Keeping Track: A Mammal Tracking Inventory of Focal Species in the Cold Hollow Mountains

Trends in Abundance, Habitat, and Conservation

2010 - 2014

(Corbis, G. J.)

Report Compiled and Written by: James Farrell, Rhianna Sommers, and Michael Storace, University of Vermont

Community Partner: Cold Hollow to Canada Regional Conservation Partnership

INTRODUCTION

Setting:

The Cold Hollow Mountains are part of the Green Mountains, which stretch from the border of Massachusetts through the spine of Vermont, and north to Quebec, Canada. The Northern Green Mountains house the Cold Hollow Mountains, which make up part of the larger Northern Forest. The Northern Forest is the largest block of contiguous forest east of the Mississippi River, and consists of 26 million acres of forested areas in New York, Vermont, Maine, New Hampshire, Quebec, New Brunswick, and Nova Scotia (National Wildlife Federation, 2014).

The Northern Green Mountains typically have a cooler climate than much of the rest of the state because of their altitude. This cool altitude results from less warming from the surface of the Earth and cooling from air that arises in the mountains. The Northern Green Mountains also receive more precipitation than other parts of Vermont (Thompson and Sorenson, 2005).

The most prominent natural communities in the Northern Green Mountains are Montane Spruce-Fir Forests, Montane Yellow Birch-Red Spruce Forests, and Northern Hardwood Forests. Northern Hardwood forests make up the matrix natural community in Vermont (Thompson and Sorenson, 2005).

The Northern Forest, Showing the Northern Green Mountains Linkage Area (Two Countries, One Forest)

Common Regional and State Human-Wildlife Conflicts:

Human-wildlife conflicts are inevitable in almost any region of the country - wherever people live because there is bound to be wildlife. Even in relatively rural places like northern Vermont, human-wildlife conflicts exist. These problems include wildlife-vehicle collisions, dealing with sick wildlife, and interactions with "nuisance wildlife." Specifically, black bears are sometimes viewed as a nuisance in parts of Vermont because when food is scarce, individuals will sometimes wander into people's yards to explore "easy options" for food such as bird feeders and beehives. They will also explore open dumpsters, campsites where food has been left out, pet food that is left outside, and barbecue grills. Taking precautionary measures such as keeping chickens in an electric fence, and honeybees within a bear-proof enclosure, feeding pets indoors, only feeding birds between the winter months, when bears are in their dens, and *never* feeding bears are essential to avoid these problems (Vermont Department of Fish & Wildlife).

Another common conflict at the human-wildlife interface described by the Vermont Department of Fish & Wildlife has to do with beavers and their impact on development. Beavers are a keystone species, as they alter the landscape, creating and maintaining habitat for many species. However, the creation of beaver dams can cause problems for humans, such as upstream flooding of land, contamination of water supplies, and interference with the action of septic systems (2002). These are just a few examples of how wildlife can affect humans (and vice versa). Learning to live cooperatively with the species we share the landscape with is a critical part of maintaining a sustainable ecosystem.

The list of potential conflicts goes on - disease, vehicle collisions, and human interference with abandoned wildlife can all negatively affect people and animals alike. However, human development and conservation of wildlife habitat do not have to be mutually exclusive. Perhaps the most important aspect to mitigating one's impact on natural areas is education: understanding key issues of wildlife conservation in your area, and how you can make a difference.

Importance of Conflict Mitigation:

As there are usually many stakeholders involved, human-wildlife conflicts require the use of democratic, participatory, and transparent methods for implementing wildlife conservation projects. These conservation efforts must both increase the welfare of residents and manage for the needs of the resident and temporary wildlife. Since many of these issues are quite complex, there must be interdisciplinary approaches to mitigate and resolve the conflicts between humans and wildlife (Treves, 2006).

In an ideal setting, communities would manage their encounters with wildlife so as not to cause any permanent harm to the diversity of biological communities. Unfortunately, many of the conflicts fall on the borders of conserved areas and involve threatened species whose management falls under the jurisdiction, but beyond the capacity of, many wildlife managers. In these instances, a third party can be

very useful in bolstering the resources wildlife managers and citizens have, but also act as an ambassador and intermediary between wildlife managers and citizens if there is mistrust of citizens in the effectiveness of wildlife managers (Treves, 2006).

Making assumptions about the complexity of human-wildlife conflict issues can cause the failure of management efforts. The assumptions are that the level of wildlife damage is directly related to the damage engendered, that the level of damage elicits a equal proportionate response, and that altering the relationship to conflict will have equal conservation effects. It is better when mitigating conflicts between humans and wildlife to consider how the damage by wildlife is assessed and its perceived severity, how intensely a group or individual will respond to the conflict and damage, and how directly linked the management of a species is to the reported conflict. The perception of risk and whether an individual or group feel they had a say in accepting or not accepting that risk can have major influence on conflict management because it can change the way individuals relate to the wildlife. This is only further complicated by the lifestyle of the individuals, such as if they are dependent on one kind of lifestyle that conflicts with certain wildlife, making them more antagonistic towards wildlife. People react with different levels of severity to different levels of wildlife damage and many times are influenced by social factors, such as attitudes and current cultural norms, that make elicited responses to wildlife damage not proportionate to the level of damage (Dickman, 2010).

Not surprisingly, the physical landscape plays a major role in conflict mitigation. Power relations, such as differences in rural and urban populations, in society and religious views further complicate the framework of human-wildlife conflict and mitigation. Moving forward in human-wildlife conflict mitigation, parties must consider the relations between levels of wildlife damage and perceptions of conflict on many social levels, examine the relations between wildlife damage and human perception and retaliation, evidence-based examination of conflict mitigations conservation efforts, and broaden the approach from species to communities and societies (Dickmans, 2010).

The Role of Citizen Science and Cold Hollow to Canada:

Accommodating the needs of wildlife and people is a daunting task that crosses state and town boundaries on numerous occasions. Information about the distribution of focal wildlife species in the area allows conservationists and managers to critically assess land use practices in the region, provides a basis for the improvement of future conservation agendas, and balances the needs of communities with the needs of wildlife. The journal *Urban Ecosystems* addresses how the greater trend towards community engagement in wildlife issues has brought along many advantages, such as better identification of common concerns and co-management between communities and state managers (Decker et. al, 2005).

What is Citizen Science?

One way to collect information about local wildlife populations and improve public access to trends in these data, while also spreading information about conservation that will benefit both people and wildlife, is through the work of citizen science. Citizen science refers to public participation in scientific research projects. This can include voluntary monitoring and recording of observations and data. Often the data collected is part of a long-term project, with a goal in mind (Cornell Lab of Ornithology, 2014). Some examples of citizen science projects are eBird, the Audubon Christmas Bird Count, and Monarch Watch. A well-known online program among birders and wildlife enthusiasts, eBird

is a real-time, online program that allows people to sign in, select their location, and list all of the bird species they saw. The program was created by the National Audubon Society and the Cornell Lab of Ornithology in 2002, and it allows people to document what they have seen and contribute to a meaningful database that includes valuable information on the distribution and abundance of bird species (eBird). It benefits birders, conservationists, and residents.

Cold Hollow to Canada:

One citizen science group that works to bridge the gap between citizens and wildlife is Cold Hollow to Canada Regional Conservation Partnership (CHC). CHC is a community member partnership organization that aims to promote land stewardship and habitat conservation. CHC employs collaborations between public entities and local conservation commissions to spread awareness about wildlife issues regarding healthy wildlife populations for future generations. CHC partners with conservation commissions and consists of citizen science in the Vermont towns of Bakersfield, Belvidere, Enosburg, Fletcher, Montgomery, Richford, and Waterville. These towns reside within the northern forest on the western side of the Green Mountains that stretches from the southern portion of the Cold Hollow Mountains to the Canadian border. The vision of CHC is to conserve wildlife habitat in the participating towns by promoting wise use of resources and encouraging a sustainable economy. Cold Hollow to Canada's goal is to conserve their part of the Northern forest for long term use by people and wildlife (Cold Hollow to Canada, 2010). Cold Hollow to Canada's main strategies towards achieving this mission are conserving large blocks of contiguous forest, conserving corridors to maintain population connectivity, and encouraging landowners to engage in permanent conservation easements (Cold Hollow to Canada, 2014).
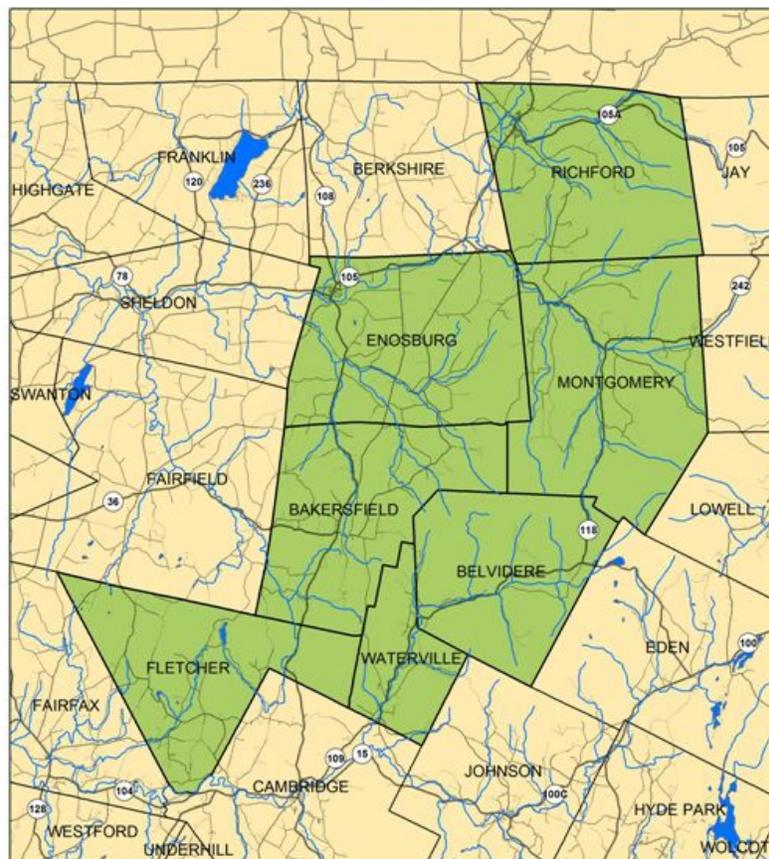
Keeping Track Monitoring Program:

Cold Hollow to Canada has three main wildlife tracking and monitoring programs, the Wildpaths Program, a public wildlife observation program, and the Keeping Track Monitoring Program (KTMP). The Keeping Track Monitoring Program's mission is "to inspire community participation in the long-term stewardship of wildlife habitat" (Hass, Morse, Shaw, 2000). Keeping Track teams consist of three individuals who have taken part in the Keeping Track training programs. Teams conduct four survey per year, one in each season, along predetermined transects. Transects are about 2.5 miles long, 60 feet in width, are usually a loop shape, and should be located at least .6 miles from another transect (Hass, Morse, & Shaw, 2000). During transect walks, keeping track teams collect data points for wildlife signs, such as tracks, urine and scat, scent posts, hair, and marked trees. Teams also record several other habitat variables such as landform type, habitat type, and forest type, if applicable.

Montgomery Transect Walk, Fall 2014

FOCAL SPECIES

American Black Bear (*Ursus americanus*)

(New Jersey Department of Environmental Protection)

Physical Description:

Though generally shy in nature and uncommon to see, black bears are well-established dwellers of the Cold Hollow Mountains. These adaptable animals can be found throughout much of North America, typically along the east coast, extending north into Canada, and in the western United States and Alaska. In Vermont most black bears have a black coat, but out west they are often brown or cinnamon-colored. Weight is an indicator of food availability. Adult females tend to range in size from 120 to 180 pounds, and males can be as large as 300 to 400 pounds (Vermont Department of Fish & Wildlife, 2011). The cubs are tiny, and stay with their mother until they are about sixteen months old. Some bears are born with a light-colored blaze on their chest, which can be useful in identifying different individuals. They have an excellent sense of hearing and their sense of smell is approximately seven times greater than a bloodhound's (The American Bear Association). Their eyesight is thought to be comparable to that of humans.

Habitat Requirements:

Black bears are often found at higher elevations, and prefer a mixture of multiple habitat types. They prefer a combination of coniferous and hardwood forests, as well as forests in close proximity to wetlands. While evergreen trees provide concealment and protection from the elements, hardwoods provide the bears with some of their main food sources, including beechnuts and acorns. Wetlands are

valuable sources of water and vegetation. They are especially important in the spring, when bears emerge from their dens. Wetland vegetation is among the first forage available for the calorie-driven bears during this time. Mother bears will often leave their cubs in a tree while foraging in a wetland or elsewhere.

Black bears typically create dens from naturally-occurring burrows or gaps in the forest, such as brush piles, cavities in rocky ledges and outcroppings, or hollows in a fallen tree. Though their respiration and metabolic rate decrease during the winter, bears are not considered true hibernators because their body temperature does not significantly decrease during this time. This means that bears *can* in fact be awoken from their hibernation "sleep", and respond to a threat in a relatively quick manner (Vermont Department of Fish & Wildlife, 2011). How late in the fall bears go into hibernation depends on the availability of food in their home range. The more food there is, the later bears will enter their dens.

Ultimately, black bears require large tracts of forested land to provide a sufficient home range and food sources. Home range sizes vary greatly at different geographic locations. Males have significantly larger home ranges than females. In Idaho, male home ranges averaged 56 square miles, while in western Massachusetts the average home range size for adult males was estimated at 123 square miles. For females, average home range size was 2.6 square miles in Minnesota and 15.8 square miles in Pennsylvania (Massachusetts Executive Office of Energy and Environmental Affairs).

A black bear yearling in its den.   (North American Bear Center, 2014)

Behavior:

Black bears are generally shy animals that keep to themselves and avoid humans. They are solitary for the most part, other than a mother with cubs. During their second year, they are referred to as yearlings. Yearlings tend to be among the most curious and bold of bears. Black bears are diurnal, meaning they tend to forage, travel, and carry out their day-to-day activities during the daytime. However, in developed areas and campgrounds, they can become habituated or used to human presence, and may alter their behavior to obtain food from bird feeders, coolers that are left out, and other human sources.

 It is uncommon for black bears to show aggression toward humans, unless from a mother defending her cubs. "Huffing" and "clacking" are sometimes used when they are confronted with a threat.

Bears sometimes huff, or make deep exhaling sounds, when they retreat from a potential threat. "Clacking" or "chomping", which refers to the popping of the jaw, is a sign of nervousness, another behavioral response to fear. Bluff charges are another common behavior used by bears when they feel "cornered" or crowded but do not want to retreat because of cubs, food, or some other reason. Bluff charging involves taking a quick, swift step towards a person, slap the ground, and huff (North American Bear Center, 2014). This is a sign of defense. It signals to the threat to give the bear some distance, but it generally does not result in any harm. "Treeing" is also a defense mechanism used by black bears. They are excellent climbers, and use trees to mark their territory. (North American Bear Center, 2014).

(Sommers, 2014)

The above photo shows an example of a bear-scarred beech tree. This particular tree has been marked several times over the years by black bears. It is located along the Montgomery transect.

Black bears reach maturity at three and a half years of age. Breeding season is during early to mid-summer, and females give birth to cubs every other year (usually one or two, but occasionally more). The cubs are born in January or February in the den. Food supply directly affects cub survival (Vermont Department of Fish & Wildlife, 2011).

Though some people assume black bears are carnivores, they are actually omnivores, with plants making up the majority of their diet. Beechnuts and acorns are valuable sources of fat and protein. In addition, bears may go after the occasional fawn or moose calf, but this is relatively uncommon.

Threats and Conservation:

The greatest threat to black bear survival in Vermont in habitat fragmentation, which occurs in the form of roads, mountainside homes, and other forms of human development (Vermont Department of Fish & Wildlife, 2010). Another potential threat is the variation in the production of beechnuts from year to year, one of their major food sources. During years when beechnuts are in short supply, bears must

travel further to find food, leading to higher mortality rates (McLaughlin et al., 1994). For this reason, concentrated beech stands are optimal when considering black bear habitat. Bears require large contiguous blocks of habitat, and for this reason are great indicators of other mammalian species that have similar habitat requirements. This is just one of the many reasons it is important to conserve bear habitat.

The four components of Vermont's bear management program are public education, habitat protection, regulation of harvest, and responding to human-bear conflicts. While reducing suburban sprawl and development in defined optimal habitat areas is an obvious conservation strategy, there are other ways to protect bears. Social carrying capacity refers to the ability of humans to coexist peacefully with bears, without viewing them as a "nuisance" species. Hunting regulations aim to keep bear populations at target levels, therefore reducing the number of bears that could potentially cause human-wildlife conflicts, such as getting into dumpsters or eating crops. Education also plays into this. Knowing a little bit about bear biology and behavior makes it easier to understand their conservation. Feeding bears and leaving out bird feeders when bears are not in hibernation can habituate them and cause them to no longer be as "wild" as they once were. Biologists and conservationists discourage this behavior, using the slogan "a fed bear is a dead bear" (Vermont Department of Fish & Wildlife, 2010).

Moose (*Alces alces*)

(Hagerty, 2007)

Physical Description:

Moose are members of the family Cervidae along with other ruminant mammals like deer and elk. Physically, they are characterized by a long nose, a "dewlap" or bell on the throat, and of course their large size (Saunders, 1988). The northeastern subspecies can grow to be as large as 1400 pounds. Males are easily recognized by their large palmate antlers which develop each spring and are lost at the beginning of the winter. Females have a white patch of fur under their tail. Their front legs are longer than their hind legs to help them jump over logs (Vermont Department of Fish & Wildlife).

Habitat Requirements:

Moose live in cold climates and prefer to inhabit boreal forests, which generally consist of mostly coniferous trees. Moose are generally intolerant of high temperatures and can actually become overheated if they are in temperatures above 75 degrees Fahrenheit for prolonged periods of time (Saunders, 1988). Thus, access to either dense vegetation that provides shade or cool water in a wetland is essential when considering habitat. They also must be in close proximity to wetlands and early successional vegetation, on which they will browse. They are excellent swimmers and often feed on wetland vegetation as well (Vermont Department of Fish & Wildlife).

Behavior:

Moose are solitary animals. They begin breeding season ("rut") in early September and it generally ends in November. The antlers are shed with the end of the mating season, and don't begin to grow back until March or April (Vermont Department of Fish & Wildlife). Both males and females are capable of breeding at a young age (approximately sixteen months), but usually will not breed until they are older. Cows will generally have either one of two calves, which are born reddish in color.

Moose are generally solitary animals but may coalesce in small groups in the winter if they find an optimal foraging area. They are generally pretty slow-moving, but are capable of running at high speeds, despite their size and lanky nature. Cows with calves and bulls during rutting season can display signs of aggression (Saunders, 1988). Bulls engage in intense fights over calves during the mating season. The bell of the throat is thought to disperse pheromones (a type of chemical scent signal) (Vermont Department of Fish & Wildlife).

Moose are primarily browsers and feed on the leaves and twigs of young vegetation, including saplings and shrubs. Common plants they will browse include hobblebush, pin cherry, red, striped, and mountain maple, and aspens. They will also peel off and eat the bark off of mountain ash and maple trees. Aquatic plants such as water lilies are favored in the warmer months. In the winter, woody plant parts are consumed. They also love salt licks, which can occur naturally in some parts of the soil which are particularly high in calcium and sodium. Roadside salt licks stemming from manmade causes can attract moose to roads and put the moose (and drivers) in danger of a car accident.

(Hildreth, 2012)

Moose will mark their territory by scraping bark off of trees, and will also peel off the bark to eat the cambium layer. These markings are made with the incisors, and trees marked this way provide one way to track moose year-round (Peziol).

Threats and Conservation:

The National Wildlife Federation (NWF) has worked to identify priority wildlife corridors for moose throughout Vermont. Roads are one type of fragmenting barrier. Working with state agencies, transportation experts, and citizens, the NWF hopes to develop strategies that mitigate this impact, such as gaps in guardrails to allow for wildlife crossing. Other conservation strategies for moose include applying less salt to the roads, improving signage and visibility for drivers, removing salt licks, and conserving the land around these roads (National Wildlife Federation).

Additionally, climate change poses a major threat to moose populations. Overheating, disease, and heightened tick populations and infestations are all climate change-related threats that are likely currently impacting moose populations, and are expected to do so in the future (National Wildlife Federation). Moose are weakened by blood loss due to ticks. Some moose develop anemia and die from this. Attempts to scrape off ticks often leave bare patches of skin remaining, which makes moose more vulnerable to cold temperatures in the winter. Tick overloads often lead to calf mortality. In New Hampshire, "over a five year period, ticks accounted for 41 percent of all moose deaths in the state" (National Wildlife Federation). Preserving large blocks of habitat for the moose, and maintaining connectivity between core habitat blocks, are important steps in protecting moose populations. Also, reducing the effects of climate change, both at local and larger-scale levels, would benefit the moose. Adopting clean energy techniques, reducing the amount of energy consumed, and using public transportation or other more environmentally-friendly travel mechanisms are just a few ways to reduce personal impact on climate change.

American Marten (*Martes americana*)

(Cox, D.)

Physical Description:

The American marten is a small omnivore in the weasel family Mustelidae. It is smaller than a house cat, and similar in appearance to the closely related fisher. The fisher is larger. Members of the Mustelidae family are unique in that they have anal scent glands which produce a strong odor used to mark their territories. The marten's bushy tail is about a third of the length of its whole body. It has round ears and a pointed snout. They are generally quite shy, but curious creatures (New York State Department of Environmental Conservation).

Habitat Requirements:

Martens are an arboreal species, meaning they spend much of their time in trees. Preferred habitats include mature spruce-fir forests and mixed hardwood forests. Red squirrels are one of their main food sources, along with other small mammals; however, martens aren't too picky when it comes to food - they will eat fruit, carrion, fish, nuts, and seeds - basically whatever is available to them (New York State Department of Environmental Conservation). They will create several dens within their home range, containing nests made of plant matter within hollowed out logs and other natural cavities, often under snow cover. Snow is important for martens as in the winter they can easily hunt by leaping across and burrowing into the snow-packed ground (Saunders, 1988).

Behavior:

The American marten is a natural climber - easily navigating its way through the trees and chasing its prey. They are generally polygynous; a territorial male will mate with multiple females. Mating begins in mid-summer, but the kits are not born until March or April (New York State Department of Environmental Conservation). The kits will generally stay with their mother until they are about three months of age. Both males and females begin breeding at age two or three. The marten is a solitary species, spending much of its life traveling and hunting alone. It hunts by scanning the ground and trees for prey, and then pouncing on it. It do not have many natural predators; however, it is not uncommon for animals like the Great Horned Owl, coyote, and bobcat to hunt them on occasion (Saunders, 1988).

Threats and Conservation:

Martens were extinct in Vermont in the early 1900s; however, in recent years scientists have noted the presence of two small populations within the state. One population in the southern Green Mountains is the product of a reintroduction that was done between 1989 and 1991. The second population is located in the Northeast Kingdom and likely formed from nearby populations in either New Hampshire or Canada that branched off and formed a new population. State biologists believe that these populations are actually expanding, as more observations have been reported in the last few years. This species faces threats including habitat fragmentation across the state, competition with the fisher, and milder winters (snow cover is one of their habitat requirement, as they hunt and den in the snow). Fishers not only prey on many of the same animals as martens, but will also prey on martens themselves. Martens' small size aids them in burrowing underneath the snow and finding small mammals that are inaccessible fishers (Vermont Department of Fish & Wildlife, 2014).

Climate change may result in decreased snow depths, which is predicted to affect the marten by causing populations to shift farther north and into higher elevations. Since martens have an advantage over fishers in deep snow, reduced snow levels due to climate change could be a threat for marten populations in the coming years (Kelly, J.R.). Conserving blocks of coniferous forest would be especially beneficial in protecting the growing marten population in the state. Maintaining connectivity of these forest blocks is also key to conserving this species, as that would facilitate migration to higher elevation - or snowier - habitats. This would give the marten a better chance of being able to compete effectively with the fisher, which does not hunt as well in snowy habitats.

American Mink (*Neovison vison*)

(http://www.arkive.org/american-mink/neovison-vison)

Physical Description:

The mink is a small mammal with a sleek body, which makes it an excellent swimmer. Its legs are short and stubby with webbed feet. It has small ears and eyes and a long thick tail. The mink's versatility in water is due its thick water-repellent fur which contains oily guard hairs. Mink are small animals that usually weigh between two and three pounds. The mink has light to dark brown and black fur with white spots on its chin and throat ("American Mink –Neovison Vison", 2014 & Schuh, 1997).

Habitat Requirements:

The American Mink's native range is the entirety of Canada and the majority of the United States, except for Arizona and the arid parts of California, New Mexico, Utah, and Western Texas (International Union for Conservation of Nature). Water is a critical component of habitat for mink, and they prefer locations such as streambanks, lake shores, and marshes. Mink favor habitat located close to small streams over areas near larger water bodies. They prefer forested wetlands with thickets, fallen trees, and rocks for abundant cover. Increased frequency of American mink occurs in areas where abundant downfall and debris creates foraging cover. For the mink, areas including irregular and diverse shorelines are more advantageous that straight, open, and exposed shorelines. The American mink avoids open areas and searches for shrubby dense thickets. Depending on availability and accessibility of prey, American mink are adaptable in their habitat needs and can be tolerant of human activity (Sullivan, 1996).

American Mink place their den sites in areas of thick cover that include hollow logs, natural cavities, under tree roots, and burrows along stream, march, and lake edges. Mink have been known to use old beaver burrows as den sites (Sullivan, 1996).

The shape of a Mink's home range tends to approximate and resemble the shape of the body of water the American mink uses most and home range usage and intensity varies with prey availability. Because core areas are usually areas with relatively high prey abundances, mink switch den sites and core areas several time seasonally (Sullivan, 1996).

Behavior:

This animal is usually nocturnal, but has been known to be active during the day. Even with the adaptations to be an excellent swimmer, the American mink only partially spends its time in water and can only dive to five or six feet, which prevents it from pursuing prey in open water. The American mink compensates for this by being a skilled climber that can jump from tree to tree and come down trees head-first. Mink commonly have a surplus of kills and store the remains for later. Mink are opportunistic voracious predators, killing a variety of prey including small mammals, amphibians, birds, crayfish, crabs, insects, and worms (Wildscreen Arkive, "American Mink (Neovison Vison)".

Mink are usually solitary, marking their territory with pungent secretions from anal scent glands. These secretions can also be used as a defensive strategy in response to stress. Minks are commonly invaders of vacant muskrat and beaver houses, and burrows of other small mammals, but can dig their own dens that are close to water with multiple entrances (Wildscreen Arkive, "American Mink (Neovison Vison)").

Mating primarily occurs in the spring between February and April and with births taking place in April, May, and June. Each litter consists of two to ten offspring, with five being the average number. The bind, naked, and helpless young are born into a den lined with fur, feathers, and dried plant material. Although young are weaned at 5-6 weeks and open their eyes at 4-5 weeks, they remain with their mother until autumn. Female mink reach sexual maturity at 12 months and males reach sexual maturity at 18 months. Mink typically live to be only three or four years old. Their main predators are owls and other birds of prey, foxes, coyotes, lynx, and otters (Wildscreen Arkive, "American Mink (Neovison Vison)").

Threats and Conservation:

Because mink are adaptable and successful predators, they exert powerful impacts on the native animals outside and inside their range, competing with otters, preying on native species, and being possible vectors for disease. Due to the tendency of American mink to kill more than they eat, they have the potential ability to decimate waterbird colonies (Wildscreen Arkive, "American Mink (Neovison Vison)") .

Mink are lucky that generally large predators do not prey on them, but have to be careful of the occasional gray fox, bobcat, or great horned owl. Mink are also fortunate that although they have a host of parasites on them, including fleas, mites, and lice, these parasites don't cause them significant individual or population mortality. Ranch raised mink populations do suffer from salmonella, distemper, and tularemia, but for the wild, salmonella and tularemia do not appear to be an issue, however, some evidence does show distemper could be a potential problem for wild mink. Instead, environmental contaminants, including DDT, PCBs, and mercury have unknown effects in wild mink and have been known to cause weight loss and reproductive problems in ranch mink. In the past, mink pelts were considered high class and ranches were prevalent in North America and have increased and decreased over the years due to cultural trends in Europe and North America. Even though there has been a decrease in the societal interest for mink pelts, trapping of mink is still a popular activity ("Mink Scientific Name: Mustela Vison, 2014).

Prime threats to mink are habitat destruction and degradation, an example being water pollution because of land use and chemical pollutants. The generalist eating habits of the mink could potentially be a buffer to habitat destruction and degradation. Development of shorelines, along with effecting water quality, alters vegetation structure and composition, species composition of the vegetation, and the mink's prey abundances, all of which can negatively affect mink population densities. Mink are difficult to census and are believed not to be in danger and are not studied throughout parts of their range because of these factors. The minks that are recorded are usually ones accidentally caught in muskrat traps (Ray, 2000).

Fisher (*Martes pennanti*)

Physical Description:

The fisher has a slender weasel-like body with a bushy tail, short legs, and a triangular head with large round ears. The body is mostly brown, but the hairs can be tipped gold or silver. Individuals are identified by the variable cream-colored patches on individuals. Males are typically larger and females have variance, both by sex and by season, in their colors and fur patterns. Fishers are known to weigh between three and twelve pounds and vary in length from 29 to 47 inches (University of Montana, "Martes Pennanti" & Center for Biological Diversity, "Fisher").

Habitat Requirements:

The fisher is native to Canada and the United States and its current range is Quebec, the Maritime Provinces, and New England west across boreal Canada to Southern Alaska, south in the western mountains of Utah, Wyoming, Idaho, and California (International Union for Conservation of Nature). This animal is associated with large tracts of structurally complex land that includes high cover with mature old growth forests. Factors such as proximity to water, slope, and elevation are important as well. Early and late successional forests stands are generally avoided by fishers, but they have been known to utilize young forests stands extensively. Fishers also often prefer areas near the water. Fishers have been documented to show preference for comparatively steep slopes when compared to random locations chosen across the larger area in places like Central Alberta and California. Fishers occur most commonly in low elevations sites (Meyer, 2007).

Snow depth and consistency are also of great importance when considering fisher habitat. A study in California found that most fisher tracks were observed in areas where average snowfall was <5 inches (<13m) with only 1% of occurrences happening in area of 5-9 inches (13-23cm) and none occurring in areas with greater than 9 inches (23cm). Boreal regions in southeastern Manitoba saw significantly less fisher tracks appear in the middle of winter when the snow was deep and soft (Meyer, 2007).

There is substantial variation in the home range size and density for the fisher, but male home ranges are typically larger than females. The median home range for fishers in the coniferous and mixed forest of southern-central Maine was 12.2 km2 for females and 25.5 km2 for males (Meyer, 2007).

Behavior:

Fishers are active during the day and night, but their activity peaks occur in the early morning and late afternoon. Fishers will travel long distances in search of prey, repeatedly checking porcupine dens and other possible food sources. When prey is more abundant and predictable, they will zigzag to flush out possible prey from cover. Root wads, brush piles, tree cavities, and underneath logs and snow have all been found to be temporary den sites. Its name is misleading because fishers typically do not eat fish. They are best categorized as opportunistic, looking for whatever is seasonally and readily available. They primarily carnivorous, though, eating a variety of small mammals like mice, moles, shrews, and muskrats.

They have also been known to eat birds, reptiles, amphibians, and insects, along with berries, beechnuts, and acorns. With its amazing agility both on the ground and in trees, the fisher even manages the feat of preying on porcupines (Vermont Fish and Wildlife, "Fisher –Martes Pennati).

Males and females reach reproductive capacity at one year and can live, in places like Vermont, up to ten years. Breeding behaviors occur between March and April, when after a week of giving birth, adult females will search for a new mate with a high probability of finding multiple suitors (Vermont Fish and Wildlife, "Fisher –Martes Pennati).

Litters are one to four kits that are born in March. The female alone cares for the blind, helpless young who are dependent on the mother. By four months, they are taught to hunt on their own, completely weaned and mobile. After another month, the young are fully-grown effective hunters who disperse from their mother (Vermont Fish and Wildlife, "Fisher –Martes Pennati).

Threats & Conservation:

A current and long-term threat to fishers in their range is the loss of critical features such as den sites and forest habitat. This loss of habitat can be from extractive land use activities such as logging, gas, oil, and mineral exploration, which also negatively impact the species' food sources. Increases in forest harvesting could lead to increases of targeted and incident la mortality and diminish local fisher populations. The act of trapping can have negative effects on the reproductive age, abilities, and balance of adults that would affect overall population levels (Zevit, 2010).

Fishers are particularly sensitive to disturbance caused by motorized vehicles used for recreational backcountry activities. As these remote areas are opened up from logging and other resource extractions practices, the negative impact on fishers increases. Because fishers are an arboreal as well as ground level species, in order for viable populations to survive there must be an abundance of structurally diverse mature forests components made up of both coniferous and deciduous species (Zevit, 2010).

When thinking more specifically about fisher conservation, there must be more information to predict the responsive nature of fishers to alterations to harvest regimes and habitat structure, which can be done by filling in the gaps of knowledge in breeding success and population trends. It must be determined what spatial fragmentation threshold, or how much splitting and breaking of its habitat the fisher can tolerate to sustain a viable population. Due to the nature of its home range, there must be well-distributed core areas with additional well interconnected seasonal habitats all spread out across large landscape units. Because they rely on mature forests, there must be active maintenance of forest attributes such as mature cottonwoods, large diameter fir and spruce, and riparian and riparian-associated habitats. Citizens must be informed of the fisher's sensitivity to disturbance and landowners must be urged to follow land management practices that will limit such disturbances. If an area currently has low road density, try and keep it that way and make sure to close existing roads at critical times during the year, such as during the breeding season. Closing the roads and restoring the forests when logging ceases would greatly benefit the fisher (Zevit, 2010).

Canada Lynx (*Lynx canadensis*)

(U.S. Fish and Wildlife Service, 2004).

Physical Description:

The Canada lynx is a medium sized cat that ranges in size from 2.5 to 3 feet long (76.2 to 91.4 meters), 10 to 25 pounds in weight (4.5 to 11.3 kilograms), and 2 feet tall (60.96 centimeters) (Defenders of Wildlife, 2014). They are incredibly light for their size, and this helps them to stay atop deep snow. The Canada lynx has black-tufted ears, round paws, and a short black tail (U.S. Fish and Wildlife Service, 2013). A Canada lynx lives for an average of 15 years (Defenders of Wildlife, 2014).

There are four species in the *Lynx* family. These include the Eurasian lynx (*Lynx lynx*) , the Iberian lynx (*Lynx pardinus*), and two that are native to North America, the Canada lynx (*Lynx canadensis*), and the bobcat (*Lynx rufus*). Due to their biological relationship, there are many similarities between the two North American members of the *Lynx* family. However, there are certain differences in appearance that distinguish the two species. The Canada lynx has an all black tail, while bobcats have a tail that is white underneath and black on top (Defenders of Wildlife, 2014). Lynx also have longer ear tufts and larger feet than bobcats (Defenders of Wildlife, 2014).

Habitat Requirements:

The Canada lynx's typical range is Newfoundland to Yukon, and Alaska, as well as Northern Oregon, Northern Wisconsin, and Northern New England in the contiguous United States (DeGraaf and Rudis, 1968). The Canadian Lynx is uncommon in New England, and is more typically found in Canada. However, there have been documented sightings of Canada lynx individuals in New England, including by members of Cold Hollow to Canada's Keeping Track teams. Individual Canadian lynxes have very large home ranges. Adult canada lynx individuals can range from 9.6 to 137 miles (15.5 to 221 km) (Ulev, Degraaf, and Rudis, 2001).

Canada lynx's preferred habitat includes old, mature, contiguous, boreal forests with little human disturbance (U.S. Fish and Wildlife, 2013). Lynx also prefer bogs, swamps, and rocky areas (Degraaf and Rudis, 1968). In the Northeast, the Canada lynx habitat is more of a mix between coniferous and hardwood trees (U.S Fish and Wildlife, 2013). Lynx utilize fallen trees, hollow logs, and rock shelters to

make dens where female lynx raise their young (Degraaf and Rudis, 1968). The Canada lynx prefer deep snowpack, and prefer 8.86 feet, or 2.7 meters, of snow (Butcher, 2013).

Behavior:

The Canada lynx is classified as nocturnal and is active all seasons of the year (Degraaf and Rudis, 1968). The Canada lynx is a solitary creature, and it prefers to hunt and travel alone. The Canada Lynx's main diet is snowshoe hare, and its movement and population patterns follow that of its prey. Snowshoe hare makes up 80% of Canada lynx diet, making it a specialist (Butcher, 2013). Although the lynx sometimes consumes mice, voles, , grouse, ptarmigan, and carrion from deer, it prefers snowshoe hare, and it is specifically adapted to hunt this prey (Defenders of Wildlife, 2014). Canada lynx and snowshoe hare have coevolved, and their skeletons are very similar in size and shape (Butcher, 2013). The lynx's large feet and long legs act as natural snowshoes, allowing the lynx to keep pace with the snowshoe hare and stay on top of the deep snow, acting as natural snowshoes (U.S. Fish and Wildlife, 2013). Canadian lynx populations mirror those of their prey, following boom and bust cycles two to three years after snowshoe hare populations exhibit these patterns. Canada lynx population reach peaks every ten years (Degraaf and Rudis, 1968).

The Canada Lynx becomes sexually mature after one year, and mates during the months of January and February. Lynx young are born in May and June in dens, and litter sizes range from 1 to 4 kittens. Canada lynx have one litter per year (Degraaf and Rudis, 1968). Kittens stay with their mother for 9 to 10 months to nurse and learn hunting skills (Ulev, Degraaf, and Rudis, 2001).

Threats and Conservation:

The Canada Lynx was officially listed threatened in the United States in the year 2000, and is nearly extinct in the state of Vermont (U.S. Fish and Wildlife Service, 2014). It is facing a number of threats, including climate change and habitat fragmentation. Because the Canada lynx has such a large individual home range, it depends on large blocks of contiguous forest. Therefore, habitat fragmentation is a critical threat to lynx populations. Logging, development of buildings near forested landscapes, and construction of roads near critical habitat all contribute to lynx habitat fragmentation (Defenders of Wildlife, 2014). Creating large habitat connectivity is crucial to maintaining healthy Canada lynx populations.

Climate change is also a major threat for Canada lynx populations. Lynx are adapted to hunting and travelling in snow covered landscapes. Rising temperatures and declining snowpack are a direct threat to lynx ways of life. As snowpack decreases in the Northeast as a result of climate change, lynx populations will move farther north (Butcher, 2013).

Bobcat (*Lynx rufus*)

(Ohio Department of Natural Resources, 2012)

Physical Description:

The bobcat is similar in appearance to the Canada lynx, with several important differences. The bobcat has smaller ear tufts than the lynx, it has a tail that is white on the bottom with black bands on top, and it has smaller feet. The bobcat is also much more common in the Northeastern United States. Bobcats range in weight from 15 to 20 pounds (6.8 to 9 kg), however they can grow to be much bigger in certain circumstances. The largest bobcat ever recorded was 52 pounds (23.6 kg) in Jackson, New Hampshire (VT Fish and Wildlife, 2014). Bobcat fur contains black spots, and its face and head contain black streaks (VT Fish and Wildlife, 2014). The bobcat's coat changes color depending on seasonality and specific habitat. During the summer it has tints of red, brown, and yellow in it, while in winter it is grayer (VT Fish and Wildlife, 2014).

Habitat Requirements:

Unlike Canada lynx, bobcats are common in New England and the contiguous United States. Their habitat ranges from Southern Canada throughout the United States and Canada (Degraaf and Rudis, 1968). The northeast, most specifically northern Vermont, represents one of the northern boundaries on their range. Bobcats thrive in several different natural community types, and prefer habitats that feature heterogeneous plant communities. Bobcats live most frequently in coniferous, deciduous, or mixed forests that are interspersed with swamps, bogs, thick undergrowth, and rocky ledges (Tesky, 1995). Rocky ledges are a crucial habitat requirement for bobcats. They are the location of bobcat breeding rituals and are the settings for most bobcat dens. Female bobcats choose den locations, and prefer to locate these dens in rock crevices, although they sometimes choose to make dens in tree stumps (VT Fish and Wildlife, 2014). Bobcats tend to choose their habitat based on the cover it provides them and the prevalence of prey species (VT Fish and Wildlife, 2014). Bobcats are also known to traverse agricultural areas and recently logged forest (VT Fish and Wildlife, 2014).

Behavior:

Bobcats are solitary creatures that are most active during dawn and dusk. They travel very large distances, are good climbers, and, although they generally avoid water, are adept swimmers. Bobcats

have a wide prey preference, and hunt a variety of small animals, most specifically mammals. Bobcats hunt snowshoe hare, cottontails, squirrels, mice, voles, rats, chipmunks, birds, snakes, fish, and deer (VT Fish and Wildlife, 2014). During winter, when prey is scarce, bobcats tend to scavenge carrion (VT Fish and Wildlife, 2014).

Male bobcats reach sexual maturity during their second year of life, while females reach sexual maturity after one year. Bobcats typically breed during late February and March, although they may breed into June (Degraaf and Rudis, 1968). Male bobcats will mate with more than one female during a season (VT Fish and Wildlife, 2014). Female bobcats have litters between one and four kittens and usually only have one litter per year (Degraaf and Rudis, 1968).

Threats and Conservation:

Bobcats have had an interesting history in the state of Vermont. The arrival of European settlers led to increased hunting and subsequent extirpation of many of the bobcat's carnivorous competitors in the Northeast. As mountain lion, lynx, wolf, and fisher numbers decreased in the region, bobcat populations rose as they were able to fill the voided niche (VT Fish and Wildlife, 2014). The bobcat population reached its peak for the state of Vermont in the mid 1950s (VT Fish and Wildlife, 2014). There was a historic bounty on bobcats in Vermont from 1856 to 1971, and bobcat hunting season is currently monitored at 20 to 30 taken animals per season (VT Fish and Wildlife, 2014). Today the bobcat faces more predator competition from coyotes and fishers (VT Fish and Wildlife, 2014).

Because bobcats prefer a range of habitat types, specific ecosystem conservation is difficult. Conservation efforts should be directed towards protecting early to mid successional forests because they provide optimum bobcat prey habitat. Rocky ledges are crucial habitat components for bobcat, and should be protected, as well. Bobcats perform mating rituals on rocky ledges, and they provide locations for bobcat dens (Tesky, 1995).

North American River Otter (*Lontra canadensi)*

(Duplaix, 2014)

Physical Description:

The North American river otter is in the weasel, or *Mustelidae* family. River otters are typically brown or black-furred on top and silver or grey-furred underneath. They range from 35 to 48 inches (88.9 to 121.9 centimeters) and 11 to 33 pounds (5 to 15 kilograms) in weight (VT Fish and Wildlife, 2014).These slender animals have streamlined bodies and are adapted to aquatic life (Wildscreen Arkive, 2014). They possess powerful tails and webbed feet that help them swim faster and more efficiently (VT Fish and Wildlife, 2014). River otters are able close their ear and nose valves while underwater, they are able to use their sensitive whiskers to locate prey while underwater (VT Fish and Wildlife, 2014). River otters also have oils in their fur that both insulates it and keeps it waterproof. North American river otters live for an average of 8 years (National Geographic, 2014).

Habitat Requirements:

The North American river otter's range is widespread in North America. It is found in every state in the United States. The only places in North America that it is not found are the northern parts of Canada and Alaska (Wildscreen Arkive, 2014). Its home range is between 1 and 29 miles (1.6 to 48 kilometers) (Degraaf and Rudis, 1987).

River otters inhabit wetland areas with permanent bodies of water, such as lakes, ponds, rivers, and streams (VT Fish and Wildlife, 2014). Although they are capable of walking and running on dry land, they prefer aquatic environments where they are more suitably adapted. River otters are unsuited for desert ecosystems, making them infrequent in the American southwest (VT Fish and Wildlife, 2014).

River otters prefer habitats where they can build dens. These dens can take a variety of different forms, such as crevices in rocky ledges, areas underneath fallen trees, or locations inside dense thickets (Degraff & Rudis, 1968). River otters will also utilize abandoned habitat structures such as muskrat dens and beaver lodges (VT Fish and Wildlife, 2014).

Behavior:

River otters are nocturnal. They are most active at dawn, dusk, and at night, which is when they hunt their prey. River otters are carnivores and consume primarily aquatic species, such as fish, frogs, crayfish, salamanders, and turtles, as well as non-aquatic animals such as small birds and snakes. Specific fish include trout, bass, and perch (VT Fish and Wildlife, 2014). They are proficient aquatic hunters, and have specific styles depending on the depth of the water. In shallow water river otters will stand on its legs searching with their heads above water, and in deeper water they will immerse their entire heads and bodies (VT Fish and Wildlife, 2014).

River otters do not hibernate. They are active year round, but typically avoid stagnant bodies of water that freeze over during winter months. During the winter otters prefer flowing bodies of waters, such as rivers and streams, that will not freeze. Their warm fur coats keep them warm during cold temperatures and in cold waters (VT Fish and Wildlife, 2014).

River otters reach sexual maturity at two years of age. They mate in the months of March and April, and females birth their young in March, April, and May of the following year. River otters will

typically have litters between one and five pups, with an average of two or three (Degraff and Rudis, 1986). Pups are born without sight and vulnerable, so mothers raise them for the first few months in their den (VT Fish and Wildlife, 2014).

River otters are generally solitary creatures. Female otters take care of their young, but do not generally live with male otters. Otters are adept swimmers and spend most of their time in the water. They are playful creatures, and can often be seen sliding down river banks for fun (VT Fish and Wildlife 2014).

Threats and Conservation:

Because it lives in wetland and aquatic environments, the North American river otter is highly vulnerable to pollution. It is also the top predators in its ecosystems. For these two reasons, river otters are indicators of the environmental quality of a specific habitat. The North American river otter is listed as a species of least concern by the International Union for the Conservation of Nature (IUCN). However, it has historically faced extensive hunting and trapping by humans. Otters are prized by hunters and trappers because of their fur. Pelts are worth about $70 today (Memmott, 2012). River otters were extirpated from some parts of the United States during the late 19th and early 20th centuries. River otter populations diminished in Vermont and the Northeast as well (VT Fish and Wildlife, 2014). However, thanks to reintroduction of otter populations in the central United States and more careful regulations on river otter hunting, populations in the Northeast and around the country have recovered.

River otter hunting and trapping continues today, however both practices are more closely monitored. Most states have established capture limits, both for individual hunters, and for the season as a whole. In Vermont, river otter hunting season lasts four months: from October through February. This hunting season occurs before the spring mating and birthing season (VT Fish and Wildlife, 2014).

Another strategy for river otter conservation is by preserving and restoring the animal's wetland habitat. Wetlands are ecologically important habitats that provide benefits to water quality and contribute to a diversity of ecosystems in Vermont and across the country. Preserving wetland habitat will provide more habitat for river otters and will contribute to health of the landscape as a whole.

TRENDS IN ABUNDANCE AND SEASONALITY BY TOWN

Richford
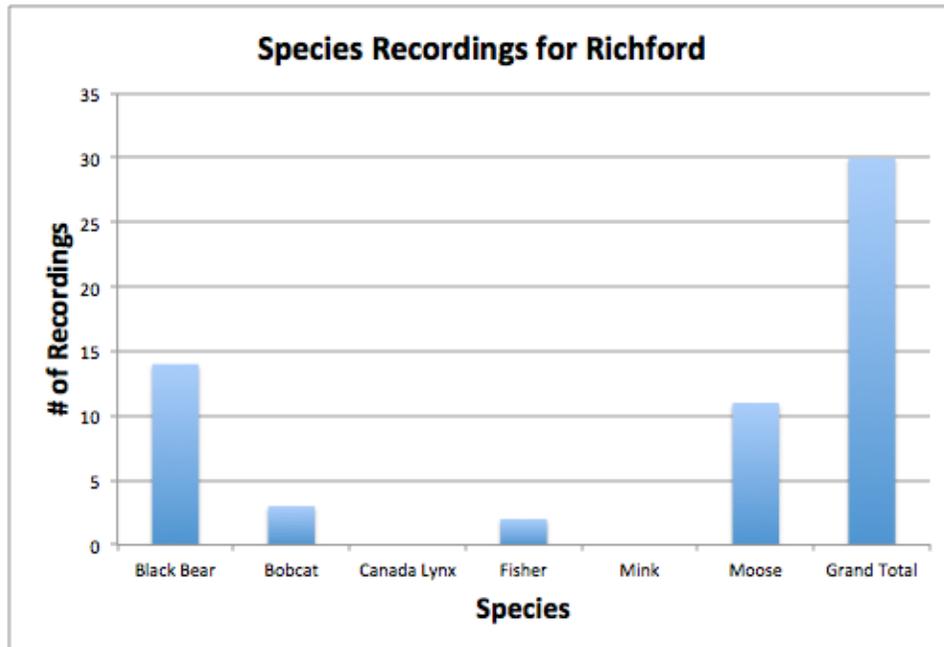
Graph 1: Breakdown of species abundance recordings for the town of Richford.

In Richford, black bear with a count of 13 and moose with a count of 11 were seen most frequently. Bobcat and fisher were also seen, but much less so than black bears and moose. This could be due to differences in behavior, for example being that fisher are secretive and solitary animals. Richford had a total species count or species recordings of 30.
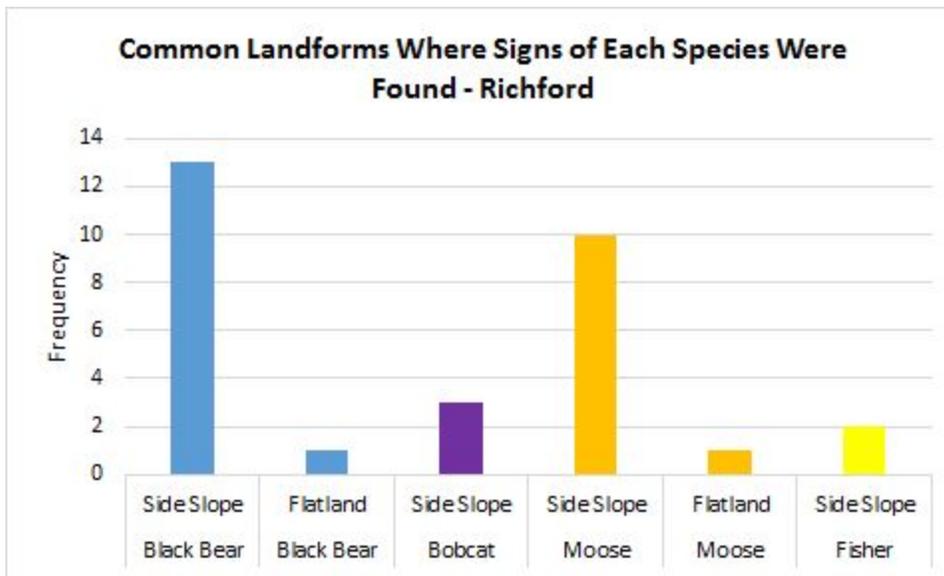
Graph 2: Analysis of species distribution and occurrence by common landforms for Richford.

The landscape can be better understood when it is broken up into landforms - side slopes, drainage areas, flatlands, ridgelines. The landforms in an area can affect the soils, vegetation, and wildlife habitat within the landscape. For each track, claw mark, or sign that was found, the type of landform it was found on was recorded. Black bear signs were commonly present on side slopes, more so than in

other landforms. Moose were another prominent species leaving tracks or scarred trees on side slopes as well. Overall, it is clear that side slopes were a dominant landform supporting habitat for all of the focal wildlife species that were documented on the Richford transect. Side slopes likely support habitat for a lot of these animals that prefer slightly higher elevations, and also have different soil and vegetation than lowlands and flatlands that often better supports their habitat needs.
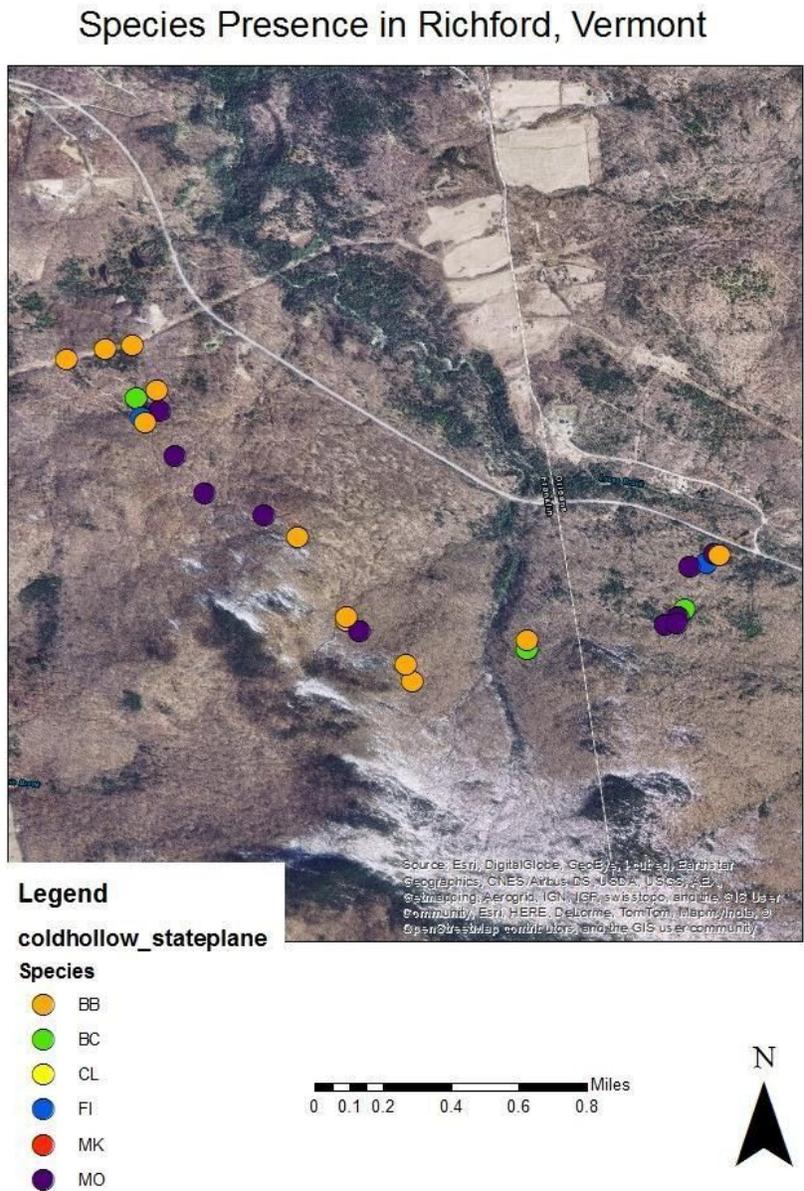
Figure 1. Spatial map of species presence in Richford, Vermont

There were high numbers of moose and black bear in Richford, There was evidence of two fisher signs and three bobcat signs. There is a cluster to the northwest portion of the transect that contained two black bear, one bobcat, one fisher, and one moose sighting.

Figure 2. Black Bear Presence in Richford, Vermont by Season

There were black bear track sightings in all four seasons. However, summer and winter seasons yielded the highest numbers of sightings.

Moose Presence in Richford, Vermont
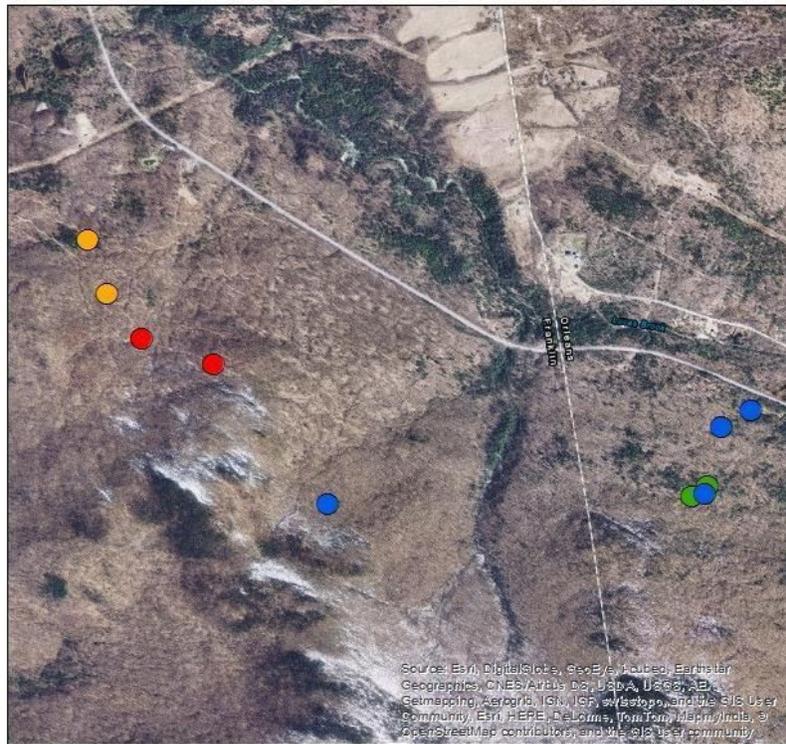
Legend

coldhollow_stateplane
Species, Season
- 🔴 MO, Fall
- 🟢 MO, Spring
- 🔵 MO, Summer
- 🟠 MO, Winter

N

Figure 3. Moose Presence in Richford, Vermont by Season

Moose signs were spotted in all four seasons, but summer months featured the most sign sightings.

Montgomery

Species Recordings for Montgomery Center, VT
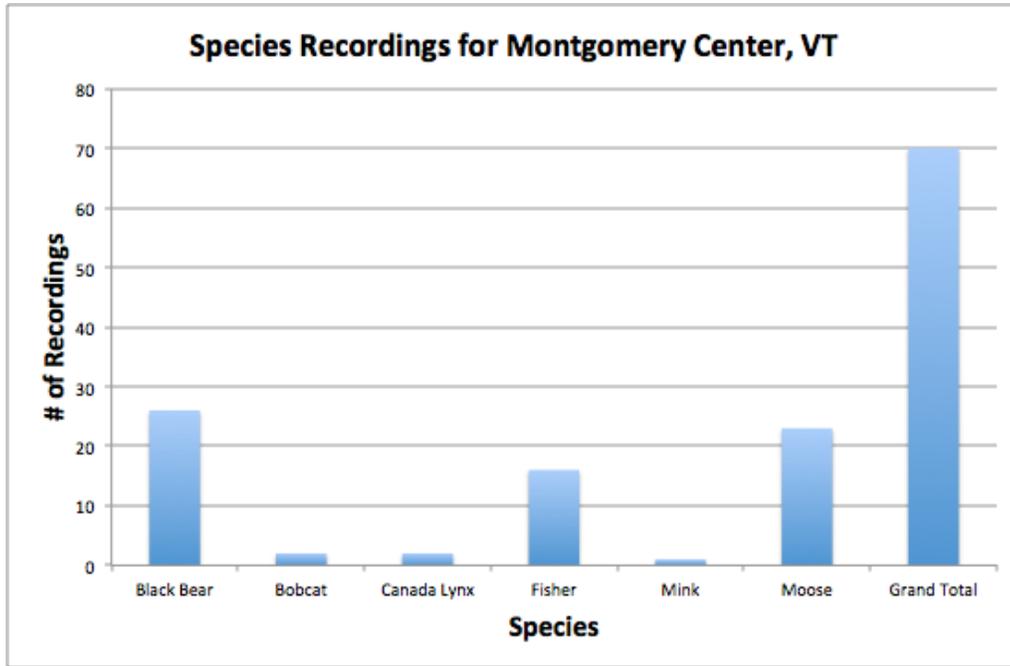
Graph 3: Breakdown of species abundance for the town of Montgomery.

The most frequently observed animal tracks and signs in the town of Montgomery were black bear, with 26 observations, and moose, with 23 observations. Montgomery also had 16 fisher observations, which was significantly higher than the other towns. Overall, Montgomery has the highest total wildlife track and sign observations of the three towns with 70.

The Montgomery Keeping Track team put up trail cameras along the transect and captured these photos of a black bear marking a tree:

(Keeping Track Montgomery Game Camera, 2013)

(Keeping Track Montgomery Game Camera, 2013)
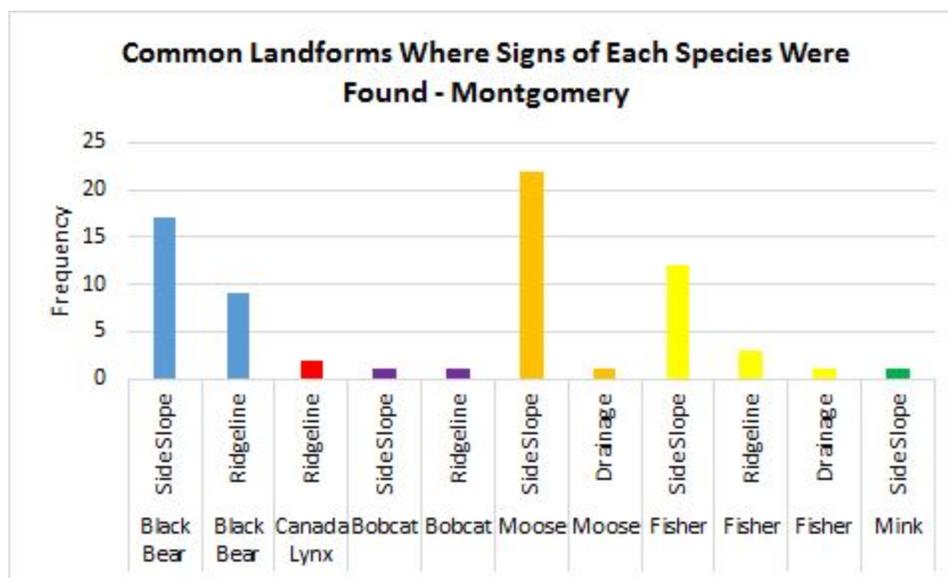
Graph 4: Analysis of species distribution across general landforms for Montgomery.

The landscape can be better understood when it is broken up into landforms - side slopes, drainage areas, flatlands, ridgelines. The landforms in an area can affect the soils, vegetation, and wildlife habitat within the landscape. The most frequent wildlife track and sign observations were made on side slopes for moose, black bear, and fisher. Side slopes likely support habitat for a lot of these animals that prefer slightly higher elevations, and also have different soil and vegetation than lowlands and flatlands that often better supports their habitat needs. However, there were also a significant number of observations along ridgelines for black bears and fishers. Drainages can include wetland areas such as fens, seeps, and intermittent streams. These areas are useful for many species because they provide valuable vegetation food sources. The only Canada lynx tracks were found on the ridgeline, and there was also one bobcat observation found on a ridgeline.

Shown below are a few more pictures that were captured by the game camera on the Montgomery transect. Going clockwise around the pictures below, there is a fisher, a coyote, a deer, and a raccoon.

30

BUSHNELL   9.17.2013   9:42:28

BUSHNELL   9.12.2013   19:05:54

BUSHNELL   9.09.2013   23:40:44
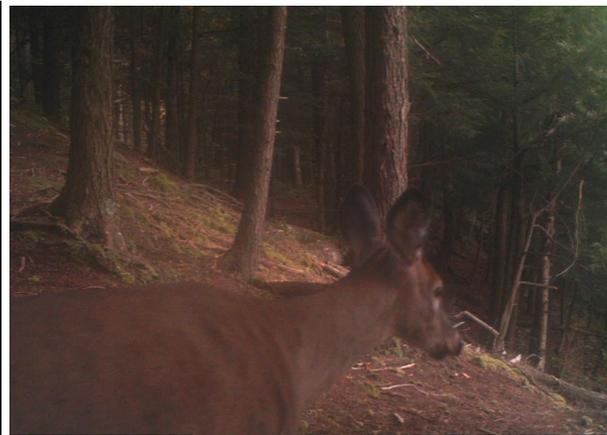
BUSHNELL   9.25.2013   17:05:47

(Keeping Track Montgomery Game Camera, 2013)

Figure 4. Species Presence in Montgomery, Vermont

Figure 4 indicates that the town of Montgomery saw high numbers of Moose, Fisher, Black Bear. All three species were dispersed throughout the transect. There was also one bobcat sign sighting.

Black Bear Presence in Montgomery, Vermont

FIgure 5. Black Bear Presence by Season in Montgomery, Vermont

Black bear signs were witnessed all four seasons in Montgomery.

Moose Presence in Montgomery, Vermont
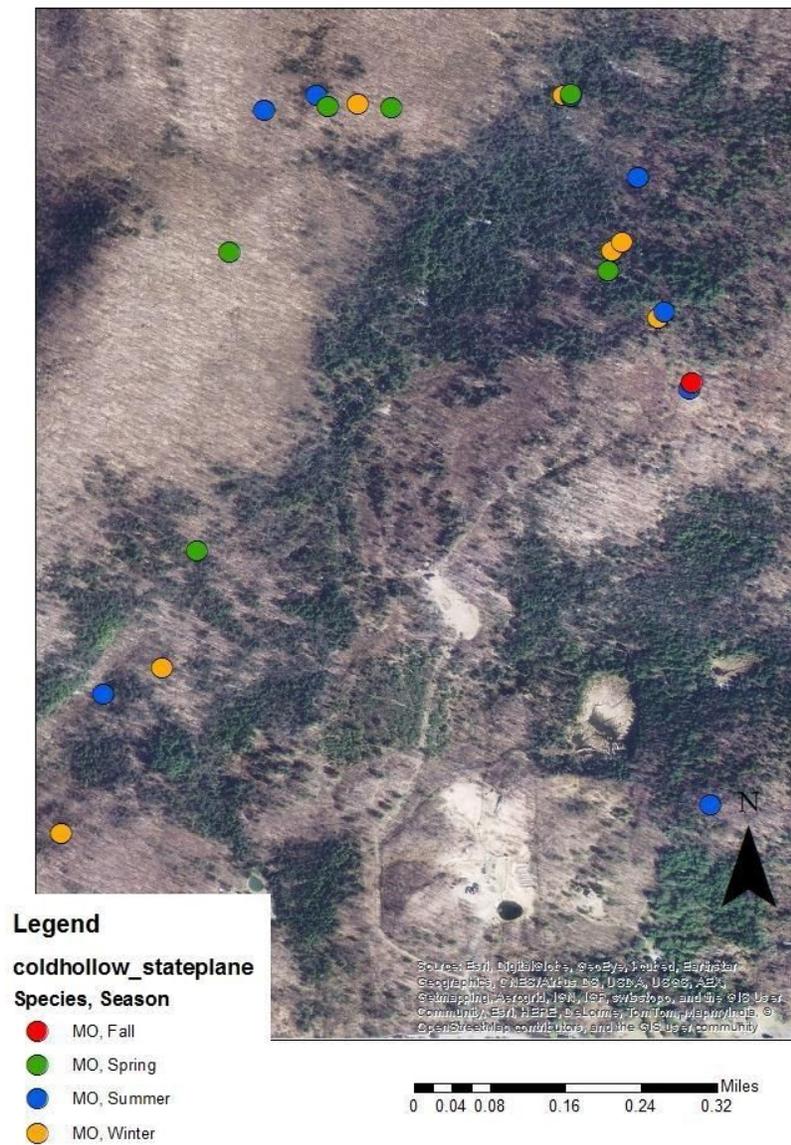
Figure 6. Moose Presence in Montgomery by Season

Figure 6 indicates that moose signs were witnessed during all four seasons. Fall sightings were infrequent due to the fact that fall leaves cover up many animal tracks.

Fisher Presence in Montgomery, Vermont
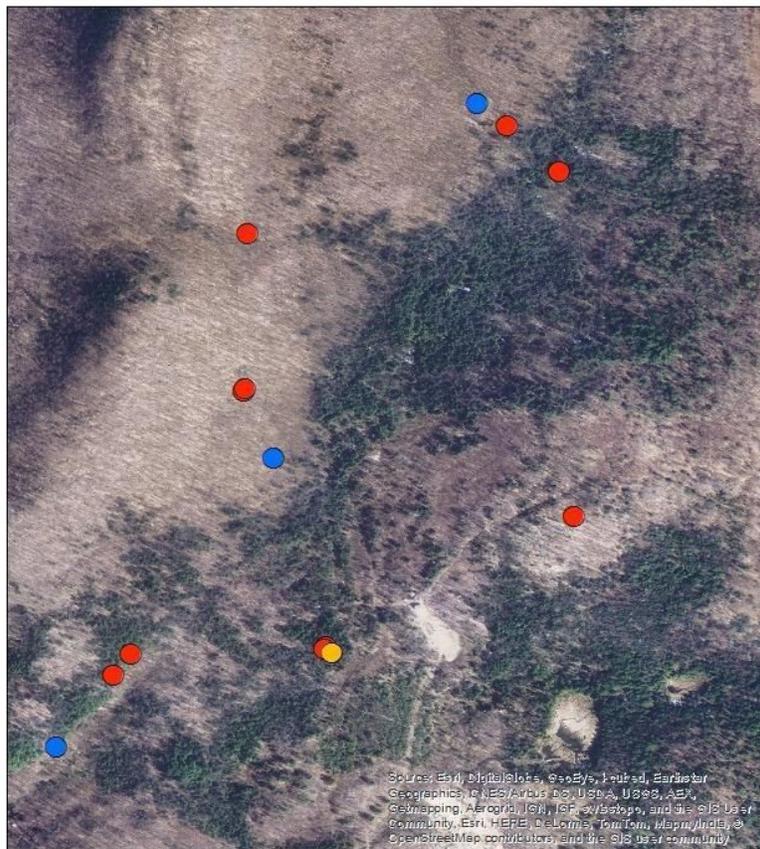
Figure 7. Fisher Presence in Montgomery by Season

Figure 7 indicates that the majority of fisher sign sightings were seen during spring and winter. Keeping Track trackers did not witness any fisher tracks during fall due to the difficulty in spotting tracks through fallen leaves.

Enosburg
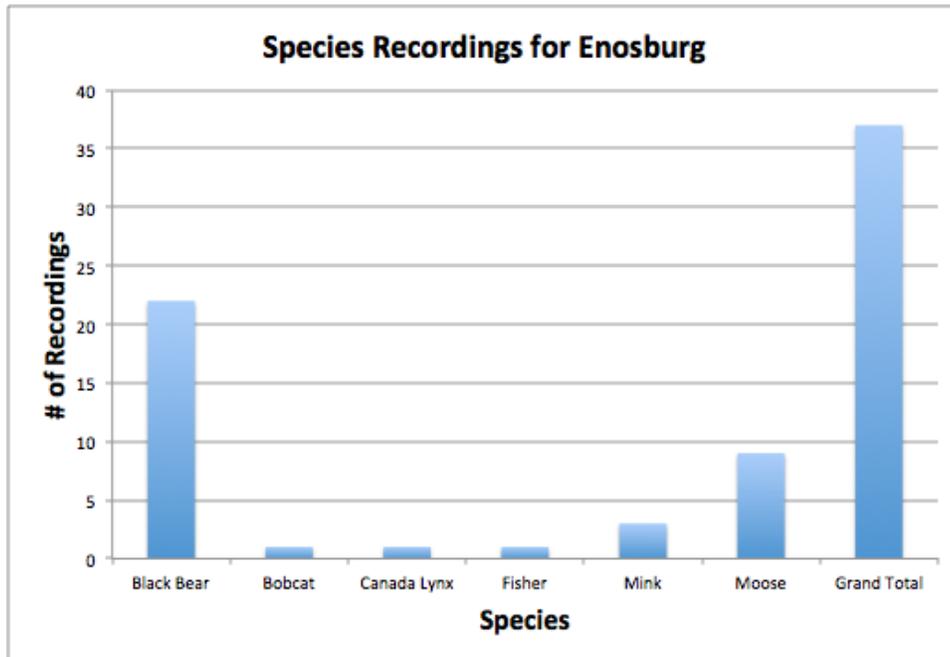
Graph 5: Breakdown of species abundance for Enosburg.

The most frequent animal recordings in Enosburg were Black Bear with a recoding number of 22. Among the other species with lower recordings, Moose and mink were the most prevalent with Moose having 9 and mink having 3. The total amount of recordings in Enosburg was 37.
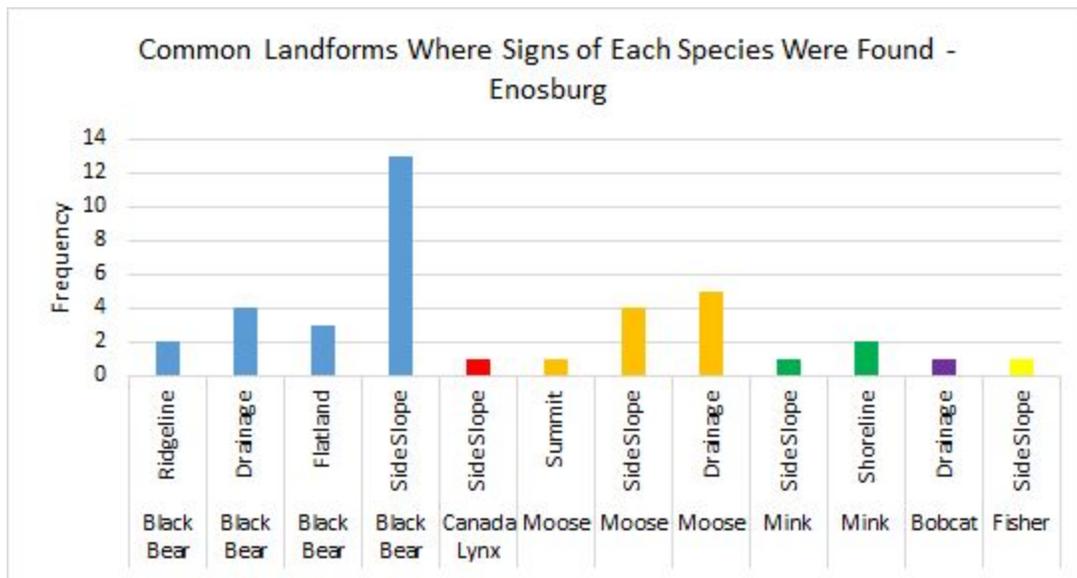
Graph 6: Analysis of species distribution across general landform in Enosburg.

The landscape can be better understood when it is broken up into landforms - side slopes, drainage areas, flatlands, ridgelines. The landforms in an area can affect the soils, vegetation, and wildlife habitat within the landscape. Like in Richford and Montgomery, side slopes were the dominant landform where most signs were seen along the Enosburg transects. Side slopes likely support habitat for a lot of these animals that prefer slightly higher elevations, and also have different soil and vegetation than lowlands and flatlands that often better supports their habitat needs. Several of the tracks were also

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found in drainages, such as seeps and other types of wetlands where animals go to forage. These drainage areas are particularly important for animals like black bears. Mothers with cubs will often leave the cubs in a tree while they go to eat the vegetation growing in nearby wetlands. One Canada lynx track was seen along one of the Enosburg transects - which is an exciting sign for this rare species.
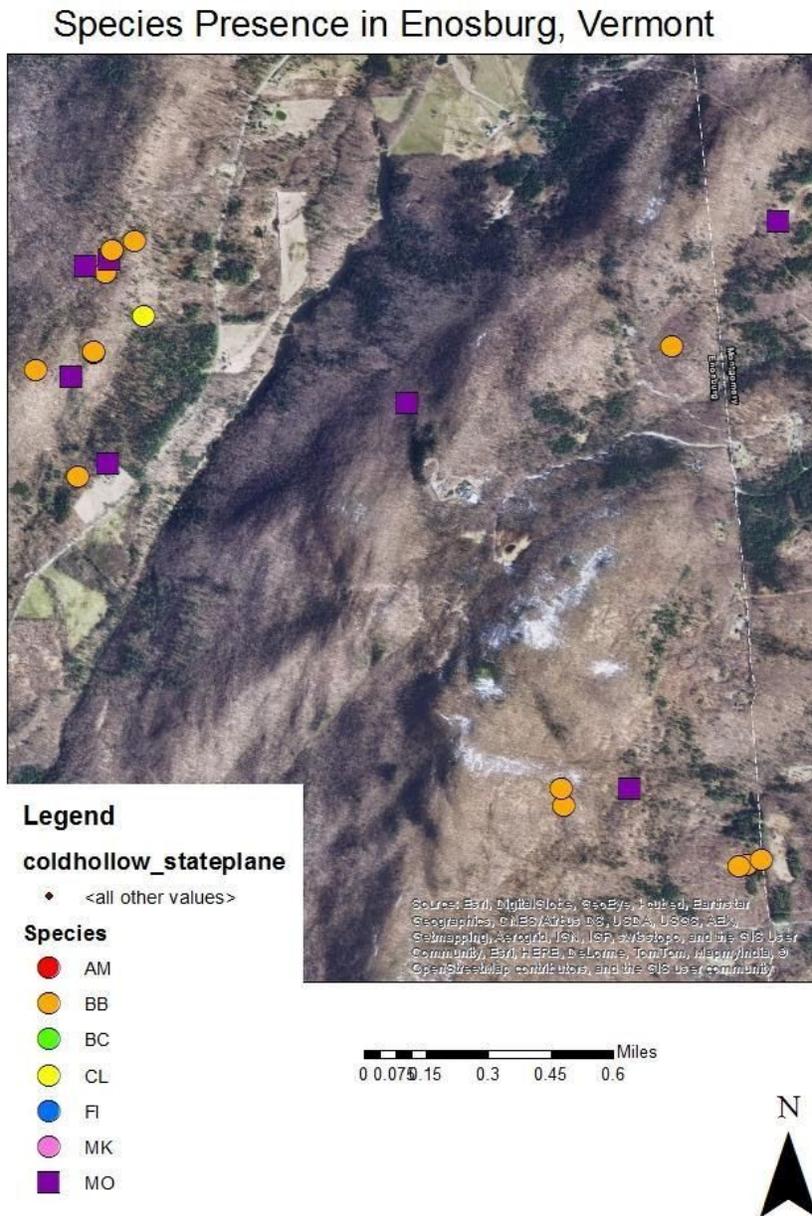
Figure 8. Species Presence in Enosburg, Vermont

Figure 8 indicates that there were high presences of black bear and moose in Enosburg. There was also evidence of one Canadian lynx track.

Black Bear Presence in Enosburg, Vermont
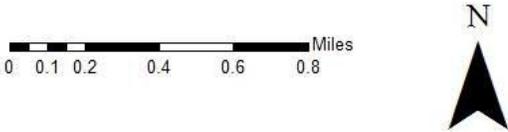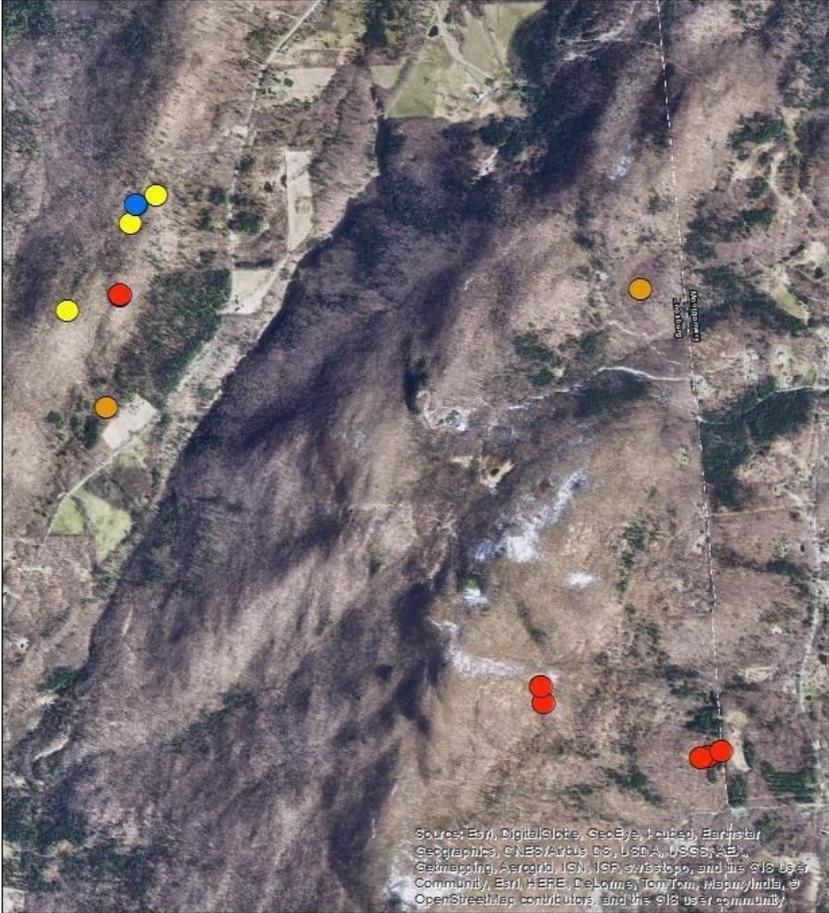
Figure 9. Black Bear Presence in Enosburg by Season

Figure 9 indicates that black bear signs were observed during all four seasons in Enosburg. The most sightings were observed in winter, which is abnormal due to decreased black bear activity during winter months.

Moose Presence in Enosburg, Vermont
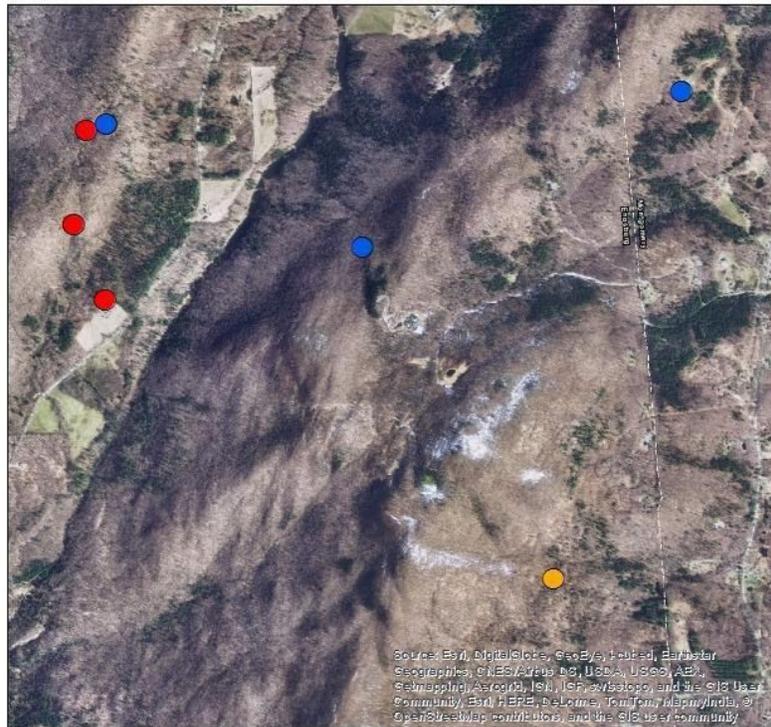
Legend

coldhollow_stateplane

Species, Season

- 🔴 MO, Fall
- 🟢 MO, Spring
- 🔵 MO, Summer
- 🟠 MO, Winter

Figure 10. Moose Presence in Enosburg by Season

Figure 10 indicates that moose were observed in fall, summer, and winter in Enosburg.
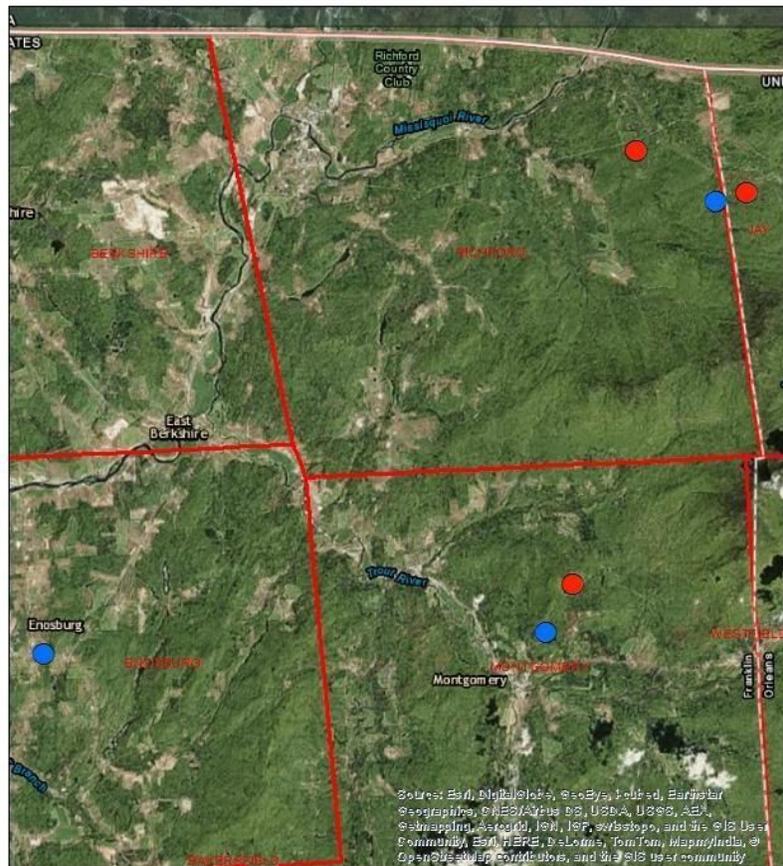
Figure 11. Bobcat Presence in Enosburg, Richford, and Montgomery by Season

Figure 11 indicates that Keeping Track team members observed bobcat signs in spring and winter seasons. Bobcats were observed in Richford, Enosburg, and Montgomery.

CONCLUSIONS AND CONSERVATION IMPLICATIONS:
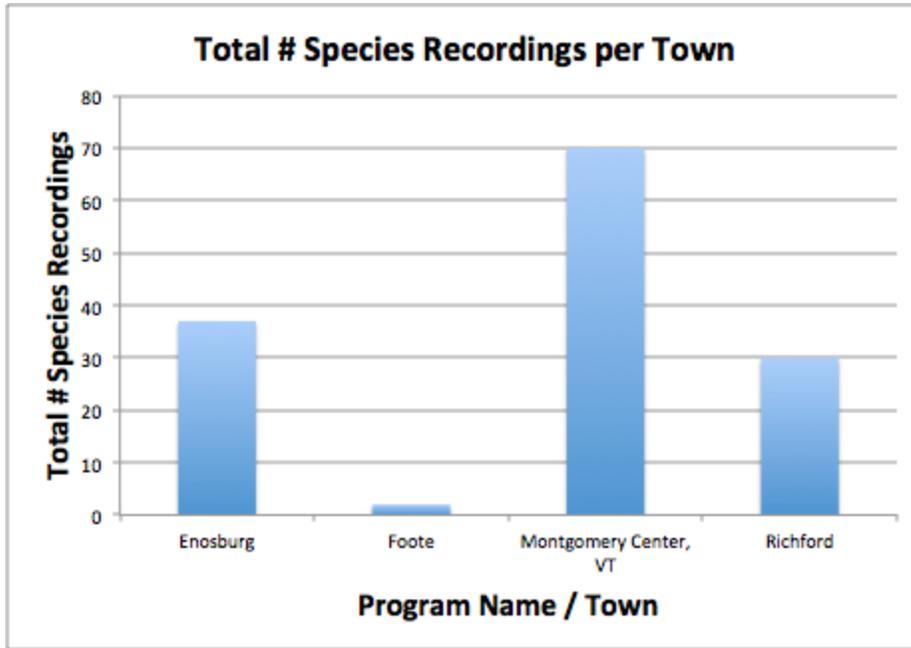
Graph 7: Comparison of total species recordings across Richford, Montgomery, and Enosburg.

Looking at the total number of recordings across the three towns, Montgomery had the highest with a count of 70, Enosburg had a count of 37, and Richford had a count of 30, giving an overall count of 137 recordings, excluding the two recordings for the Foote category. The reason that the two recordings in the Foote category are separated from the rest is because there were no geographic coordinates, such as latitude or longitude assigned to these points, meaning they could fall within in any of three towns. Our data could show some bias because Montgomery Center made up about half the data, the number of recordings nearly double of the other two towns.
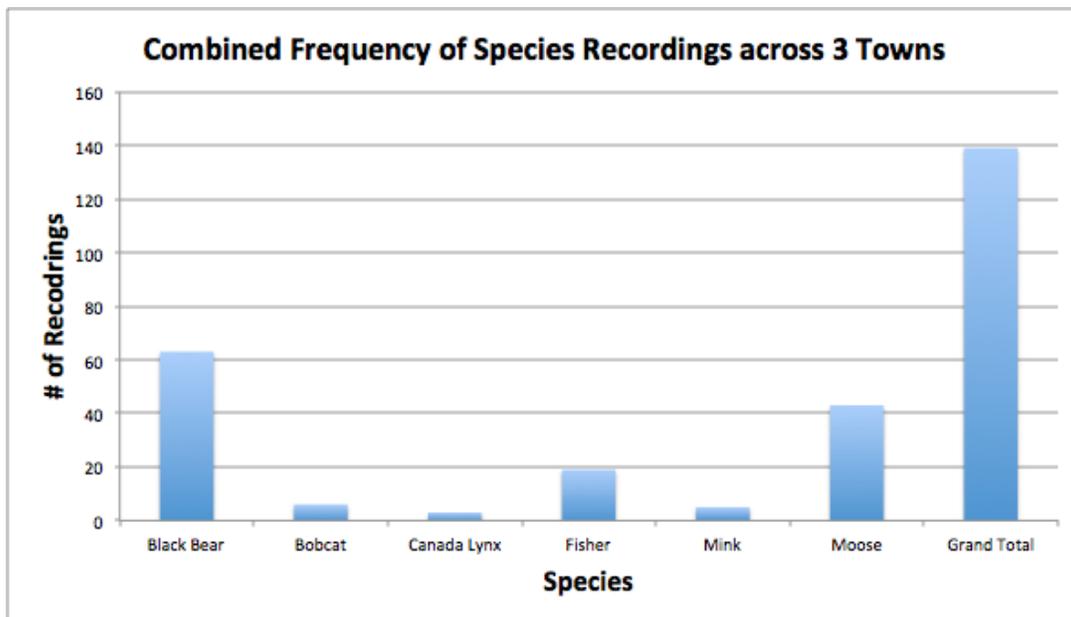
Graph 8: Comparison of overall species recordings from Richford, Montgomery, and Enosburg.

Across the three towns, the most frequently recorded species were Black Bear with a count of 62, Moose with a count of 43, and fisher with a count of 19. It is interesting to note that when comparing numbers across the three towns, Montgomery Center had the highest counts for these same species, meaning the numbers for Montgomery Center were a major factor in which species were the most recorded and frequent. If graph # is compared to graph 8, there is a definite similarity, just differing numbers of counts for Black Bear, Moose, and Fisher.
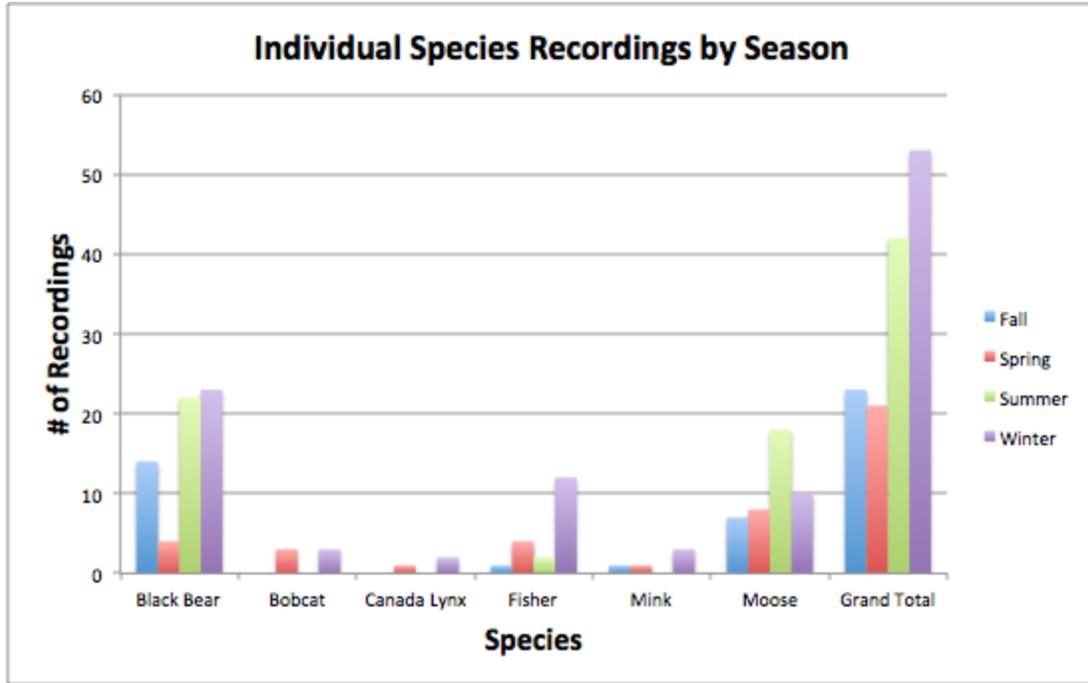
Graph 9: Individual species distribution by season.

Transect walks have been conducted during every season. To get an idea of when it might be most common to find signs of a species, and whether each species might be resident or transient in the Cold Hollow Mountains, we looked at the seasons in which each species was tracked. "Transient" species do not inhabit an area year-round, but the habitat may temporarily support the species while it travels or disperses to other areas. Black bears, moose, and fishers have been tracked every season in this area. Mink have been tracked every season except for summer, but there are also generally not as many tracks seen during this season anyway - it is clearly much easier to see tracks in the winter, when there is snow on the ground, than in the summer.

Bobcats have only been recorded in the spring and winter for this project; however, the number of track seen so far is too low to make an accurate prediction of whether the species is resident or transient in this region. Signs of the Canada lynx, a rarely seen species in the state of Vermont, have been seen along the Montgomery and Enosburg transects - an exciting finding for conservationists! Though there have only been a couple of sightings, it is likely that this species is transient due to its habitat needs and behavior: its large home range requirements means it travels long distances, and it has only been reported in the winter and spring.
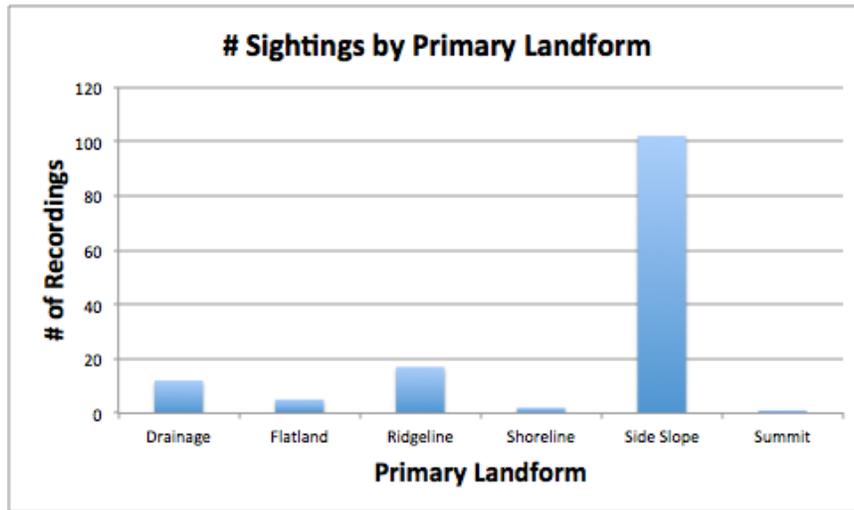
Graph 10: Overall species recordings by Landform.

Many times, species were recorded as being seen on side slopes. This could be because on most of our physical records, side slope was the category most often checked off. It could also be because these side slopes were one of the more frequently used lanes of travel for animals as to give them views of the landscape. Because of the way Vermont's landscape it, and the fact that were looking at these records in the landscape context of a mountain range, the side slopes of hills and cliffs would logically see more recorded wildlife.
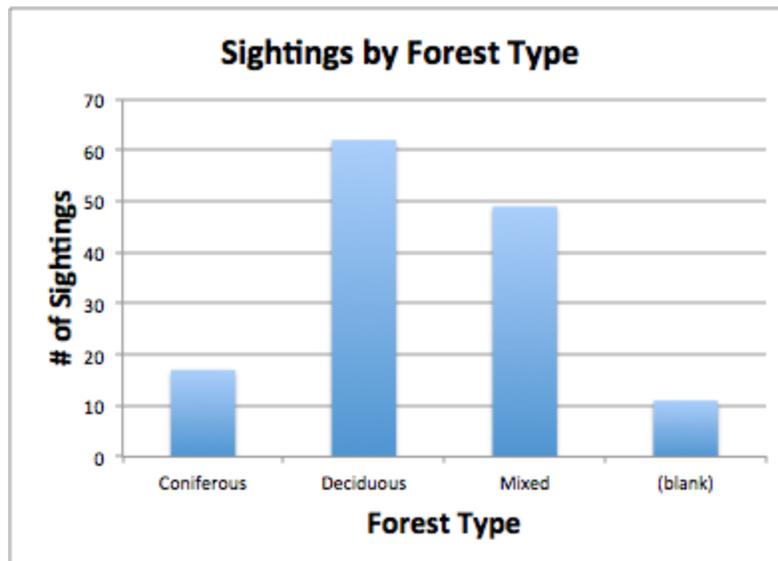
Graph 11: Number of species recordings by Forest Type.

Most species were recordings were taken from forested landscapes, most times in deciduous forests. The occurrence of deciduous forest recordings could be a factor of the how Vermont was once cleared for agriculture, but has over time had forest regrow and cover a vast majority of the state. Because forest types can shift based on elevation, this trend of forest change could explain why going from only coniferous forests to mixed forests and finally deciduous forest only has an increase in the

number of recordings. The blank recordings could be because those animals' recordings were taken in non-forested habitats or the recorders forgot to note that aspect of the record.

Location of Unique Land Features
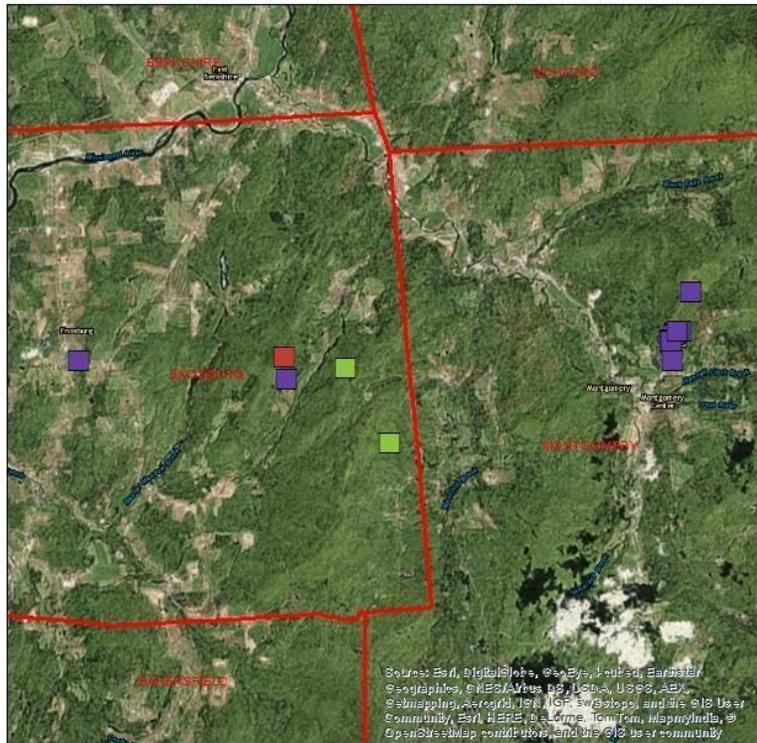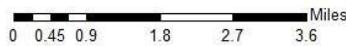
Figure 12. Presence of Unique Habitat Features in Enosburg and Montgomery

Conservation Suggestions:

 Many of the focal species assessed in this study have large home ranges and require large, contiguous blocks of forest habitat. When thinking about the forest preference of our focal species, they prefer either deciduous, coniferous, or both and varying stages of forest development. Based off our

results, it would be beneficial to make sure that the conserved forest blocks are mixed forests, with an emphasis on mid to late successional forest age classes.

Another important habitat to protect is wetlands, which are critical for many of these species. One way to protect wetlands is to keep pollutant runoff to a minimum. This could include reducing the amount of salt applied to roads, which would not only protect wetlands but also would directly protect moose, which often take advantage of salt licks adjacent to roads. Being close to major roads can lead to conflicts with humans, and automobile accidents. When using household items, consider buying ones that are low in pollutants, such as phosphate-free laundry detergents. Another way to preserve wetlands is through the use of culverts and bridges in places where roads cross over wetlands (Vermont Fish & Wildlife). This way, habitat (not only for mammalian species, but also for migrating fish) can be preserved instead of being abruptly halted.

Development should be limited to upland sites, and vegetative buffer strips should be maintained at a safe distance from development. Also, learning a bit about the watershed in which you live can always be helpful for better understanding and protecting nearby wetlands (US Environmental Protection Agency).

By analyzing trends in landform type where signs of the focal wildlife species were found, side slopes were by far the most common landform utilized. Figure 12 indicates the locations of unique land features such as rocky outcroppings, talus, and large cliffs. Cliffs are areas of exposed bedrock with slopes greater than 60 degrees, and talus are areas with accumulated rocks that have been broken off of cliffs (Thompson and Sorenson, 2005). Features on the landscape including slopes, rocky outcroppings, and cliffs are extremely important for the focal species mentioned and should be maintained in order to preserve their habitat. Bobcats, lynx, black bears, mink, and otter all have habitat preferences that involve rocky landscapes which play a crucial role in mating and denning behaviors. These areas should be given preference towards conservation.

Better signage on roads where wildlife are commonly hit is another way to help reduce human-wildlife conflicts and conserve wildlife, along with just respecting the animals when you do see them and maintaining a safe distance. When performing conservation efforts, it is always beneficial to remember to include communities in the process. Also, just being cautious of neighboring wildlife can go a long way. Not leaving your bird feeders out when bears are active, and leaving your pet food inside helps keep animals wild. Minimizing habituation to humans and preserving these species is essential for their long-term success, and doing all these things, coupled with preserving their habitat, will do so.

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Appendix:

Count of Species by Program Name	Species						
Program Name	Black Bear	Bobcat	Canada Lynx	Fisher	Mink	Moose	Grand Total
Enosburg	22	1	1	1	3	9	37
Foote	1				1		2
Montgomery Center, VT	26	2	2	16	1	23	70
Richford	14	3		2		11	30
Grand Total	63	6	3	19	5	43	139

Table 1: Tabular representation of the distribution counts of species by Program.

Count of Species:	Vegetation Type				
Primary Landform	Coniferous	Deciduous	Mixed	(blank)	Grand Total
Drainage	1	8	1	2	12
Flatland		2	2	1	5
Ridgeline	8	2	7		17
Shoreline			2		2
Side Slope	8	49	37	8	102
Summit		1			1
Grand Total	17	62	49	11	139

Table 2: Tabular representation of species recordings by forest type and primary landform.