, respectively (Zumtobel) and slaughterhouse waste with average influent COD concentration of 500 mg l^{-1} (Shushufindi). The Zumtobel Staff daily flow is 1100 gal per week spread over 5 days, but in 200 gal doses from a pump station. The slaughterhouse operates an average of 3 hours, 6 days a week, and all flow comes during this period. Located in the Ecuadorian Rain Forest, the slaughterhouse wetland may also receive several inches of rain in a short period of time (several hours) as a daily occurance. Both systems are producing superior quality effluent with less than 5 mg l^{-1} BOD_5, < 1 mg l^{-1} COD, and < 10 mg l^{-1} NH_4^+. The Tillson Farm system receives minimal daily flow (from refuse container washing) and potentially large doses of runoff from the 46,000 ft^2 asphalt pad. Typical Massachusetts rainfall is 4" per month, which may come in a few hours, or be spread more uniformly over the month.

A PHASED APPROACH TO RESTORATION OF A FORESTED WETLAND IMPACTED DURING NATURAL GAS PIPELINE CONSTRUCTION

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During the summer and fall of 2003, KeySpan Energy Delivery installed approximately five miles of new 12-inch natural gas pipeline to reinforce its existing system in Concord and Pembroke, NH. The completion of construction activities did not occur until December, which precluded final restoration and revegetation of the right-of-way. Several significant precipitation events coupled with on and off-site drainage patterns resulted in the failure of a steep slope disturbed during construction and deposition of approximately 900 cubic yards of material within a forested wetland within the Soucook River floodplain. Working closely with the New Hampshire Department of Environmental Services, a wetland restoration plan was developed to stabilize the site and complete the restoration in two phases. The first phase involved the removal of the deposited sediment under frozen conditions in winter to avoid potential discharges of material to the river associated with spring floods. The majority of the material within the wetland was comprised of fine sands and gravels that were excavated in plates when frozen. The existing underlying natural soil and leaf litter served to identify the limits of sediment removal. Upon completion of the sediment removal, the site was stabilized through the extensive use of erosion control materials including silt fence, hay bales, erosion control blankets and FilterSoxx. The second phase of restoration occurred in late Spring after the floodwaters had receded and included hand removal of remaining sediment, restoration of impacted channels and replanting of the shrub and herbaceous layers. Through implementation of this plan, the majority of the existing overstory trees survived, and the native seed bank provided for natural revegetation that was not anticipated. Based on initial restoration efforts and through continued monitoring, it appears that the erosion event will have no permanent adverse impact on the function of the wetland.

SPOTTED TURTLE HOME RANGE SIZE AND USE OF EMERGENT AND PALUSTRINE SCRUB SHRUB WETLAND HABITAT WITHIN AN ELECTRIC TRANSMISSION RIGHT-OF-WAY

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Tennessee Gas Pipeline proposed an approximately 5.1-mile, 8-inch diameter natural gas pipeline to service a new customer in Massachusetts. The preferred alignment along an existing electric transmission corridor crossed several areas of emergent and palustrine scrub-shrub wetlands classified by the Massachusetts Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program as habitat for spotted turtles (*Clemmys guttata*), which are designated as a species of special concern. As part of the impact minimization and mitigation efforts proposed by Tennessee Gas Pipeline, intensive live-trapping surveys and radio-telemetry studies are being conducted to collect data on habitat use and movement by the species as well as to locate and protect individual spotted turtles during construction. Trapping efforts were conducted in five different wetland systems along the alignment, and a total of 21 spotted turtles have been captured to date. Sex, age and morphometric data was collected on each individual, and small radio-transmitters were affixed to the carapace to allow for tracking and monitoring. Relocation of marked individuals was conducted on a weekly basis, and movement locations were documented via GPS. General habitat parameters were also collected with respect to water depth, wetland vegetation type and structure. Initial analysis has determined that home range of the turtles is variable in area and that movements of over 1,000 feet from the initial capture sites are not uncommon. Several marked females have been relocated in upland habitats not suitable for nesting. Construction of the pipeline is scheduled for the first quarter of 2005, and additional measures such as daily monitoring, relocation of marked individuals, habitat restoration and education of the contractors will be conducted to ensure protection of the local population.