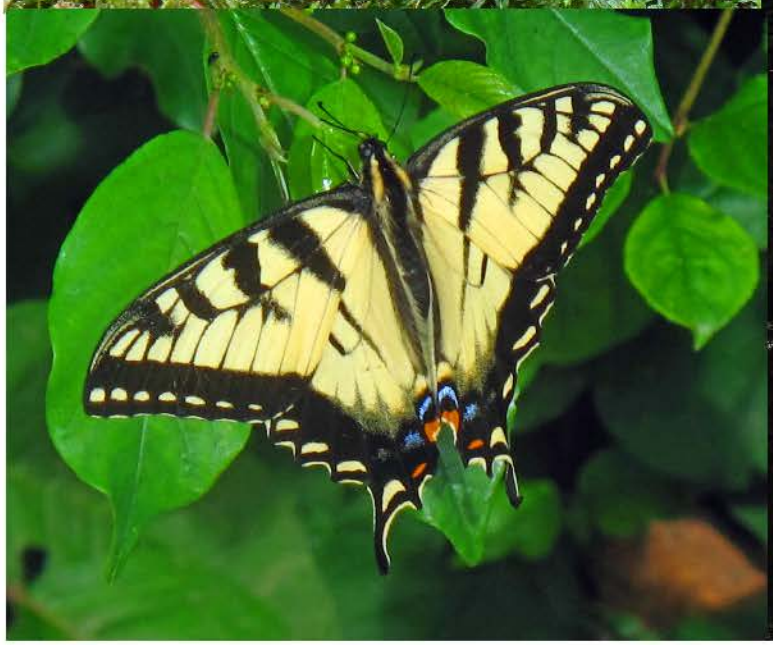
Begging the Question, is the proposed Bruce Freeman Rail Trail in Concord and Sudbury for the greater good?



Morse & Morse Forestry and Wildlife Consultants

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INTRODUCTION

I recently attended a moving recreational event in Burlington, Vermont. Thousands of people gathered to view and support Dragonheart Vermont, a spirited longboat paddling competition involving breast cancer survivors as well as other community teams, all dedicated to raising awareness and funds for cancer research and services. It was a spectacular affair! I was equally heartened to observe that many who came to watch the competition walked or rode their bikes via the popular Burlington Bike Path, which parallels Lake Champlain where the races were held.

I reflected upon my positive enthusiasm for the Burlington Bike Path, which is in sharp contrast with my feelings of disapproval and foreboding regarding the proposed Bruce Freeman Rail Trail (BFRT) through Concord and Sudbury, Massachusetts. Both paths have similar goals, including recreation, alternative transportation, and the enhancement of tourism.

The intrinsic difference between the two paths, however, is the reason I feel the way I do. The Burlington Bike Path revitalized and made accessible a formerly unattractive urban environment. On the other hand, the proposed Bruce Freeman Rail Trail would destructively introduce a paved road and tens of thousands of people and pets into what is functionally one of the region's most important remaining wildlife habitats. While there currently appears to be a well-orchestrated campaign by bicycling groups for the building of the Bruce Freeman Rail Trail, there is also considerable naiveté with regard to the alleged compatibility of heavily used recreational trails and natural resource protection.

Even though some people consider non-consumptive outdoor recreation to be environmentally benign, there is increasing evidence that these activities can affect individuals, populations and even wildlife communities (Knight and Cole, 1995a). Boyle and Samson (1983) reported that in 81% of studies reviewed, non-consumptive outdoor recreation had negative effects on wildlife. Recreational pathways are known to harm wildlife in several ways, including:

- Impacts to refugia. However seemingly harmless, trails introduce significant stress factors within the refugia that sustain numerous species of invertebrates, birds, amphibians, reptiles and mammals. For example, nesting birds, denning bobcats, foxes and mustelids are displaced, if not killed, as a result of people and domestic dogs regularly using formerly, largely undisturbed security and foraging habitats.
- Altered wildlife behaviors. When wild animals are flushed needlessly and repeatedly, their alarm and flight behaviors affect them in two ways. The cumulative effects of increased energetic demands for such activity may prove too costly for some animals, especially during the winter or during other periods of food shortage. Studies have shown increased mortality for disrupted wildlife, such as when wildlife expend energy when flushed (Whitfield et al., 2008; Taylor and Knight, 2003b); are displaced over extended periods of time (Neumann et al., 2010); and/or exhibit decreased nest fidelity after being disturbed (Vennesland, 2010). Secondly, some species may limit their use of, or even completely forsake what would otherwise be preferred foraging and resting habitats. Such altered behaviors and missed opportunities for optimal food and cover within the context of Concord and Sudbury's limited quality habitats will insidiously compromise the fitness, sustainability and diversity of many species over time.
- Impacts beyond the trail. A trail alters the surrounding environment far beyond its actual footprint and may impact wildlife thousands of feet into adjacent areas. These "distance effects" in an "area of influence" surrounding a trail may cause displacement of wildlife from otherwise suitable habitat (Taylor and Knight, 2003b). For example, when songbirds' primary song was interrupted by human disturbance, the birds were reluctant to establish nesting territory (Reijnen and Foppen, 1994). Even a single pedestrian traveling through a bird's territory causes a decline in the occurrence of primary song (Gutzwiller et al., 1994). As song is an integral component of the breeding process, birds sensitive to human disturbance may be reluctant to establish nest sites where human activity takes place, i.e., near trails (Gutzwiller et al., 1997).

- Decline of resident species. Researchers from the Department of Environmental Science Policy and Management at the University of California, Berkeley surveyed mammalian carnivores in 28 parks and preserves. Paired comparisons of neighboring protected areas, with and without recreation, revealed that the presence of dispersed non-motorized recreation led to a five-fold decline in the density of native carnivores. These biologists also noted a substantial shift in community composition from native to non-native species (Reed and Merenlender, 2008).
- Disruption of movement corridors. Thick, impenetrable vegetation and course woody debris on the ground adjacent to undeveloped riparian wetland edge habitats often provide village and suburban wildlife their only means of moving across the otherwise human-dominated landscape. The Jennie Dugan and Sudbury wetland complexes along the rail route are excellent examples of such habitats that should not be disturbed. These habitats also function as wildlife corridors that facilitate species and genetic exchange throughout an impressive assemblage of connected habitats in both towns. Corridors also offer critical opportunities for demographic rescue--the ability for new individuals to reach and replenish a habitat should some stochastic event or disease cause an entire local population to perish.
- Direct effects of increased access. Negative impacts to ecosystems include habitat fragmentation, trampling, soil erosion, nutrient loading, pollution, poaching and the introduction of non-native invasive plant and animal species. In one 20-year study, herpetologists (Garber and Burger, 1995) concluded that the introduction of recreational trails and corresponding increased public access led to the decline of turtles due to poaching and increased nest predation. The latter phenomenon was exacerbated by an increase of mesocarnivores, such as raccoon, skunk and opossum. These species are known to exploit fragmented habitats and to be subsidized by foods associated with people.

Worldwide, a growing body of scientific studies is dedicated to elucidating the aforementioned stresses. One study (Taylor and Knight, 2003b) summarized known impacts and shared the following startling information: "Millions of visitors annually are attracted to public lands to engage in recreational activities. Because outdoor recreation is the second leading cause for the decline of federally listed, threatened and endangered species on public lands (Losos et al., 1995), and the fourth leading cause on all lands (Czech et al., 2000), natural resource managers are becoming increasingly concerned about impacts of recreation on wildlife (Gutzwiller, 1995)."

In view of these scientific studies, it is understandably alarming that the BFRT is included in the 2007 Massachusetts Regional Bicycle Plan's list of recommended trails for regional use and bicycle tourism. What does this mean for the wildlife that relies on the rewilded rail corridor and abutting habitats? Can a recreational trail of this magnitude be compatible with the State's regional conservation goals that acknowledge the vital importance of securing and protecting Massachusetts' core and connective habitats? (BioMap and Living Waters, 2004).

I have much trepidation about the proposed rail trail not only because of the accumulated evidence from numerous scientific studies, but also because of what I have personally observed and learned in over thirty-six years of studying wildlife behavior and habitat. This report will explore a number of questions whose answers solidly challenge the wisdom of building the BFRT in Concord and Sudbury. The case will be made that construction and use of the proposed Bruce Freeman Rail Trail will alter the function of the rail bed as a vital regional wildlife corridor that connects attractive wildlife refugia in an increasingly threatened suburban landscape.

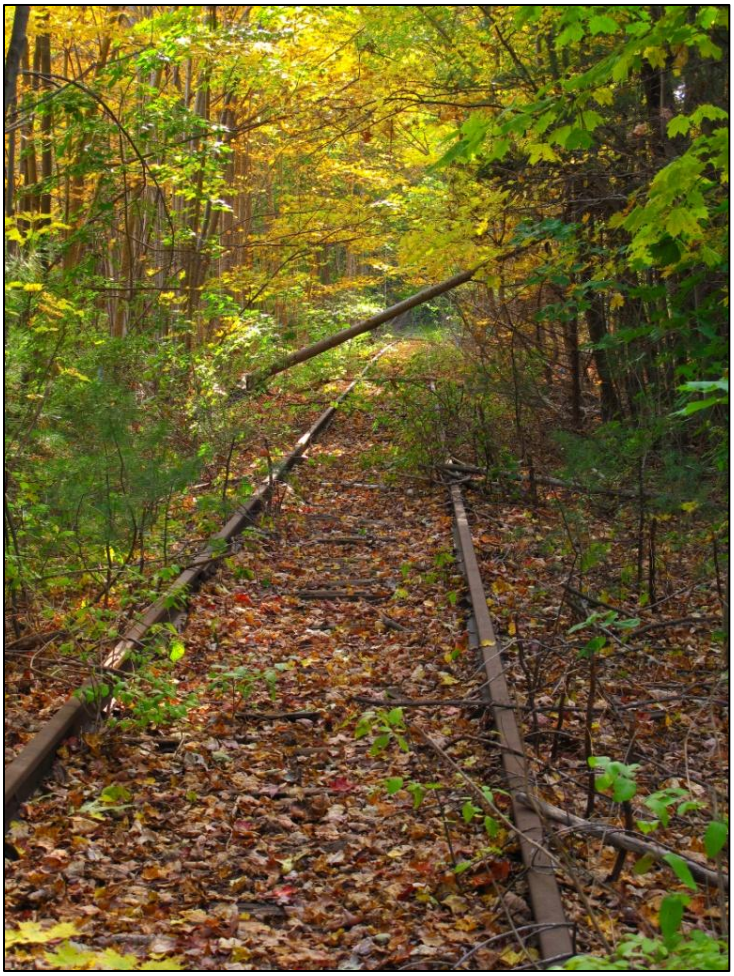
A NOTE ABOUT THE ACCOMPANYING MAPS

The maps will compile for the first time a variety of data that depict the rich distribution of smaller and larger core habitats, as well as connected habitats, throughout the region. The maps will also underscore the significance of the assemblage of natural habitats that are present on either side of the rail corridor through both towns. It is clear that this entire rail route is indeed both a priority habitat and corridor, and as such it is integral to sustaining the region's biodiversity.

The maps illustrate three kinds of information regarding the presence and possible movement patterns of wildlife.

1. Confirmed presence of wide-ranging and area-sensitive mammal species, including black bear, bobcat, and moose, and for some locations, fisher and river otter.
2. Species found close to and/or crossing the railway corridor itself.
3. A number of species found within and around open space parcels within travel range of the railroad right-of-way.

The maps also show priority habitats for state-listed rare and endangered species. However, specific locations of listed species were purposefully not depicted on the map in accordance with the Massachusetts Natural Heritage and Endangered Species Program policy.



Rewilded rail line in Sudbury

The wildlife data depicted on these maps have been collected from a variety of credible government and private sources. The reader is referred to "An annotated bibliography of map sources used in report on the Bruce Freeman Rail Trail, Concord and Sudbury, Massachusetts", located at the end of this report. Wildlife data were collected from road kill reports, animal sightings and reports from experienced naturalists and wildlife trackers.

Only data for which there was a high degree of confidence were included. In addition, in the spring and fall of 2009, I and my colleague, Roberta Summers, conducted field investigations along the entire length of the proposed BFRT in both towns, including adjoining forested and agricultural habitats. Ms. Summers' expertise complemented my knowledge of mammals and was a valuable addition to our detection and appreciation of the rich abundance of bird, amphibian and reptile species found throughout the aforementioned habitats. As more data are collected and added to the maps, they will considerably enhance the maps' value as planning documents in the years to come. Already the maps show what was evident from field study: The railway corridor is rich in species diversity and habitat functions.

BEGGING THE QUESTION, IS THE PROPOSED BRUCE FREEMAN RAIL TRAIL IN CONCORD AND SUDBURY FOR THE GREATER GOOD?

WHAT IS BIODIVERSITY?

Lexington neighbor, the internationally renowned biologist, E. O. Wilson, offers this marvelously succinct answer: "The diversity of life forms, so numerous that we have yet to identify most of them, is the greatest wonder of this planet. The biosphere is an intricate tapestry of interwoven life forms" (Wilson and Peter, 1988). Proportionate to the exponential human population growth and consumption of natural resources, a one-two punch of habitat destruction and fragmentation has resulted in a beleaguered planet; life as we know it is now seriously threatened in incalculable ways.

Today the consequences of human impacts, including the largest mass extinction in 65 million years, are calculated to be up to 1,000 times greater than natural rates extrapolated from fossil records (Cushman, 2006). Each and every loss compromises life as a whole, affecting surviving species as well as whole ecosystems in ways scientists are just now beginning to comprehend. Birds, for example, face serious threats. According to the American Bird Conservancy, more than one third of the 650 bird species that breed in the U.S. have declining populations or face serious threats due to habitat loss or degradation.

Biodiversity is the variety of life and its processes. It includes the variety of living organisms, the genetic differences among them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning…

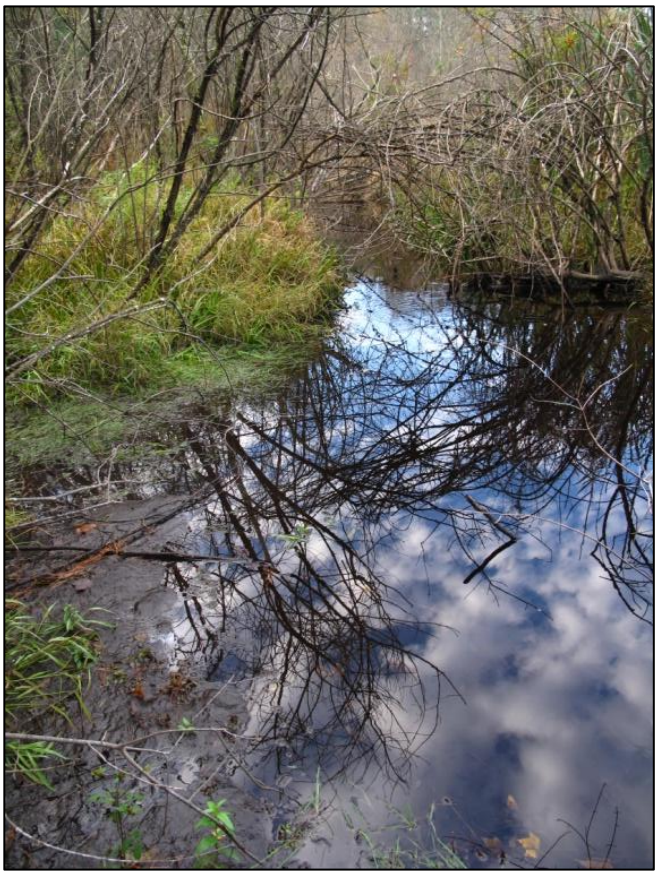
Reed Noss, 1994

American Toad (top)
Cicada (bottom), both
in Jennie Dugan Wetlands

White oaks beside cattail wetland on
Sudbury rail corridor

Many people believe that biodiversity is adequately represented and safeguarded in protected parklands and wilderness preserves. This is not the case. Throughout the world, the greatest diversity of species is found in habitats *not protected* with park status--habitats much like Concord and Sudbury's riparian, wetland and upland habitats. Yet these often more temperate and fertile environments are precisely the habitats that have been dominated and altered for human use alone. An understanding of what habitats remain within these ecosystems, coupled with what connectivity remains to facilitate species and genetic exchange, is today's most immediate conservation need. This is the very goal that is at the heart of each state's recently completed Comprehensive Wildlife Conservation Strategy. Clearly, with respect to steadily increasing recreational pressures, there is an urgent need to find more effective ways to encourage and engage citizens in assisting natural resource and planning

departments so that the Massachusetts Comprehensive Wildlife Conservation Strategy can be more fully implemented.



Pantry Brook, beside Sudbury rail corridor

Either we begin to embrace the revolutionary aspects of protecting biodiversity – the challenge of saying 'less' to population growth and habitat destruction, of questioning the ethic of dominion – and seek education for the ecological self, or we create almost by default a world where one animal (the human being), having appropriated to itself the fate of other species and ecological processes, causes the degradation of all.

R.E. Grumbine, 1992

… Developing a deeper understanding of ecological communities has an urgent timeline. If we fail to develop such an understanding within the next 20 to 50 years, there will be very few intact communities to use as models for the restored communities we hope to build. This will significantly reduce our ability to maintain the processes that make a major contribution to the viability of all human health and economic welfare.

A. Dobson, 2005

Biodiversity is not just the myriad of organisms of life's community, ranging from single-celled bacteria to multi-cellular fungi plants and animals. Biodiversity also includes genetic diversity of organisms encompassing individuals and populations, as well as the geographically separate populations of any and all species. **Ecosystem diversity** is also considered in the full meaning of the term, biodiversity. An ecosystem comprises a multitude of complex interrelationships involving bedrock geology, soil, climate and biota (including plants, insects, animals, fungi and microbes). Interactive networks of species profoundly influence and are influenced by the structure and functions of the ecosystems upon which they depend.

Stewards of biodiversity must be evermore knowledgeable and respectful of the various ways in which an environment physically and chemically interacts with communities of species that in turn respond to and influence the habitat and each other. Terms like "resistance", "resilience", "process" and "integrity" are measures of living species' complex influences upon their habitats, as well as their responses to change and challenges in the environment. Indeed, the very process of **evolution** itself is biodiversity's ongoing and miraculous legacy--the opportunity for living entities to adapt and grace the future with their being. For example, more disturbance and fragmentation of the rewilded rail line habitats puts these vital natural processes and ecosystem functions at risk. Conservation biologists emphasize the need to preserve intact and connected habitats worldwide because unnatural and precipitous changes caused by global climate change will severely threaten life as we know it today.

Short-tail weasel with mouse prey

Some people are skeptical about the importance of biodiversity, "What benefit is all of this to me?" they ask. Consider the vast numbers of small mammals, for example, which reside by the proposed rail trail corridor and within the rail bed itself. Woodchucks, voles, mice, shrews, chipmunks, squirrels, weasels and bats--these creatures play essential roles in the maintenance of healthy and diverse ecosystems. Many consume huge quantities of vegetation, seeds and invertebrates, and as such, contribute to valuable nutrient cycling, as they in turn are consumed by predators and scavengers. Their wanderings near and far provide a grand way for plant seeds and mycorrhizal fungi to become dispersed throughout the environment via their feces and food-caching activities, resulting in increased plant diversity and productivity. Even the tunnels and subterranean dens of small mammals serve to aerate, fertilize and improve moisture retention of the soil.

In another example, research has revealed that greater bird and mammal diversity lowers the risks of people contracting Lyme disease and West Nile virus. The presence of a greater diversity of species that are poor hosts to the respective disease-causing organisms, results in what is called a "dilution effect", with a corresponding reduction in encounters with host species and the insect vectors which may transmit Lyme *Borrelia* bacteria and/or West Nile virus to humans (Meadows 2008, Sachs 2010) . Furthermore, habitats that are not small and isolated are more likely to support natural predators of deer, which in turn helps keep these large herbivores in check.

No attempt to ponder the significance of biodiversity should conclude without some attempt to articulate and appreciate the wonder of it all. Here, along Concord and Sudbury's rewilded rail line corridor, or any place in all of planet earth, E. O. Wilson's intricate tapestry of life is at risk. Frayed in places, in complete disarray in others, remaining natural habitats must be studied, conserved and even restored wherever possible by the one and only species that can do these things.

Vernal pools are contained basins that collect spring's snowmelt and rain. They are usually dry by mid to late summer. Drying of the pools, like this one in Sudbury, is vital to their contribution to the breeding habitat of numerous species, including wood frog, spotted salamander, fairy shrimp and other pool-dependent biota. Pools that dry up by summer prevent their use by fish that would otherwise prey upon the deposited eggs and developing young.

Eggs of the American toad found within a rewilded rail bed wetland require proper conditions in which to develop. Trail construction will require the removal of acres of carbon-dioxide absorbing vegetation. Due to the close proximity of the railway corridor to wetlands and vernal pools, loss of canopy will cause drying effects from sun and wind and will change water temperature, plant species, and overall hydrology.

WHAT IS HABITAT?

Habitat is simply home, the physical space where wildlife lives according to each species' needs. Habitat is as complex as the multitudinous influences that function and make it whole. Habitat requirements vary, yet for all species they include food, water, cover, and space. Wildlife select habitats by optimizing these needs against the thermal and security risks they encounter in their daily lives. The *best* habitat for most wildlife enables them to reproduce and meet their energy needs while offering a minimum of challenges. A species' home range, the amount of space a given individual uses, may span 20-60 acres for an ermine, 2-10 square miles for a moose, or as much as 15-30 square miles for a bobcat. Hazards associated with human activity, including development, roads, traffic, pets, pollution, recreational pressures and introduced invasive species, all cause wildlife habitat to be less suitable and productive.

An appreciation for how to best conserve core and connective wildlife habitat requires understanding which species are using which habitats within the Concord/Sudbury rail corridor and neighboring wildlands. It requires answers to these questions: *How does this linear rail line habitat fit into the scheme of things? Are there extensive lands surrounding this natural area that are part of the larger home range of a wide-ranging species like fisher or bobcat?* The included maps show there are indeed large and small private and public open-space areas that are interconnected on a landscape scale. A fisher could easily travel unimpeded from White Cedar Swamp through Great Meadows National Wildlife Refuge, follow the

Concord and Assabet River corridors to access a matrix of habitats along the rewilded rail line. Then he could easily travel along the wooded rail corridor protected from human activities all the way to Sudbury's Pantry Brook Wildlife Management Area, Bridge Brook Swamp and Hop Brook to the south. The secretive bobcat also uses rail line wildlands and adjoining natural areas, hunting an impressive diversity of prey in a corresponding diversity of habitats.

The bobcat is quintessentially wild, yet wonderfully near us. No different from the leopard and the lion, the bobcat must hunt, travel, rest and find a mate in a vast matrix of habitats that must be conserved if he or she is to survive. Follow along on a bobcat's back trail in the snow for a day and you'll get the picture--it is the big picture.

Susan C. Morse, Wildlife Ecologist , 2010

Along the rewilded rail line near the Concord/Sudbury border I documented that bobcats are indeed using this habitat. Here, Roberta Summers is inspecting pungent evidence of where a bobcat scent marked by spraying the absorbent under surface of the downed log. Urine is sprayed by males and females alike in order to communicate with one another.

Many people honestly believe that wild animals can adjust to losing their habitat. People reason that wildlife will change their behaviors and get used to humans, or simply relocate to another habitat. Unfortunately, these happy endings rarely happen. Each animal's familiar home range is critical to its success at living and reproduction. Refugees from destroyed habitats are generally not successful at finding another vacant habitat nearby--much less mastering quickly enough the essentials of survival, including finding food, shelter and mates while avoiding enemies. Surrounded by the urban habitats of humankind, most homeless animals are killed by predators, competitors or vehicles.

People find it hard to comprehend that their activities may significantly impact wildlife. Human actions can cause harm over a much larger area than the rail bed itself, depending on the species and on habitat factors. It is tempting to conclude that wild animals will be unaffected by people using the rail trail because people will only use the trail during the day. Regrettably, this does not hold true for several reasons. Many wildlife species are most active during dawn and dusk, when people would also be on the trail, especially if commuting to and from work or recreating after work. Some animals, such as basking snakes, will choose to use the paved rail bed, seeking the surface environment which has been warmed by the sun. Further, there is no guarantee that officials may not at some point decide to illuminate the trail with nighttime lighting fixtures in the name of human safety. What is more, the Sudbury Police Department has stated it would consider patrolling the rail trail by motorcycle.

> The biggest problem I see with using old railroad right-of-ways for trails is the alteration of habitat used by herps and other animals. If old railroad ties are there, then those features break down and are used by snakes and salamanders for hiding places. Railroad ties are famous places to find snakes. Tearing them up would increase the probability that these animals will be killed, and it certainly causes loss of habitat. The right-of-ways themselves are used by lots of animals as corridors for movement and for basking and egg-laying sites for species like box turtles.
>
> Dr. Joseph C. Mitchell, 2010

The **conservation value** of the rewilded rail line is both local and regional. It is *local* for the natural beauty and biodiversity that clearly exists here; it is *regional* for the intact and connected diversity of surrounding additional habitats that enrich and sustain the larger ecoregion--even as the Concord/Sudbury rail corridor enriches the biological integrity of surrounding wildlands. It is important to think "big picture" when it comes to stewardship because global trends point to an alarming depletion and fragmentation of forested and wetland habitats, with an unprecedented loss of biodiversity. Many species of local wildlife, from wood turtles and green herons to mink and river otters, depend upon local towns' rich assemblage of connected habitats. The habitats along the rail line corridor, including forested upland, riparian and wetland habitats, as well as the highly productive early-successional fields and neighboring farms, are regionally important for providing habitat connectivity and sustaining biodiversity.

When seeking to safeguard habitat resources for wildlife, one must take into account which habitat attributes are being sought after by each species. Such habitat selection patterns may be influenced by the gender, age or life cycle for a particular species. The bottom line is that there is considerable variability in the habitat values that all wildlife seek, in each season, according to each species' unique requirements. There is no "one size fits all" in conservation planning; each and every habitat, including the rewilded rail line, plays a role in supporting the residential and migratory wildlife of our region. The protection of some preserves, while allowing other natural areas to be spoiled, will not satisfactorily meet the needs of future wildlife.

While an ermine may fulfill all of its life cycle within the environment of the rewilded rail line, red fox will need to use neighboring farms and natural areas as well.

Members of weasel family, fishers are wide-ranging omnivores that must move about the larger landscape of connected habitats.

Rail line wilds, as well as adjoining open space habitats provide wildlife an abundance and diversity of soft and hard mast–producing trees and shrubs.

WHAT ABOUT DOGS AND THEIR IMPACTS ON WILDLIFE AND HABITAT?

We love our dogs! However, the growing body of research findings is clear; recreational dog walking within wildlife refugia is harmful to the habitat and species therein. The expected exponential increase of dog walking along the proposed Bruce Freeman Rail Trail will dramatically increase a number of acknowledged threats to wildlife, including:

- Harassment and disruption within security habitats, affecting successful birthing, nesting and lactation.
- Compromising wildlife species' energy management during stressful seasons when food and cover are limited.
- Significant reduction of the diversity and abundance of numerous avian species.
- Increased competition and predation risks posed by coyotes which have been discovered to explore and exploit habitats frequented by domestic dogs.

The general public is not always aware of the phenomenon that the introduction of domestic dogs into wild habitats transmits various canid parasites and diseases. Canine distemper, parvovirus and rabies have resulted in high mortality experienced by wild canids and other carnivores throughout the world. Finally, new research tracking microbial sources of *E. coli* contamination of water has documented that domestic dog feces are a significant source of these disease-causing bacteria (Lenth et al., 2008; Sime, 1999; Banks and Bryant, 2010; Butler et al., 2004; Hickey, 2007; Souza, 2003).

Though my search and rescue dogs were highly trained, and always at hand, I was stunned to discover through tracking that the weekly introduction of my dogs into the wildlife habitat I was studying resulted in increased intrusions into bobcat core habitats by coyotes. These opportunistic wild dogs were following my dogs' trails in order to reaffirm their territorial boundaries which my dogs had trespassed upon. Undoubtedly, this put bobcat females and kittens at risk. Several years of such observations led me to completely abandon taking my dogs into such refugia.

WHY ARE INVASIVE SPECIES HARMFUL TO WILDLIFE AND HABITAT?

Invasive plants and animals that are not indigenous to a region further degrade habitats and alter biodiversity. These invasive organisms proliferate rapidly, overwhelming and displacing native species by out-competing them for space, nutrients and opportunities for reproduction and recruitment. Trail construction and use by people and pets provide means for non-native species to become established, even from something as unnoticed as the dispersal of seeds transported on clothing and shoes (Mount and Pickering, 2009).

WHAT IS HABITAT FRAGMENTATION?

A growing number of conservation biologists are alarmed about how habitat fragmentation irreversibly damages healthy ecological functions. Removing more forest and inviting more roads and human access into an otherwise unfragmented habitat dramatically increases disturbance and wildlife mortality. Crucial security habitat becomes degraded and wildlife recruitment is compromised, threatening the long-term viability of populations. Acre by acre, disruptions and disappearing habitats represent incremental and cumulative losses (Noss, 1994a; Tigas et al., 2002). Fragmentation of wildlife habitats already compromised by urban and suburban development, results in habitat patches that are too small and too insular to provide adequate food and security for wildlife. Heavy human and pet recreational uses, such as are expected on the Bruce Freeman Rail Trail, will disrupt, if not destroy, wildlife's daily and seasonal movement patterns, resulting in increased mortality as a consequence of starvation, predation and road kill (Cushman, 2006; Buchanan et al. Colorado State Parks and Hellmund Associates, 1998; Harris, 1984; Hilty et al., 2006).

In its current, undeveloped form, the rail bed through Concord and Sudbury provides a secure movement corridor for wildlife at a safe distance from roads. The staggering numbers of vehicle collisions with large and small mammals, amphibians, reptiles, birds and insects are increasing, and these loses are unsustainable for some species. Uncounted millions of animals are killed annually worldwide. Young and dispersing animals are particularly susceptible, due to their inexperience and/or lack of familiarity with the habitats through which they must attempt to travel.

This painted turtle was killed on Concord roadway while trying to get to a habitat in which she could lay her eggs.

In fragmented habitats many young animals, like this red fox, never make it while seeking a home range of their own.

I have already emphasized in the introduction that isolation of fragmented habitat also leads to loss of genetic diversity and natural opportunities for demographic rescue--the ability for representatives of a given species, or community of species, to access and repopulate a habitat should some disease or stochastic event cause the residents to die off (Soulé and Noss 1998).

The fact that mink and otter live within and travel throughout the railway wetland and riparian environments proves that water quality has not been severely compromised by pollution. These mammals are known to be vulnerable to the bio-accumulation of toxins in the aquatic food web. Lethal and sub-lethal amounts of PCB's, mercury and other toxins cause reproductive, endocrine and immune system malfunctions, and in severe cases, death.

Populations of opportunistic species, such as foxes, opossums, skunks, and raccoons, as well as aggressive bird species, such as crows, are known to exploit and proliferate in fragmented habitats. Their unsustainable predation impacts and nest parasitism penetrate deeply within the forest interior. Trails or roads cause these and other "edge effects" to extend into the forest for hundreds if not thousands of feet (Buchanan et al. Colorado State Parks and Hellmund Associates, 1998). Large mammalian carnivores are particularly vulnerable to extinction in fragmented landscapes, resulting in the "ecological release" of the above mentioned opportunistic species. Crooks and Soulé (1999) documented that the loss of the top predator coyote in Southern California's fragmented coastal habitats resulted in higher mortality and local extinction rates of avian species and other prey taxa. Increased numbers of mesopredators, as well as subsidized recreational hunters like housecats, were no longer controlled by apex predators in these fragmented habitats, resulting in significantly reduced biodiversity.

Potential negative effects of habitat fragmentation reach far beyond the loss of a few species. Even if it could be found acceptable to lose species within a habitat, this would ignore the complex cascade of extinctions that ensue as a consequence of community level effects (Terborgh, 1976).

Young coyote hunts for small mammals and insects

Habitat loss and fragmentation are among the most serious threats to reptile and amphibian populations native to Concord and Sudbury wetlands

The majority of our herptofauna have a life cycle that involves annual movements between various habitats (wintering, breeding, foraging), and many of our species use both terrestrial and aquatic habitats throughout the course of the year. Aquatic and semi-aquatic turtles leave the water to seek egg-laying sites, and then return; terrestrial salamanders, toads, and some of our frogs migrate from upland habitats to vernal pools and other wetlands to breed, and then move back to the uplands again; certain snakes make annual loops from their dens to favored foraging areas, and back again. The extensive network of roads that we have constructed throughout the state – along with the ever increasing amount of traffic on those roads – creates a significant hazard for many of these species, and road mortality can be very high. Mole salamanders migrating from the uplands on one side of a busy road to a breeding pool on the other are especially vulnerable. Snakes also suffer from high rates of road mortality, not only because they regularly cross roads, but also because they are attracted to warmth – holding pavement when evenings are cool. And for turtles, road crossing is nothing short of a form of Russian Roulette that often ends in instant death under a tire, or a shortened and disrupted life in captivity, or in an unfamiliar, uninhabitable habitat to which they are transported and released.

Wayne F. MacCallum, Director
Massachusetts Division of Fisheries and Wildlife, 2009

Clockwise from bottom left: Adult wood frog, spotted salamander eggs, red eft seeking woody cover in upland habitat, baby wood frog and painted turtle preparing her nest (unfortunately, right in the middle of a recreational trail).

PLANNING TRAILS WITH WILDLIFE IN MIND:
A HANDBOOK FOR TRAIL PLANNERS 1998
Buchanan et al. Colorado State Parks and Hellmund Associates, 1998

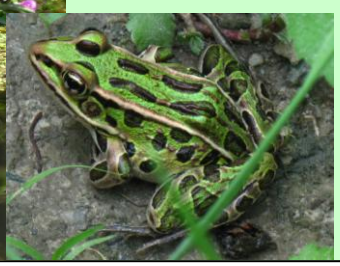
Observation: The best strategy in planning trails is always to avoid impacts to wildlife. The next best strategy is to minimize the impacts. The last resort is to mitigate for impacts.

Key Concepts for Trail Creation:

1. Riparian areas play a disproportionately large role in maintaining biodiversity.
2. Monitoring and other aspects of effective trail management may seem like luxuries, but they are actually basic stewardship requirements. Finding the resources to accomplish this stewardship will require the same levels of creative effort as building the trail.
3. Sound regulations are needed to protect wildlife, but they also need to be enforced.
4. In the case of wildlife and trails, sustainability is about enjoying trails today without precluding the ability of future generations to enjoy wildlife.

Rules of Thumb:

1. Big habitat areas. When possible, leave untouched large, undisturbed areas of wildlife habitat. They are an important – and rapidly vanishing – resource. Identify and seek to protect all such areas when aligning a trail.
2. Edge trails. It is better to route a trail around the edge of an area of high quality, undisturbed habitat, than through its center.
3. Trail density. Keep the density of trails lower within and near pristine or other high quality areas to reduce the contribution of trails to fragmentation.
4. Avoiding sensitive areas. Generally avoid specific areas where there are known species, populations, or communities of special interest [including threatened or endangered species] and where potential impacts of a trail are uncertain.
5. Impacts vs. benefits. Don't assume all wildlife impacts can be resolved through management. There may be situations where the negative impacts of a trail to wildlife outweigh the benefits to trail users and a trail should take a different alignment.



Quiet, undisturbed wetland and riparian habitats like the Jennie Dugan Swamp and Sudbury's Sawmill Brook are essential for both residential and migratory wildlife, in addition to being hot spots for botanical diversity. Such habitats also provide local and regional wildlife with secure corridors for movement.

Local farms and early successional habitats abutting the forested wetlands along the rewilded rail line enrich the environment as a whole, and provide wildlife with an even greater diversity of food and cover resources.

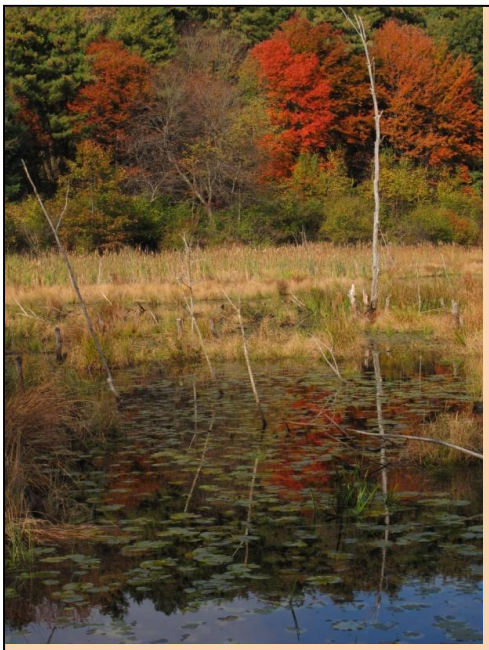
WHAT ARE CONSERVATION CORRIDORS? WHY ARE THEY IMPORTANT?

The Wildlife Sign and Sightings Map, included at the end of this report, illustrates an interesting concentration of wildlife data points depicted along the length of the rewilded rail line in Concord and Sudbury. While the collection of data is continuing, there is nonetheless a significant pattern of wildlife presence and movement along the rail corridor. The reason is simply that Concord and Sudbury's rail line is functioning as a habitat for many species as well as a "corridor" for others. A conservation corridor is a linear landscape feature that facilitates effective movement of plants and animals between patches of conserved habitat (Soulé and Gilpin, 1991; Hilty et al., 2006; Rosenberg et al., 1997).

The protection and restoration of large and small wildlife corridors are now recognized to be important conservation planning goals for maintaining viable populations of many plant and animal species, particularly in areas where little functional habitat remains (Beier and Noss 1998, Hilty et al. 2006, (Soulé and Orians, 2001). Animals are not the only beneficiaries of corridors. New research has elucidated an unexpected "spillover effect", concluding that corridors increased the diversity and distribution of plant species beyond the borders of connected conserved areas (Haddad and Kulikowski, 2009). Animal movement along corridors will also transport the seeds of plant species, on fur and in feces alike.

The Concord and Sudbury rail line corridor keeps the towns' habitats interconnected throughout the larger region, preventing the isolation and reduction of species and genetic diversity. One study documented that carnivores, such as bobcats and coyotes, may be more able to persist in fragmented habitats, provided there are corridors for safe passage between fragments. The authors noted that as many as 50% of the animals that live in such habitats are killed by vehicles while trying to cross roads, however, underscoring the importance of corridors (Tigas et al., 2002).

A functioning corridor may be as small as a thickly vegetated hedgerow through an open field or forest cover beside a river or stream. Such a corridor in an urban setting provides concealment cover and possibly some food for animal travelers. Landscape linkages do the same thing, only on a larger scale. It is of extreme concern that the proposed construction of a major recreational trail along the rewilded rail line will not be in the best interest of resident flora and fauna. Equally worrisome, the construction of the Bruce Freeman Rail Trail will also disrupt and disassemble a major habitat corridor that today maintains and enhances landscape permeability and supports species and genetic exchange throughout many excellent habitats, both locally and regionally. Indeed, while trains no longer travel the abandoned rail bed, it is teeming with a diversity of life which Henry David Thoreau admired.



From the Journal of
Henry David Thoreau – April 9, 1856

I go off a little to the right of the railroad, and sit on the bank of that sand-crater near the spring by the railroad. Sitting there on the warm bank, above the broad, shallow, crystalline pool, on the sand, amid russet banks of curled early sedge-grass, showing a little green at base, and dry leaves, I hear one *Hyla* peep faintly several times. This is, then, a degree of warmth sufficient for the *Hyla*. He is the first of his race to awaken to the new year and pierce the solitudes with his voice. He shall wear the metal for this year. You hear him, but you will never find him. He is somewhere down amid the withered sedge and alder bushes there by the water's edge, but where? From that quarter his shrill blast sounded, but he is silent, and a kingdom will not buy it again. The communications from the gods to us are still deep and sweet, indeed, but scanty and transient--enough only to keep alive the memory of the past.

Thoreau and Rorer, 2005

Restoration is inclusive, all places and all people

"There is something for everyone to do that is important to the larger effort to save naturalness. At first I was dismissive of the restoration value of small sites because of their inherent limitations as a functioning ecosystem. Since then, however, I have observed a few remarkable projects that have changed my mind. It's all about propagation of the wild in the wild. If we are to save our native biodiversity it will take the full panoply of strategies from corridors of wildlands down to seed banks.

Leslie Sauer, 2010

Spring peeper in Sudbury wetland

In conclusion, the evidence is clear. The railroad right-of-way through Concord and Sudbury has irreplaceable value for wildlife. On both a local and regional level, the rail bed and adjacent lands function as wildlife habitat and sustain biodiversity and connectivity. Scientific studies have solidly demonstrated that recreational trails can have deleterious effects on wildlife. Here, there is special concern because the proposed Bruce Freeman Rail Trail would traverse extensive riparian areas, including habitats in which there are State listed species.

The question remains: Is it truly for "the greater good" that we would consider further destruction of what little is left of our precious suburban wildlife habitat for the sake of more human recreational opportunities?

A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.

Aldo Leopold, A Sand County Almanac, 1949

"The one process now going on that will take millions of years to correct is the loss of genetic and species diversity by the destruction of natural habitats. This is the folly our descendants are least likely to forgive us".

E. O. Wilson, 2010

"There can be no purpose more enspiriting than to begin the age of restoration, reweaving the wondrous diversity of life that still surrounds us".

E. O. Wilson, The Diversity of Life, 1992

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Annotated bibliography of map sources used in report on the Bruce Freeman Rail Trail, Concord and Sudbury, MA

Map Data Sources:

MassGIS data

Base map layers (roads, surface water, political boundaries):
Massachusetts Office of Geographic Information (MassGIS). Last accessed June 2010.
http://www.mass.gov/mgis/download.htm.

This site is the main repository for public GIS data in the State of Massachusetts. Detailed descriptions of these data (meta data) are also available at this site.

Other thematic layers:
Protected and Recreational Open Space (http://www.mass.gov/mgis/osp.htm) (Last accessed Jan 2010)

From the meta data:

> The protected and recreational open space data layer contains the boundaries of conservation lands and outdoor recreational facilities in Massachusetts. The associated database contains relevant information about each parcel, including ownership, level of protection, public accessibility, assessor's map and lot numbers, and related legal interests held on the land, including conservation restrictions. Conservation and outdoor recreational facilities owned by federal, state, county, municipal, and nonprofit enterprises are included in this datalayer. Not all lands in this layer are protected in perpetuity, though nearly all have at least some level of protection.
> **Although the initial data collection effort for this data layer has been completed, open space changes continually and this data layer is therefore considered to be under development. Additionally, due to the collaborative nature of this data collection effort, the accuracy and completeness of open space data varies across the state's municipalities. Attributes, while comprehensive in scope, may be incomplete for many parcels.**
> Details about the new OpenSpace feature dataset, including all table schemas and field code values, are provided in the small poster MassGIS Protected & Recreation OpenSpace Schema (PDF).
> The following types of land are included in this datalayer:
>
> · **conservation land**- habitat protection with minimal recreation, such as walking trails
> · **recreation land**- outdoor facilities such as town parks, commons, playing fields, school fields, golf courses, bike paths, scout camps, and fish and game clubs. These may be privately or publicly owned facilities.

NHESP Priority Habitats of Rare Species (http://www.mass.gov/mgis/prihab.htm) (last accessed 3/19/2009)

From the meta data:

> The Priority Habitats of Rare Species datalayer contains polygons representing the geographic extent of Habitat of state-listed rare species in Massachusetts based on observations documented within the last 25 years in the database of the Natural Heritage & Endangered Species Program (NHESP). Priority Habitat polygons are the filing trigger for project proponents, municipalities, and all others for determining whether or not a proposed project or activity must be reviewed by the NHESP for compliance with the Massachusetts Endangered Species Act (MESA) and its implementing regulations. Areas delineated as Priority Habitats can include wetlands, uplands, and marine habitats—in fact, over half of the total acreage of Priority Habitat is mapped for marine habitats of state-listed rare species. The Priority Habitats presented here are those published in the 13th Edition of the Massachusetts Natural Heritage Atlas, and are effective beginning **October 1, 2008**.

Land Cover/ Land Use (http://www.mass.gov/mgis/lus2005.htm) (Last accessed Jan 2010)

From the meta data:

> The Land Use (2005) layer is a Massachusetts statewide, seamless digital dataset of land cover / land use, created using semi-automated methods, and based on 0.5 meter resolution digital ortho imagery captured in April 2005.

These data were reclassified into slightly broader (fewer) groupings to aid map interpretation.

Project-specific data

Wildlife Sign and Sightings
These data were compiled from a variety of local sources, including:

- Carlisle Mosquito Bear sightings: Bear Sightings Oct. 1 – Nov. 12, The Carlisle Mosquito, 2006. Map prepared by Jane Hamilton.
- Validated reports from qualified field naturalists.
- Anecdotal reports from a variety of reliable sources

The numerous Carlisle sightings have been collapsed to a single, central point. Generally, individual observations are shown as symbols keyed to the species. However, in some cases individual observations were generalized into areas, largely to protect the identity of specific locations. All observations were reviewed for reliability.

Habitat patches
The habitat patch layer was "derived" from other of the above layers. A standard geoprocessing approach combined landform (derived from elevation), elevation, land cover, distance to water and roads into "patches" of potentially suitable habitat. These habitat patches were then classified by size into small (< 200 acres), medium (between 200 ac and 1000 ac) and large (>1000 acres). This layer is designed as another attempt to visualize habitat potential in the vicinity of the trail.

Bruce Freeman Rail Trail
This layer was digitized from map documents available at
http://www.brucefreemanrailtrail.org/maps/trail-map.html (last accessed Jan 2010)

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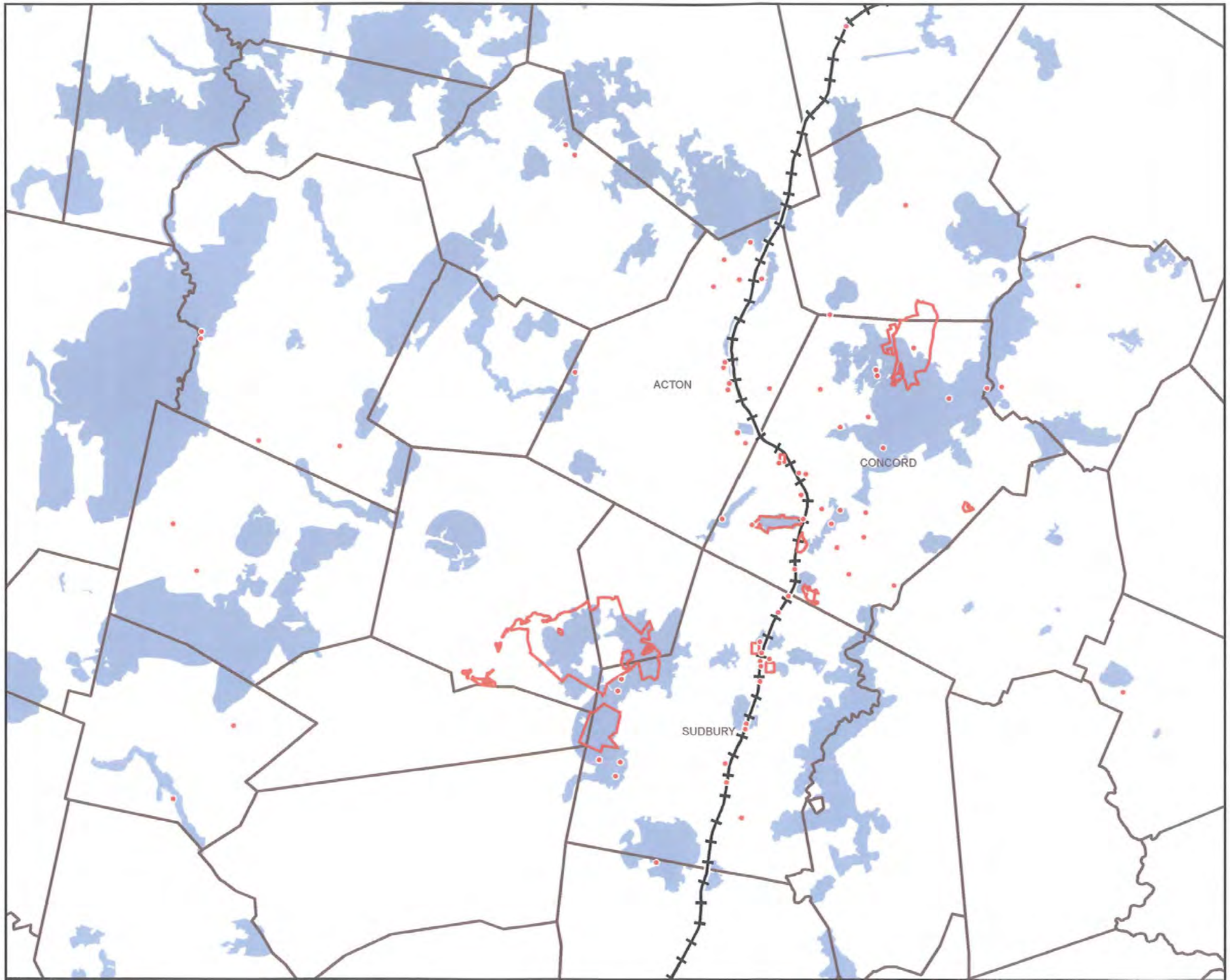
Information about Susan C. Morse

Throughout North America, Susan Morse is highly regarded as an expert in natural history and tracking. Ms. Morse has more than thirty-five years experience monitoring wildlife and interpreting wildlife habitat use. Her research has focused on cougar, bobcat, black bear, and Canada lynx. She has given workshops on wild felids and other carnivores to a wide range of audiences, including the general public, conservation leaders and professional biologists.

In 2001 Morse received the Franklin Fairbanks Award for her lifelong creative and dedicated service to enriching the awareness and understanding of the natural world among the residents of New England. She and Keeping Track® were recently recognized by the Adirondack Council for decades of conservation work in the Champlain basin bioregion. Ms. Morse has authored numerous articles and authors a regular column on wildlife in *Northern Woodlands Magazine*. Her work has been featured in many other publications, including *Smithsonian, Audubon, Amicus Journal, Forest Magazine, Wild Earth, Vermont Life, Adirondack Life, The Nature Conservancy, and Ranger Rick,* as well as on National Public Radio's "Morning Edition". Morse's life work and photography is highlighted in **The Woods Scientist** by Stephen Swinburne (Houghton Mifflin, 2002). Ms. Morse is currently under contract with Princeton University Press, publisher for her upcoming two-volume text covering the monitoring of selected focal wildlife species.

Sixteen years ago, Morse founded Keeping Track®, an organization devoted to training professional biologists and citizen scientists alike in wildlife monitoring skills. Keeping Track's mission is to empower multiple stakeholders to use their knowledge to detect, record and monitor the status of wildlife and wildlife habitat in their communities. Data collected by Keeping Track teams has influenced the conservation of over 30,000 acres of habitat in twelve states and Quebec.

Wildlife Sign and Sightings in Relation to NHESP Priority Habitats of Rare Species



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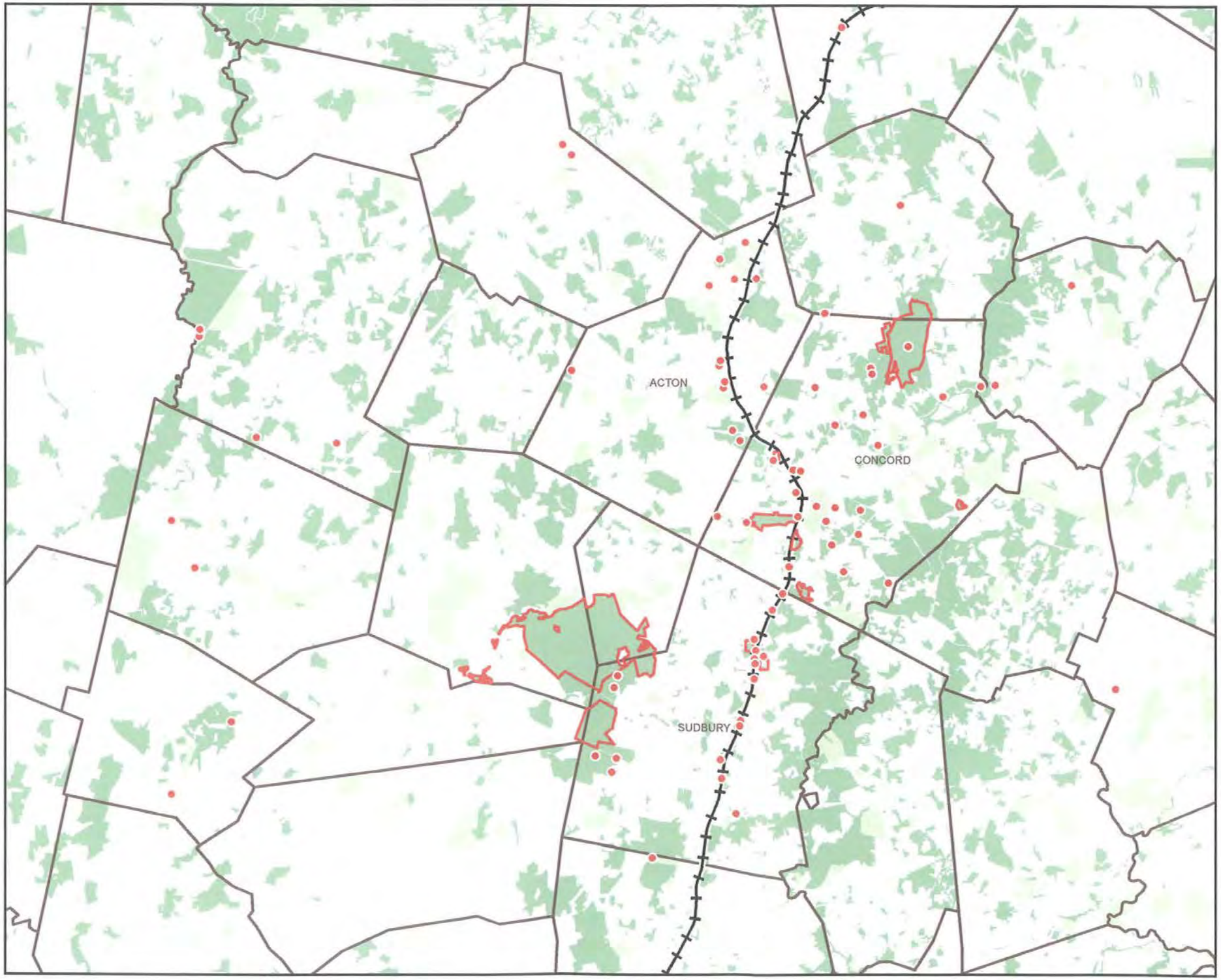
Legend

- Wildlife Sign and Sightings
- Wildlife Sign and Sightings
- Bruce Freeman Rail Trail
- Town Boundary
- NHESP Priority Habitats of Rare Species

1:125,000

Wildlife Sign and Sightings in Relation to Protected and Recreational OpenSpace



Legend

- Wildlife Sign and Sightings
- Wildlife Sign and Sightings
- Bruce Freeman Rail Trail
- Town Boundary

Protected and Recreational OpenSpace

Primary Purpose

- Agriculture; Conservation; Recreation and Conservation; Habitat Protection
- Recreation; Historical/Cultural; Flood Control; Water Supply Protection; Site is Underwater; Other; Unknown

1:125,000

October 1, 2010