ALPINE

ACADEMICS FOR LAND PROTECTION IN NEW ENGLAND

2020 ALPINE Summer Institute

Bridging the Gap

Final Participant Essays
August 2020

Contents

Cover photo courtesy of Manel Vinuesa, Getty Images: Bulls Bridge, Kent, Connecticut

Introduction

The ALPINE Summer Institute program, now in its fourth year, is designed to enable undergraduate students, graduate students and early-career professionals to learn more about the theory and practice of large land conservation. The program is staffed by professionals in the field of land conservation from the Lincoln Institute of Land Policy, the Harvard Forest and the Highstead Foundation, as well as subject experts from other land conservation organizations. The program also provides an opportunity for college and university students, and for early-career professionals, to meet and network with leaders in the field of land conservation and think about what role they might play in that field in the future.

Due to restrictions and limitations imposed by the Coronavirus epidemic, in the spring of 2020 the ALPINE Summer Institute staff pivoted to "bridge the gap" -- that is, to reformat the program so that it could be carried out without two face-to-face weekend seminars. The Institute was for the first time held virtually – that is, over a series of seven Zoom sessions held over eight weeks beginning on June 10 and concluding on July 29. The five initial sessions dealt with different aspects of large landscape conservation, including one session focused on the issue of diversity, equity and inclusion in the conservation field. The last 2 sessions were devoted to presentations on selected topics relevant to large landscape conservation by ALPINE Summer Institute participants. They were fortunate to have leading experts in the field share their expertise with them during the sessions, including: David Foster, Leigh Youngblood, Bill Labich, Simon Rucker and Karena Mahung.

We had twelve participants coming from institutions across New England including Smith College, Harvard University, Middlebury College, Greenfield Community College, University of Vermont, University of Massachusetts, and Unity College. Additionally, because the program was virtual this year, the Summer Institute expanded to include two participants from the University of Montana. Each of the Summer Institute participants had internships with, or were employed for the summer by, land conservation organizations. The participants came from a variety of backgrounds and levels of experience in land conservation; all of them wanted to learn more about the theory and practice of large landscape conservation, and had a chance to think through, present and write about a plan for a conservation initiative of interest to them. They were instructed to present on an "identified large landscape challenge" that is a tractable problem (that is, a practical problem that appears to have a feasible solution) that is directly related to a particular large landscape. The projects should include the following questions***:*** **What** is the challenge they are proposing to address and what is its significance in a larger context, **Why** this initiative is important, describing the qualitative and quantitative benefits and co-benefits, as well as the potential dis-benefits, of this initiative, **Where** this place/initiative takes place, **Who** initiated the project - how homogenous, and how diverse is the team over the proposed life of the project**, When** and over what timeframe this strategy will be implemented, **How** this initiative is being organized, financed, governed, held accountable, managed and stewarded *and* what is the lasting impact of this initiative, does it have/will it have a lasting impact going forward.

As you will see from the reports that follow, the participants are highly articulate, thoughtful, curious individuals. As a community enterprise, land conservation clearly requires many kinds of talent, and we had the pleasure of spending part of our summer with a multi-talented group that will leave their own significant mark on this long term, multi-generational work.

With best regards,

Jim, Marianne and Robin

James N. Levitt
Director of the International Land Conservation Network, Lincoln Institute of Land Policy, jlevitt@lincolninst.edu

Marianne Jorgensen
ALPINE Program Coordinator, Lincoln Institute of Land Policy, mjorgensen@lincolninst.edu

Robin Austin
Project Coordinator, Lincoln Institute of Land Policy, raustin@lincolninst.edu

Summer Institute 2020 Schedule

June 10

Introductory Session:

- Welcome and Purpose of the 2020 ALPINE Summer Institute
- Faculty and Staff Introductions
- Student Introductions
- Conclusions and next session planning

June 17

Introductory seminar on land conservation
Paul Catanzaro, Extension Associate Professor at the School of Natural Resources, University of Massachusetts Amherst
Schoodic to Schoodic Initiative, Jim Levitt

June 24

Case Study 1: Harvard Forest and the North Quabbin
Invited Presenters: David Foster, Director, Harvard Forest, Harvard University and
Leigh Youngblood, Executive Director, Mount Grace Land Conservation Trust

July 8

Case Study 2: The Second Century of the Appalachian Trail
Invited Presenters: Bill Labich, Senior Conservationist, Highstead Foundation and Simon Rucker, Director, Maine Appalachian Trail Land Trust

July 15

Diversity, Equity and Inclusion in Conservation
Invited presenter: Karena Mahung, consultant

July 22

Student final presentations, part I

July 29

Student final presentations, part II

Participant Papers

ALIVIA ACOSTA recently graduated from Unity College with a degree in Parks and Forest Resources. During a three-year college hiatus, Alivia travelled across the country following her passion for building connections to environmental landscapes through hands-on trail stewardship. Alivia currently works for the Harris Center for Conservation Education as an Easement Monitoring Intern and for the Appalachian Trail Conservancy as a National Service Coordinator. She has made a detailed study of the management of the Bulls Bridge site in Kent, Connecticut for her essay.

Managing Visitor Use with Interpretation and Communication for Bulls Bridge in Kent, Connecticut

Executive Summary

Located in Litchfield County, Kent, CT the variety of natural and cultural resources offered on this connector trail of the Appalachian Trail has created a host of visitor use concerns and could be considered a possible "hot spot" along the Appalachian Trail. From its expanding trail width to the fast accumulation of trash being discarded along its riverbanks, Bulls Bridge provides an opportunity for land managers to consider new and diverse ways of protecting a valuable resource while ensuring it remains accessible and enjoyed by all, for generations to come.

The following proposal provides brief explorations in the development of not only (i) a visitor use management plan for Bulls Bridge but also (ii) an interpretation plan and (iii) a communication plan for the broader audiences of Bulls Bridge to ensure that the highest quality of resource protection and equitable land management takes place.

Background

Location

Bulls Bridge is in Litchfield County, Kent, CT and it serves as the name for the picturesque covered bridge that crosses over the Housatonic River. Bulls Bridge Road eventually intersects the Appalachian Trail (A.T.). Prior to this intersection and closer to the covered bridge, there is road access from Bulls Bridge Road to an officially designated – "blue blazed" – side trail of the federally designated Appalachian National Scenic Trail – "white blazed". *Blazes are placed along trails, usually on trees of rocks, and are utilized as a wayfinding mechanism for travelers. While blazes can take many shapes and forms, the common insignia of the A.T. is its iconic 2' x 6' white painted blazes.*

This blue blazed side trail follows along the edge of the Housatonic River allowing for breathtaking views of New England's granite waterfalls. It has become a popular place for picnic/beach activities as the trail winds along the cooling and scenic splashes of the Housatonic. For the purpose of this proposal and to follow in its common name, this blue blazed side trail will be referred to as Bulls Bridge and will serve as the focus of this proposed management plan.

When considering the management of any public land, it is important to understand the communities to which they serve. The local day visitors to Bulls Bridge, as well as many of its volunteer stewards, reside in the county of Litchfield, CT. A select few volunteers are also from Wingdale, NY. Demographics of the immediate area surrounding Bulls Bridge (Litchfield County) are listed below alongside the demographics of the State of Connecticut for comparison.

Demographics	***Litchfield County***	***State of Connecticut***
Population estimates (July 1, 2019)	180,333	3,565,287
Persons under 18 years, percent	18.0%	20.4%
Persons 65 years and older, percent	22.0%	17.7%
White alone, percent	93.3%	79.7%
Black or African American alone, percent	2.4%	12.2%
Asian alone, percent	2.2%	5.0%
Hispanic or Latino, percent	7.1%	16.9%
White alone, not Hispanic or Latino, percent	87.4%	65.9%
Median household income, dollars	$78,314	$76,106
Persons in poverty, percent	6.9%	10.4%
Population per square mile	206.3	738.1

Table 1: Population Demographics for the county in which the town of Kent reside, alongside the population demographics of the state of Connecticut. *(Source: www.census.gov)*

Importance and Challenges

Bulls Bridge is located on land that is owned by the Appalachian National Scenic Trail, National Parks Service Office of the Appalachian Trail. This federal office is referred to as APPA. According to the APPA Superintendent Compendium, Bulls Bridge is closed to the following as of October 1, 2019.

- The possession and/or consumption of alcohol
- The possession and/or disposal of glass bottles and containers
- Camping
- Open fires
- All swimming and wading, except for fishermen compliant with state licensing and equipment laws
- The collection of any and all plant life

Currently however, as of July 3, 2020 Bulls Bridge has been closed to the public. Below is a map that shows the closed area of NPS land in red and the Bulls Bridge area marked as the blue path. The A.T. itself however remains open as the yellow trail through this property. It can be assumed that high concentrations of day-use visitation as well as misuse from day-visitors resulting in resource damages and is what attributed to the temporary Bulls Bridge closure. A closure that has no set reopening date.

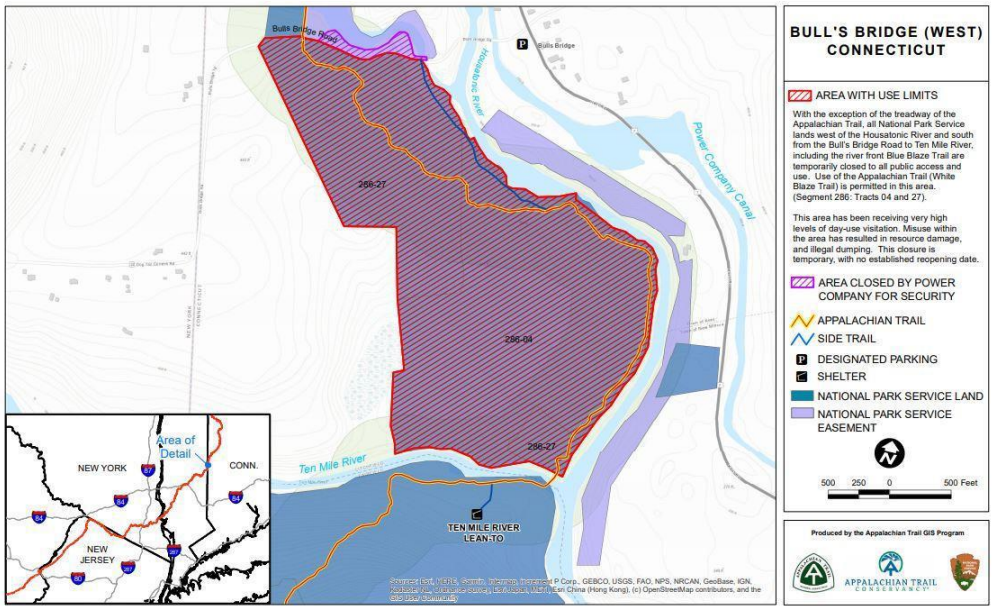


Figure 1: Map of the Bulls Bridge area and its accompanying closure which became effective July 2, 2020. *Courtesy of Kurt Spears, Acting Chief Ranger, APPA*

To understand this current closure, it is important to note the history of visitor use at Bulls Bridge and its corresponding management efforts. Prior to 2012, Bulls Bridge had been experiencing higher than normal visitor use which resulted in consequential resource damages. The local media caught wind of the trash heaps that were accumulating by the river side so in 2012 the town of Kent held a meeting which included a variety of stakeholders, including but not limited to: the Appalachian Trail Conservancy, local law enforcement and politicians, as well as the volunteers from the Trails Committee of the Appalachian Mountain Clubs Connecticut Chapter (AMC-CT).

From this meeting, the Bulls Bridge Task Force was formed. Most importantly the Bulls Bridge Task Force is comprised of around four or five volunteers who spend their time -mainly on the weekends when visitor use is at its highest- stationed at the entrance of Bulls Bridge. Not only do these volunteers talk with visitors when they arrive about the proper rules and regulations, as well as Leave No Trace (LNT) practices but they also provide visitors with garbage bags and ask that they simply bring the trash to the trailhead where the volunteers would gladly then dispose of it for them. It is also important to note that agreements between APPA and local NPS units have enabled a law enforcement presence at the Bulls

Bridge trailhead on select days. Those involved in the project suggest that this law enforcement presence contributed to a decrease in visitor misuse.

Sadly enough, these volunteer efforts and the natural resource were being pushed to uncomfortable extremes during the pressures of the 2020 COVID-19 pandemic when higher than normal numbers of outdoor recreation were being observed across the country. During this time, unusually high temperatures could have also contributed to the visitor increase. Ultimately, volunteers who are the soul of the Bulls Bridge Task Force - as it is along the length of the A.T. – respectfully stepped down from their duties as the circumstances were beyond what they could manage.

Bulls Bridge has long been a "hot spot" for visitor use and misuse. As an assumed popular natural resource for urban populations, the closure of this APPA owned land immediately adjacent to the A.T. provides the perfect opportunity to redesign and rethink what equitable land management may look like in the coming years.

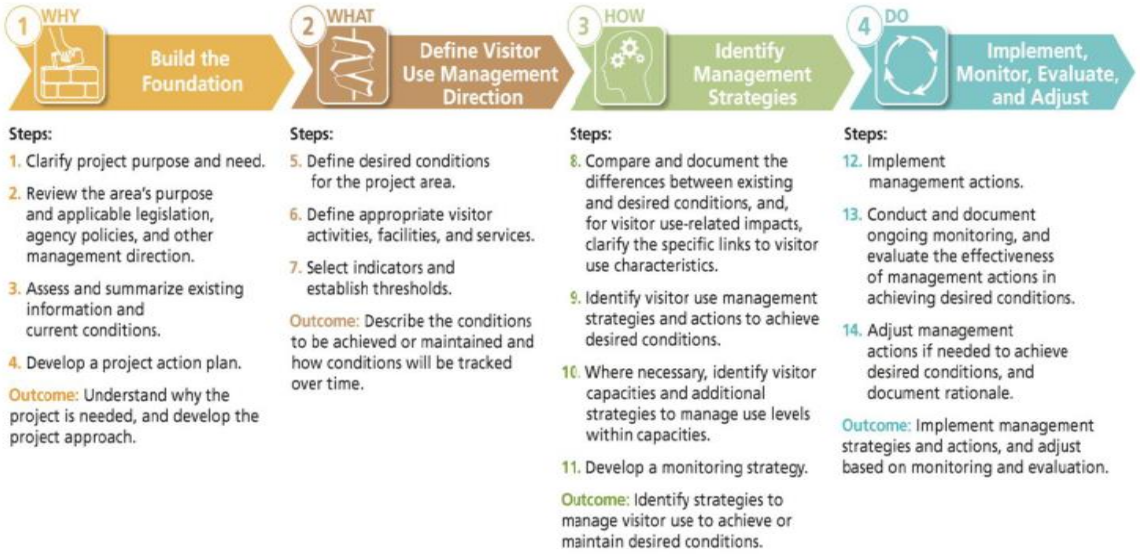
The following section of this paper provides exactly that: a management plan that discusses the need for on site visitor use management, but also an interpretation and communication plan to help reach the broader audience of visitors as a means of inspiring and learning about resource protection prior to a arrival at the gates of Bulls Bridge.

The Proposal

Visitor Use Management (VUM)

The Interagency for Visitor Use Management Council (IVUMC) has created a sliding scale Visitor Use Management Framework that land managers can use when creating a legally defensible VUM plan. Figure 2 below is a visual representation of that Framework and briefly captures the steps required. This process should be performed with a broader and more diverse stakeholder group than previously assembled. Future evaluations and considerations of the necessary stakeholders should take place before and after the necessary data collection which is described below:

Figure 2. Elements and steps of the Visitor Use Management Framework



More importantly, self-evaluations need to occur. The Bulls Bridge Task Force needs to consider where they have been, what they have been doing, and where they wish to be. When data collection and internal evaluations are paired with broader stake holders there is optimal ability to create the most effective and equitable VUM plan. This would fall into *Step 3* under *Building the Foundation* in accordance with the IVUMC Framework. The purpose of this data collection is to help in the prioritization of future VUM plans as well as aide in future evaluations of successes from enacted plans.
Social sciences data collection could take the following forms: *(please note the author is unaware of any data collection that may be currently taking place)*

- A survey for visitors created with the help of a partner organization who specializes in urban-environmental connections (i.e. Groundwork Bridgeport, CT). Data on visitor zip codes would be beneficial in assisting in future interpretation and communication planning.
- The number, type, and duration of use exhibited by visitors.
- The number of cars and the available/overflow parking.
- GPS tracking of discarded trash, as well as visitor misuse.
- Trail widths at their maximum and minimum.
- Recruitment of visitor complaints/opinions, possibly in the form of a survey.

Interpretation

Following the collection of data, and hopefully in tandem with the development of a visitor use management plan in accordance with the IVUMC Framework, a plan for interpretation also needs to be evaluated. Interpretation of a natural resource is similar to education, the only difference being that through interpretation you seek not only an understanding but to interpret a feeling of connection to a resource. As Baba Dioum, the Senegalese forestry engineer once said “In the end, we will conserve what we love; we will love only what we understand; and we will understand only what we are taught”. In interpretation we hope to inspire love for conservation. For the assumed urban visitors of Bulls Bridge, discarding trash and widening a trail along a river is inconsequential. Should they be inspired to see the Housatonic as more than a river and a trail as more than a path, then maybe their own personal conservation efforts could emerge.

Similar to visitor use management, creating an interpretation plan for this section of APPA land could take years of stakeholder recruitment and planning. Ensuring that the communities discovered within the zip codes of the surveys received by visitors are represented and are involved with the formation of this interpretation plan is essential. We need to speak their “language” – sometimes this language is subtle in order to accurately convey the interpretation to them. Another possible consideration would be to include training in soft interpretive skills for the volunteers of the Bulls Bridge Task Force. This could take shape in the form of on the site training from interpretive experts or experienced enthusiasts.

Communication

This communications plan is intended to be a form of informational education, and possibly interpretation that reaches the visitor audience prior to their arrival at Bulls Bridge. With the information provided by social science research, the hope is that a community or a select few communities outside of the immediate Bulls Bridge area, would be targeted. This communication plan can take many forms such as:

- Articles in newspapers, journals, and magazines.
- Educational sessions with schools of all levels, and socioeconomic status.
- Educational sessions with other organizations that might share common interests. *(i.e. birding, hiking, biking, kayaking, environmental groups)*
- Advertisements on television or on billboards.
- Outreach to agencies that may have volunteer benefits for their employees, or agencies that may be seeing future retirees.
- Presences on social media in these varying community groups would also be beneficial.

The Delivery

With the unique cooperative management of the nation's "smallest large park" and the limited resources that are spread throughout its ~2,100 miles, this project, as with many other initiatives along the A.T. ,will be most beneficial in strength if it is reliant upon the expertise of AMC-CT volunteers. However, as seen from recent events, this management has begun to exceed the capabilities of any volunteer. Therefore, a presence from an agency representative would be most beneficial in initiating and progressing the intricacies of this proposal. As with most conservation efforts, the one caveat to this agency presence would be the need for financing.

Fundraising and grant seeking are both viable ways to support a part-time paid internship that would be focused on organizing and managing this proposal. The ATC would most likely be held responsible for ensuring the project's accountability, whereas the stakeholder group would be tasked with its governing. It cannot be stressed enough how this proposal would not be possible without the continued support of the volunteers on the ground and the possible future community connections that may foster more engaged volunteer stewardship.

Sourcing the funding for this position alone could take well over a few years. Data collection prior to organizational planning should also take a year or two at the very least. Recruiting and organizing a broader range of stakeholders should also be done throughout the data collection.

Implications

Going forward this proposal provides a 'not so typical' VUM plan as it seeks to provide interpretive communications to audiences, specifically potential visitors to Bulls Bridge prior to their arrival. These broader initiatives need not only be focused on Bulls Bride user groups, they could be in partnership with other organizations who wish to share similar messages.

The cooperative and intricate nature as well as the relatively "new" concept of this proposal comes with many obvious and some not so obvious challenges. For example, the most drastic challenge is the possibility that no volunteers will be willing to help in the proposal's execution. Should volunteers be recruited, there is still the possibility that this proposal may not catch the interest of the necessary

stakeholders. Their engagement is necessary and direct efforts to create those connections will be vital to this proposal's success. In terms of contingency planning, the interests and directives driven by a broader, more diverse Bulls Bridge Taskforce will hopefully account for any unexpected turn of events.
In the long run, and of the greatest importance, is the implication that Bulls Bridge and the A.T. serve as catalysts for climate change mitigation. Similar to the goals of interpretation, public access to these FREE, green spaces is the prime opportunity to connect underserved and underrepresented user groups – particularly from urban spaces- with the natural world. This connection will hopefully inspire these user groups to be the driving forces behind independent acts of care on behalf of the environment. Whether it be riding their bike to work because they noticed the fragility of the rare, threatened, and endangered plants/insect that dwell along the Housatonic, or deploying personal or community liter removal initiatives, or volunteering with their local trail maintaining club as a means of giving back to the land they have personally enjoyed. The A.T. and Bulls Bridge specifically, have the capabilities of changing the world, and the lives of those who visit it.

LUKE BEESON grew up in Southeastern Pennsylvania before attending the University of Vermont where he is currently a rising senior studying Wildlife Biology and Geospatial Technologies. While attending school, Luke works with the outreach team for the Burlington hub of the Sunrise Movement, a youth-led environmental movement throughout the country, and as a research assistant on a project investigating the connection between increased forest cover and improved water quality. This summer he will be working as a land stewardship intern with the Kennebec Land Trust in Maine and will be conducting a project on identifying vernal pools throughout the county for classification and protection. Outside of school and work, Luke likes to go backpacking, birding, and rock climbing.

Proposed Hiking and Wildlife Corridor in Vienna, Maine

WHAT. A recent GIS analysis has identified the highlands in Vienna, Maine as a priority for conservation for the Kennebec Land Trust. There are loose plans to eventually begin working on protecting large blocks of the forested land there by connecting parcels already owned by the land trust and another conservation group. However, this project also presents a secondary challenge because they are quite remote and comparatively inaccessible, so conservation justification is relatively difficult compared to other projects. The eventual goal is to use the land conserved in this area as a mosaic of wildlands and working woodlots to gain revenue for the land trust through sustainable timber harvesting.

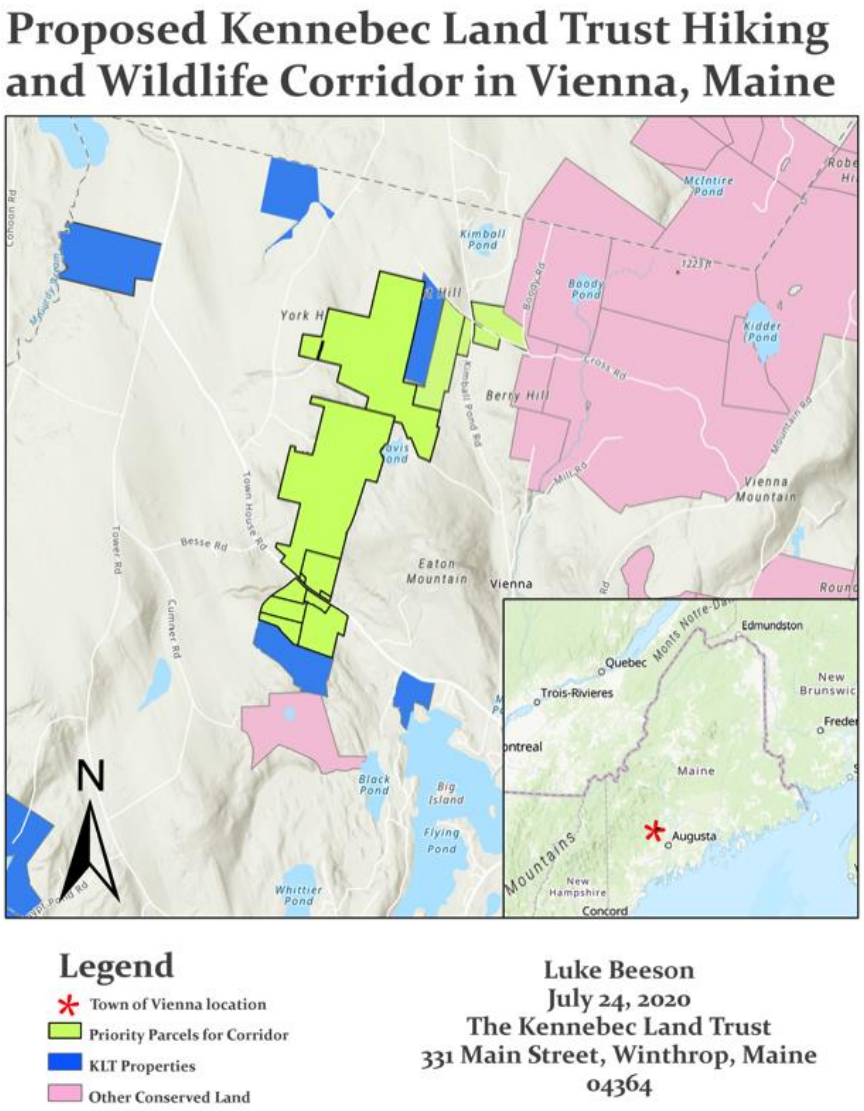
WHY. Because this area represents a high level of importance that the land trust prioritizes, it should be a focus for future conservation efforts. Along with the nearby Kennebec Highlands preserved by the 7 Lakes Alliance, this would make the Kennebec Highlands region a stronghold for conserved forested lands. The parks owned by the 7 Lakes Alliance see a lot of use in the Rome and Belgrade areas. However, this is a much more remote area that would be harder to see that same amount of use, and therefore community value. This could be changed by focusing educational programing there. It would be important to include cities outside of the traditional service area because it is rather far from the most populated towns and cities in Kennebec county. In particular, it may be useful to reach out to Farmington organizations to make it known that this space is close and open for their usage.

Conserving large forest blocks is extremely beneficial for the environment of the region. It allows for movement of wildlife through the landscape, carbon sequestration and more climate resilience opportunities, and it allows for healthy soil to remain intact. On top of this, through GIS analysis, this area is crucial for protecting water quality for the region. These large parcels that have been identified as conservation priorities would allow all of these environmental benefits as well as social benefits due to a proposed hiking trail that would traverse almost the entirety of the town of Vienna. Finally, economic benefits would still be provided to the region by the allowance for limited sustainable forestry to be continued on certain KLT properties.

WHERE. There have been 13 potential parcels of interest identified between the Peter Miller Woodland and Vienna Woods Conservation Area. Of these 13, at least 9 must be conserved through fee ownership or conservation easements with public access in order for the corridor to be completed. The distance that must be covered is about 3,000-4,000 meters. Once connected this would also connect to the privately-owned Ladd Forest which would allow for further wildlife connectivity but no increased benefit for

human use. An important but shorter connection including relatively small parcels is the connection with the Kennebec Highlands to the East.

This is a large protected area conserved for human usage by the 7 Lakes Alliance which is a partnership between the Belgrade Lakes Alliance and the Maine Department of Agriculture, Conservation, and Forestry. Of these parcels identified, lots 38 and 44 are of the highest priority because they constitute the largest continuous blocks of forest in the corridor and encompass Vienna Mountain, which has the opportunity to be used as a draw for more visitors. On top of this, there is already some infrastructure (roads and staging areas) for logging operations.



WHO. This project was initiated and run by the Kennebec Land Trust which is a very homogeneous organization. But, a diverse array of stakeholders can be brought into the management and usage of the project as it progresses by facilitating access to diverse groups. There are already existing relationships with schools throughout the service area through field trips and educational programs (specifically through the popular sustainable forestry program). However, it seems advantageous to reach out to schools, youth groups, and community centers in the greater Farmington region. Although it is outside of the service area, this proposed corridor is in the Northwestern edge and therefore closest to Farmington. On top of this, relationships should be continued and strengthened, and new relationships should be formed with centers for new Americans and under-represented groups, specifically the Capital Area New Mainers Project and the Augusta Multicultural Center. These relationships would make this project much more beneficial for the community and make this remote area much more reasonable for conservation goals.

WHEN. The Strategic Conservation Plan of 2012 started many of the ideas within the Kennebec Land Trust of protecting large blocks of forest land in this area. But, because the organization only has three full time and one part time staff member, progress is rather slow on large projects like this. Mostly, landowner contact and land acquisition are processes over many years as land is willed and donated to the land trust through deeds and conservation easements. The corridor outlined here is a shorter-term

project; part of the overarching goal to conserve and sustainably harvest some timber in this region to protect landscapes and gain some revenue for the trust.

HOW. The project is to be initiated, organized, financed, and managed by the Kennebec Land Trust, its board, and its members. The process is quite similar other conservation projects they have undertaken but considerably more targeted because the parcels that are prioritized for conservation are very focused and hopefully acquired. But once the project is created, facilitating access is going to be much more hands-on given the remoteness of the large forest block. This will then have to be done by forming partnerships and relationships with a variety of different organizations in surrounding cities and towns. Making the new property a focus for future educational programs and potentially school trips is crucial for making this place a worthwhile investment for the community that the land trust serves. The first step in completing this initiative is contacting owners of priority parcels through letters inquiring into whether they have ever considered donating their land or a conservation easement to the land trust.

HOW MUCH. The actual budget of this project is quite variable because some land may need to be purchased while other parcels will ideally be donated. But there are yearly fees through taxes and maintenance costs associated with protecting land that must be accounted for. The money for this project will come from three sources. First, like most land trusts, member donations play an important role in the daily operations. Another major potential funding source is the Wildlands Partnership from the Northeast Wilderness Trust. Money from this source will be funneled into protecting parcels that will be kept as wildlands for use by the public. Finally, some parcels are going to be used for sustainable timber harvesting. This will allow for public and wildlife usage when harvesting is not occurring and will allow the land trust to gain some additional funding for projects.

SO WHAT. Conserving large blocks of standing forest has numerous environmental and social benefits. These large areas are important wildlife habitat and have great potential for future carbon sequestration as they grow larger. On top of the ecological benefits of protecting this land, there are clear human benefits to conserving large intact tracts of forest land. Access to wildlands can be exceptionally beneficial for local people through visiting and learning on the land and the ecosystem services they provide.

WHAT IF. Even if the entire corridor is not finished, the conservation of more of these upland forests and increased usage by a diverse group of people is always positive. Having more of this land protected and open for public use and potentially some forestry practices, has clear benefits for all parties involved in the project. But, for this to be a success, there must be a strong push for use because it is in a more remote area and may, therefore, see a relatively homogenous attendance.

EMMA GUILIN is currently an Environmental Philosophy and Natural Resource Conflict Resolution graduate student at the University of Montana. She primarily researches the ethics of geoengineering and is interested in the intersection of science and collaboration. This summer, she is thrilled to be working with Heart of the Rockies to help develop a Wildlife Movement Working Group for the High Divide region. In her free time, you'll find Emma doing something silly with her pups.

SHAUNI SECCOMBE is originally from upstate New York and grew up on a farm at the foothills of the Adirondack Mountains. In this nature-rich rural setting, she developed a deep appreciation for the natural environment and a heart for conservation. Eager to put her hands to work, she served as a Montana Conservation Corps volunteer, which first sparked her interest in the working landscapes of the Intermountain West. Then, she spent three seasons working with the USDA Forest Service and one season as a Park Ranger, until deciding that it was time to apply her field experience in a broader conservation context. Currently, Shauni is an Environmental Studies graduate student at the University of Montana. Her research interests this summer will focus on wildlife movement, social justice and holistic landscape conservation with the Heart of the Rockies Initiative, as well as completing a SWOT analysis of existing collaborative partnerships in Idaho and Montana with the National Forest Foundation. As a NFF Fellow, she is looking forward to studying land conservation in greater depth while engaging with diverse stakeholders to assess the obstacles and opportunities of collaborative partnerships. During her free time, she enjoys biking, gardening, hiking in the Crown of the Continent, hunting on Montana's public lands, and fly fishing with her husband, Cody.

Emma Guilin and Shauni Seccombe co-authored the following essay.

Nonlethal Predator Control in the High Divide Region of Montana

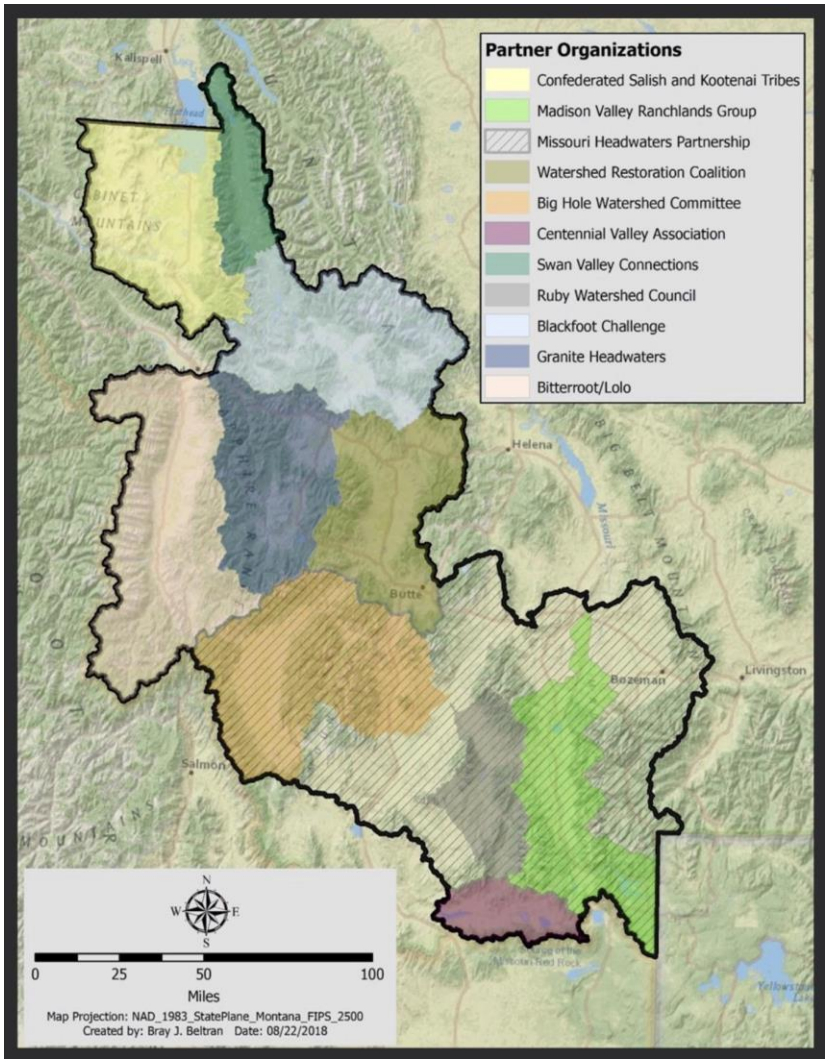
Background

As Europeans settled the U.S., there was a tremendous effort expended to eradicate all species that could potentially harm livestock, resulting in the functional extinction of many species of large carnivores, such as wolves and grizzly bears. These eradication efforts effectively ended in the 1970's with a shift in societal values. This shift resulted in the ban of most wildlife-killing poisons, and placed greater value on having large carnivores on landscapes.

Since the 1970's, all native predators including coyotes, black bears, mountain lions, wolves, and grizzly bears have seen growing populations and expanding ranges. This expansion is viewed in many circles as a huge conservation success, but, for livestock producers, it brings tremendous challenges. Predators are responsible for significant losses not only by hunting livestock, but also stressing livestock, which reduces herd reproduction. It is the aim of the Heart of the Rockies Initiative to reduce agricultural conflict between predators and working lands.

What

It is important to satisfy both the ecological and social interests of agricultural conflict reduction. It is ecologically important to maintain healthy predator populations in the High Divide Region, while it is socially important to protect working lands. Nonlethal predator control has been shown to be effective in reducing livestock loss and stress, as well as allowing predators to thrive on the landscapes, meaning nonlethal control can satisfy both interests by protecting predator populations and livestock. Nonlethal control primarily helps prevent learned behaviors in predators by managing attractants. These control methods include range riders, guard dogs, turbo flagging, electric fencing, big game fencing, as well as carcass and waste management.



Where

The High Divide Region of Montana exists between Greater Yellowstone, the central Idaho Wilderness, and the Crown of the Continent, making it especially relevant to connectivity efforts in the west. It is a critical region for grizzlies, wolverine, lynx, elk, pronghorn, salmon, and sage grouse, among other plants and animals. The High Divide is also one of the least developed landscapes in the Lower 48 – providing an incredible conservation opportunity, for both people and wildlife.

Who

The High Divide Region, as seen in the bordered area in the map, consists of several partnering organizations managed by the Heart of the Rockies Initiative (HOTR). As a convening and coordinating organization, HOTR works with the 26 different organizations to bring together a diversity of needs and interests across the High Divide landscape. The 11 partner organizations displayed in this map demonstrate the piecing together of these collaborative efforts.

Why

Healthy predator populations are an important component of functional ecological systems. First, biodiversity and connectivity are key elements to helping maintain these healthy populations. Protecting biodiversity in predator populations encourages resilience to external stressors like human development and climate change. Connectivity between landscapes allows for species movement, genetic connectivity, migration, dispersal, life history, and biophysical processes. Second, in his paper on Holistic Landscape Conservation, Michael Whitfield explains why functional ecological systems are a vital objective. He writes, “maintaining and restoring connectivity can help nature and humanity adapt to climate change and mitigate the impacts of other landscape stressors...reduced biodiversity means millions of people

face a future where food supplies are more vulnerable to pests and disease, and where freshwater is in irregular or short supply" (3-4). This acknowledges that the human-environment connection is an imperative lens for developing management strategies for future health and sustainability.

Whitefield is careful to note that, "...social connectivity across landscapes is essential to community and economic well being" (2). This highlights the need and value of collaborative conservation. Not only does collaboration build social networks to strengthen shared understanding, but it also supports the community. As such, working lands are the iconic social symbols of the region as well as crucial components of local economies, making them critical components of holistic landscape conservation.

Why Not

Since these nonlethal predator control techniques have only recently gained significant interest, there is not yet robust research to support its effectiveness, or its applicability across diverse local landscapes. Additionally, the long-term costs of these strategies remain unclear. As such, nonlethal control is experimental, which can place additional burdens on working lands, especially since it is unclear who is responsible for financing these techniques.

When, How, How Much

The Heart of the Rockies Initiatives involvement in agricultural conflict reduction began October of 2017 with the arrival of Gary Burnett, the current executive director of the organization. Surveys were conducted to determine how landowners wanted to approach agricultural conflict reduction, which indicated an interest in nonlethal techniques.

At that time, the Blackfoot Challenge was the fiscal agent of a $150,000 National Fish and Wildlife Foundation Grant: funds which were allocated to agricultural conflict reduction through nonlethal predator control. While the Blackfoot Challenge served as the fiscal agent, the Heart of the Rockies coordinated funding to landowner-led groups to implement nonlethal control strategies. In the second year of the grant, Heart of the Rockies assumed fiscal agency.

The landowner-led groups involved in this project all follow a community-based approach to conservation, and the landowners determined which nonlethal techniques could be suitable for their specific environments.

So What

This project will provide the foundational research needed to gain a clear understanding of the effectiveness of these techniques. Developing this body of knowledge will help the development of guidelines for producers and their rural communities, which could then be transferred to broader audiences. This would add tremendous value, since this project has broad transferability to wildlife conservation, particularly in landscapes with mixed ownership or where transboundary stewardship is desired. Demonstrating success is important to large carnivore conservation where ranching communities successfully live alongside grizzly bears and wolves. Visible and accessible demonstration projects are critical for leveraging lessons and innovations to other communities that reside with large carnivores.

Additionally, the Heart of the Rockies, in coordination with NRCS, is looking to solidify these nonlethal predator control techniques as formal "Conservation Practices." Integrating these techniques into standard practices will open up funding opportunities for communities who could benefit from their use, while also providing a greater platform to develop implementation partnerships.

As such, this project will provide the foundational research needed to address the questions of effectiveness, transferability, and long-term costs. It will also serve as an example of Michael Whitfield's

"Holistic Landscape Conservation," by embodying the vision of inclusivity and by strengthening the human-environment connection by layering multiple values on a landscape.

Lessons Learned

Messaging, framing, and public engagement must be approached with care. For example, it is crucial to emphasize that ecological interests are *not* of higher priority than social interests. One way to demonstrate that they are of equal importance is to gain a shared understanding of terminology. Some might interpret "connectivity" or "wildlife movement" as ignoring the challenges and interests of working lands. The term "coexistence" might suggest that it is necessary to care deeply about the wellbeing of animals, which does not have to be the case. Further, sound science should not only be used to deliver accurate information, but also support what ranchers and farmers understand about their lands. Storytelling, particularly visual storytelling, can be an effective means of connecting with the public. It's also important to select an appropriate messenger, one who is trusted and respected within a specific community.

It's not always that case that it is socially acceptable for a community to respond to predators with nonlethal control. Nonlocal conservation groups are often the agents of nonlethal control. This external status can illicit concern about local sovereignty and land access because conservation groups can rely on selective science and focus on single species. Further, there is a lack acknowledgement about and compensation for the contribution of ranchers and farmers in making healthy land management. It's important to understand both the cultural inclinations and perspectives, as well as current contributions of a community when attempting to expand nonlethal control efforts.

What's Next

Heart of the Rockies is working to secure funding to continue supporting and expanding nonlethal control efforts. This funding can propagate new and existing techniques on working landscapes driven by place-based, landowner-led collaboratives. Increased community adoption is extremely effective when neighbors and peers can share information. This is why the Heart of the Rockies is focused on expanding peer-to-peer dissemination of effective implementation approaches that can increase agricultural productivity while providing habitat for large carnivores. With long term and far reaching efforts, more research can be conducted on the efficacy and long-term cost of nonlethal techniques.

ARIELLE LANDAU grew up in Redding, CT. She is currently a rising senior at Middlebury College where studies environmental justice and computer science. This summer, Arielle is conducting an environmental justice, political ecology and GIS analysis of US nuclear testing on indigenous lands in Nevada and the Marshall Islands in order to advocate for the Marshallese and the Western Shoshone in seeking justice. After graduating, she hopes to use GIS to aid locally based environmental justice movements. In her free time, she enjoys birding, knitting as well as producing and listening to podcasts. With a focus on environmental justice, she authored this analysis of protected area in her home state.

An Environmental Justice Analysis of Protected Areas in Connecticut

Connecticut is comprised of 17.86% protected land, as derived from the USGS Protected Areas Database. With Connecticut's proximity to New York City and its many suburban communities, in addition to urban communities such as Bridgeport and New Haven, this amount of protected land is impressive. With 13,095 different parcels of protected land, Connecticut's natural landscape has been preserved by hundreds of different towns, land trusts, public and private organizations- representing a broad appeal for protected lands among residents of Connecticut. Although 17.86% is far from the Wildlands & Woodlands Initiative's goals of at least 70% of New England landscapes as forests by 2060, for a small state with over 3.5 million people, this is an accomplishment.

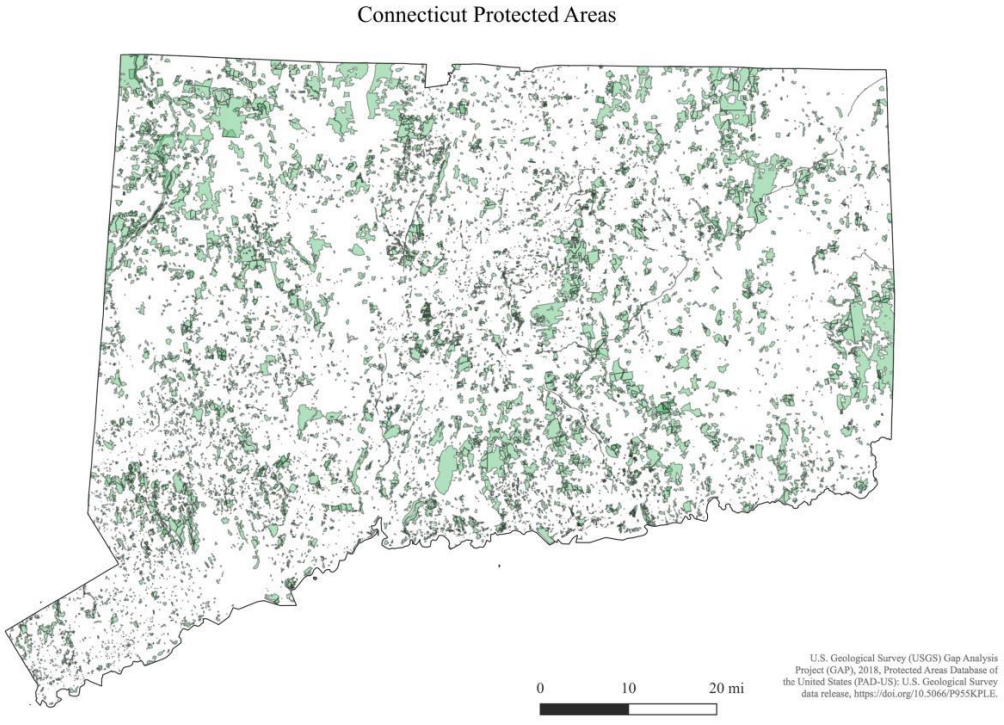


Figure 1. All the protected areas of Connecticut, including fees, designations and easements, derived from the U.S. Geological Survey's (USGS) Protected Areas Database.

Although at face value, Connecticut has done an excellent job providing protected lands to its citizens, there are important questions to be asked about *who* has access to these protected lands, and *who* has the ability to benefit from the many ecosystem services provided by protected lands. These questions are motivated by critical race theory, with the mindset that if policies and actions are not explicitly anti-racist, their outcomes will be because of the prevalence of white supremacy, and its corresponding structural racism. A cogent example would be the Clean Air and Clean Water Act, both written with no attention to the uneven burdens faced by poor and minority groups in exposure to pollution. Racism has always been part of the history of conservation and continues to the present day, beginning with the fact that almost all preserved land was at one point or another stolen from indigenous Americans. The conservation community thus has a responsibility to enact explicitly anti-racist policies, or their efforts of preserving lands will have racist outcomes. This environmental justice analysis of protected lands in Connecticut seeks to answer these important questions and identify areas that have been left out by Connecticut's conservation organizations.

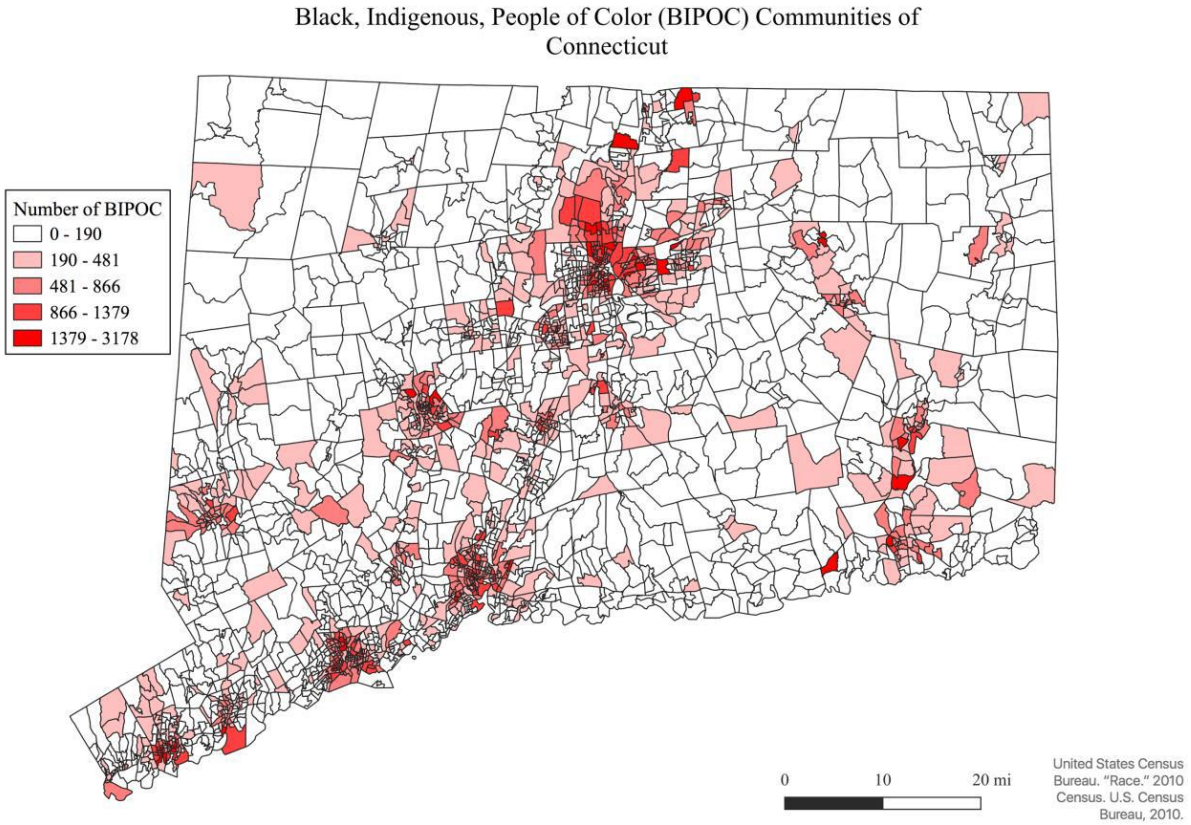


Figure 2. A map showing the Black, Indigenous, People of Color (BIPOC) communities of Connecticut.

The number of BIPOC is classified into five different groups by the natural breaks (Jenks) method, with communities represented by brighter reds as the number of BIPOC individuals increases.

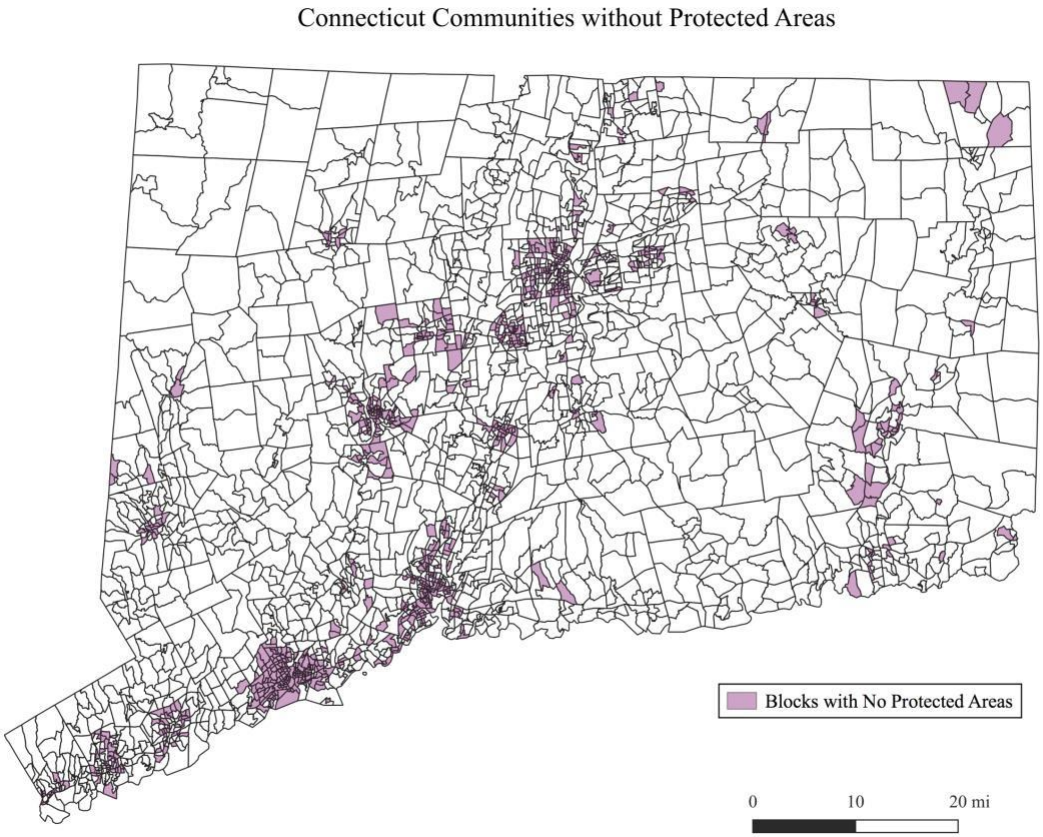


Figure 3. The purple areas each represent Census Block Groups with no protected lands within them.

There are a total of 774 communities without protected areas, out of 2581 block groups. Communities without protected lands are thus in the minority, making it important to understand *who* lives in these communities, and why they do not have access to protected lands.

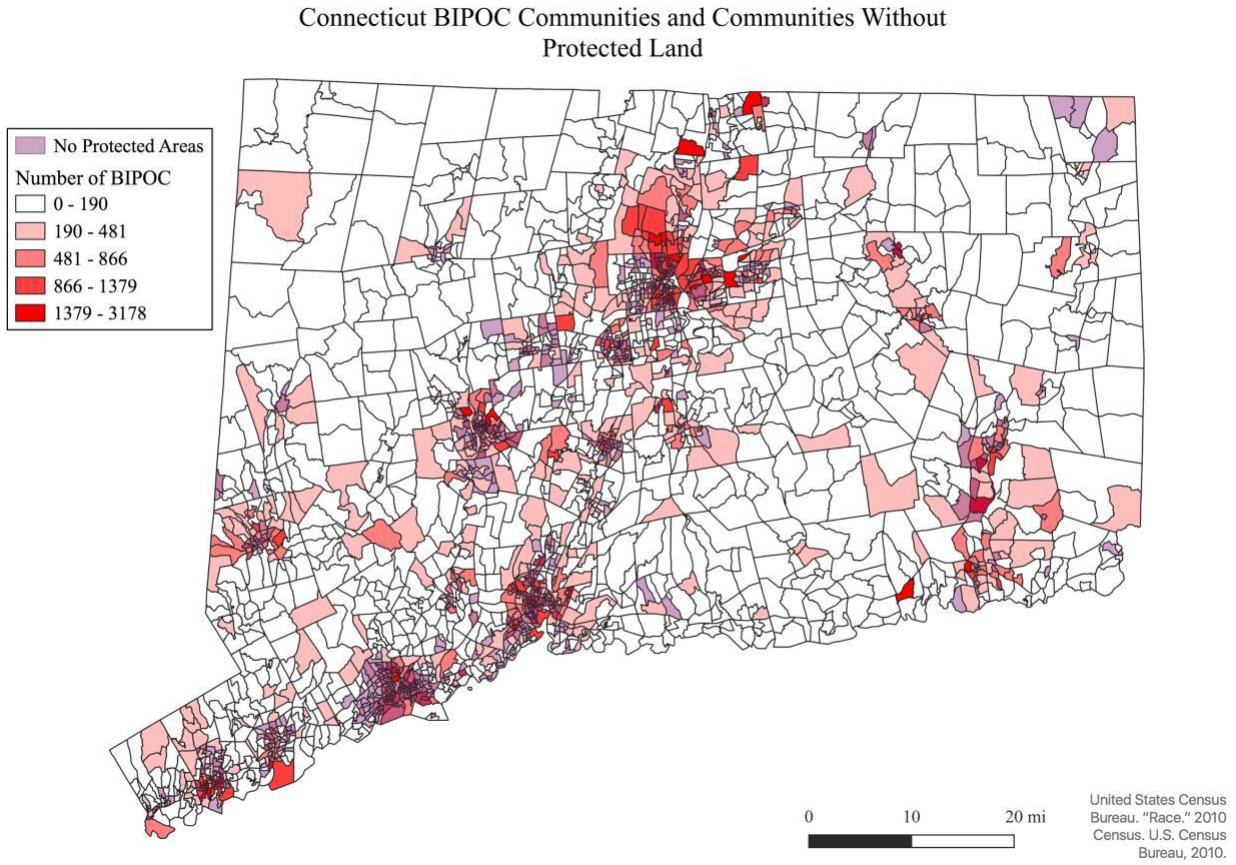


Figure 4. An overlap of BIPOC communities and communities without protected areas begins to show a pattern of communities of color without access to protected lands. The communities without protected lands, highlighted in purple, show overlap with communities of color by shading the red gradient darker.

As shown in Figure 4, below, a disparity based on race is clear, as although 73.02% of the population has access to protected lands, only 47.24% of the black population, and only 53.16% of the BIPOC population has access to lands, while 78.35% of the white population does. This table also includes general demographic information for Connecticut residents.

Race	Total Population	% of Population	Total with Access	% with Access
White	2,795,926	78.85%	2,190,743	78.35%
Black	342,764	9.66%	161,912	47.24%
BIPOC	749,911	21.15%	398,624	53.16%
All (White+BIPOC)	3,545,837	100%	2,589,367	73.02%

Figure 5. *This table shows the results of a Geographic Information Systems (GIS) analysis of which communities in Connecticut have access to protected lands.*

After performing a GIS (Geographic Information Systems) based analysis, a clear environmental injustice appeared based on race and who has access to protected areas. Access was determined by whether census block groups had any kind or size of protected land within them. A majority of block groups had access to protected lands, and the ones that did not, most often, were communities of color. Of Connecticut's white population, 78.35% had access to protected lands, which is above the total access of

Connecticut residents to protected land at 73.02%. These statistics are an example of white privilege, as being white increases one's likelihood of having access to protected lands. Only 47.24% of the black population of Connecticut has access to protected lands. Similarly, only 53.16%, of the BIPOC population has access to protected lands. While the majority of white people in Connecticut, about three quarters, have access to protected lands, only half of BIPOC residents have access to protected areas. There is thus a clear disparity of who has access to protected lands based on race.

Although it is unlikely that conservation groups in Connecticut purposefully, and with maleficent intent, excluded communities of color from conservation goals and projects, the outcome is as such. The prevalence of preserved land in white communities is likely a result of systemic racism and housing discrimination, such as red-lining, which allowed white people to own their own land at higher rates while preventing BIPOC individuals from doing the same. These outcomes show the importance of adopting explicitly anti-racist policies. Land trusts and conservation organizations must carefully study where they have missed the mark in preserving land in BIPOC communities within their areas of interest, and if their areas exclude BIPOC communities, those areas should be expanded to be more inclusive. One such area that has historically been excluded, but could easily be included, because of the resources, and prevalence of land trusts in Fairfield County, is Bridgeport, Connecticut.

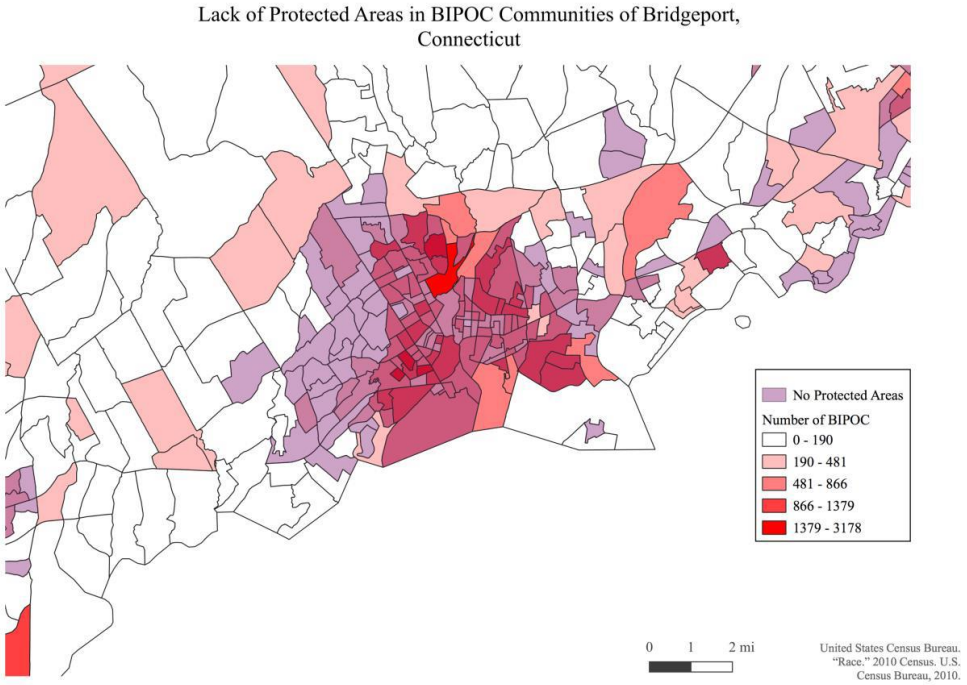


Figure 6. Bridgeport, Connecticut has a concentration of BIPOC communities, many of which lack access to protected areas.

Bridgeport is also located in Fairfield County, known for its wealth and proximity to New York City, creating an opportunity for resources to be redistributed to resolve this environmental injustice.

There are over 20 different land trusts in Fairfield County, Connecticut, providing plenty of opportunity for engagement and cooperation with a project to preserve land, or to create a unique vision of open space, in the underserved areas of Bridgeport, Connecticut. Some land trusts, such as the Aspetuck Land Trust, and the Wildlife in Crisis Land Trust, have already worked across town lines and at the regional level, which position them for ready involvement in a project in Bridgeport. Fairfield County is also home to the Highstead Foundation, which has many accomplishments in leading Regional Conservation

Partnerships and large landscape projects that advance regional conservation goals. There are thus many organizations with the resources, connections and experience to advocate for a project that partners with underrepresented communities in Bridgeport. Many land trusts, as a result of recognition that racism is nowhere near eradicated, and is currently prevalent in many spaces, have embarked on including Diversity, Equity, Inclusion and Justice (DEIJ) into their goals and missions.

Including underserved communities in projects to establish protected lands is a natural extension of these goals, one which would ensure land trusts put their money where their mouth is, and go beyond "woke-washing" proposals that fail to induce real change in racial disparities.

There are also plenty of community organizations in Bridgeport that would be excellent partners and leaders in such a project. The Burroughs Center, for example, is a community organization focused on overcoming barriers to success with a focus on diverse and inclusive communities and community building. There are also two local chapters of the NAACP (National Association or the Advancement of Colored People) in Bridgeport, an organization with a history of environmental justice based projects.

Access initiatives by land trusts can go beyond sponsored group trips to already preserved land, and instead work with the communities themselves to create a unique vision for open space that is close to home (thereby also minimizing incidents of racism that can occur in more rural communities). One model is a cultural respect easement and agreement, which centers BIPOC voices on what access should look like. Many land trusts have new projects focusing on mitigating climate change, but if land trusts are to be truly anti-racist, and be part of the growing movement for climate justice, initiatives must focus beyond prioritizing the preservation of biodiverse species and large landscapes to include initiatives for environmental justice. A project to remedy the lack of access to preserved lands in Connecticut BIPOC communities is a necessary next step in DEIJ for land trusts and conservation organizations, as well as a next step for the human right to a clean environment and environmental justice.

Works Cited

"Burroughs Center," 2018. https://burroughscenter.org/about-us/?v=f24485ae434a.
"Fairfield County Land Trusts." Connecticut Land Conservation Council, 2018. http://www.ctconservation.org/landtrusts/region/Fairfield.
Foster, David, et al. "Wildlands and Woodlands Farmlands and Communities Broadening the Vision for New England." Harvard Forest, 2017.
Purdy, Jedediah. "Environmentalism's Racist History." *The New Yorker*, August 13, 2015.
Russell, Danielle. "The Power of Land: Race, Equity and Justice." *Race, Equity and Justice: Lessons for Climate Resilience* (blog), June 18, 2020.
United States Census Bureau. "Race." 2010 Census. U.S. Census Bureau, 2010.
U.S. Geological Survey (USGS) Gap Analysis Project (GAP), 2018, Protected Areas Database of the United States (PAD-US): U.S. Geological Survey data release, https://doi.org/10.5066/P955KPLE.

STEPHANIE LONG is originally from Traverse City, MI but has been living in New England since attending Smith College. She graduated with a degree in Environmental Science and Policy in 2019 and moved to Vermont the following fall to start an AmeriCorps service term with Vermont's Department of Environmental Conservation ECO AmeriCorps program. Stephanie is currently serving as a Planning and Assessment Assistant with the Vermont Land Trust where she helps farmland conservation projects move through state and federal approval processes. She has also been helping VLT implement their relatively new restoration program on conserved properties, including properties in the Champlain Watershed about which she writes here. Stephanie is interested in getting more involved in land stewardship and restoration in the future. In her free time, she likes to go hiking and work on improving her nature photography skills.

Lake Champlain Watershed Stewardship & Monitoring Collaborative

Situated between upstate New York and Vermont, Lake Champlain is a vital natural feature for humans and wildlife alike. However, the lake is currently plagued by high levels of nutrients, such as phosphorus and nitrogen. Excess nutrients enter waterways within Lake Champlain's watershed from sources such as the agricultural industry and streambank erosion that are eventually carried into the lake.[1] This nutrient pollution degrades water quality and causes frequent, harmful algal blooms. The 6 sub basins in Vermont that drain into Lake Champlain make up 56% of the Lake Champlain watershed, and Vermont contributes the most nutrient pollution to the lake.[2]

Many organizations in Vermont are working to improve water quality and habitat through protecting and restoring riparian zones within the watershed. At least 45 organizations, including non-profits and government entities, work at scales ranging from local to state-wide to address these issues.[3] Some of these organizations protect riparian zones through acquiring easements with special protection clauses for waterways on private land. Others coordinate restoration projects such as tree plantings along riverbanks to increase bank stabilization and retain nutrients from runoff before it can enter the waterway. Still others focus on monitoring water quality in streams and rivers as well as in Lake Champlain.

But how well are these organizations functioning when it comes to keeping up with projects after initial implementation? If the protective and restorative measures taken are going to be effective at improving water quality in the long-term, projects need to be consistently monitored and stewarded over time. Are these groups working together? Some groups do partner together, such as the organizations that are part of the Lake Champlain Regional Conservation Partnership Program, but what about the rest of the organizations working in the same watershed? Considering the similarities in types of projects undertaken, project goals, and location, there is a lot of potential for these organizations to better work together to share monitoring and stewardship responsibilities as well as data.

Further explanation as to why increased collaboration and focus on stewardship would be useful comes from my experience with the Vermont Land Trust (VLT). I am currently serving as an AmeriCorps member with the VLT where I'm helping implement their new restoration program. VLT operates on a state-wide scale and holds numerous conservation easements on private land in every sub basin in Vermont, including the 6 sub basins within Vermont's portion of the Lake Champlain watershed.

Recently, to address this nutrient pollution problem, VLT started requiring 50-foot, no touch buffer zones along river and stream banks on every perennial waterway running through or along the boundaries of

properties that are being conserved. These buffers are meant to be forested to add bank stabilization, retain nutrients from runoff before they enter the waterway, and provide habitat for species living in riparian areas. Some sections of riparian buffer zones that are open land, such as recently retired agricultural land, are planted with native trees and shrubs to speed up the reforestation process. VLT often looks to conservation partners such as US Fish & Wildlife as well as more local organizations focused on riparian restoration to carry out these plantings. VLT has also started coordinating plantings on their own for properties with open buffer sections of half an acre or less.

Protocols are not currently in place for the long-term monitoring of these restoration projects to determine if they are working and how well they are working. There is a lack of continued collaboration with partners after a planting has happened as well. Some partner organizations do monitor projects they have planted, but that data is not automatically shared with VLT. This is most likely due to the lack of structured space for the data on VLT's end. Additionally, as VLT continues to increase the number of restoration projects completed per year, there will be increased need for stewardship capacity for these projects. Increased collaboration with other organizations working in the watershed could be very beneficial to VLT because it could increase stewardship capacity through involving more local organizations that have programs and volunteer bases set up in their regions. VLT could model it's monitoring protocol after protocols that have already been created and are used by other organizations in the area. Data collected by other organizations in the watershed pertaining to how well their restoration projects have held up after implementation as well as knowledge of areas with lower water quality could influence future restoration projects and priorities for VLT.

To address this lack of structured collaboration in the watershed, I am proposing the creation of the Lake Champlain Watershed Stewardship & Monitoring Collaborative. This Collaborative will be open to all organizations operating in the Lake Champlain watershed. Organizations that immediately come to mind include groups with a primary focus of protecting and restoring riparian areas, but connections will be made to other local organizations that are interested in getting involved in riparian zone monitoring and stewardship work to diversify Collaborative members overtime.

The Collaborative will function as an organization that provides structure for storing and sharing data among member organizations and facilitates collaborations between member organizations working in the same region. A core team will manage the organization. The Executive Director will cover administrative duties and facilitate member organization meetings. A Database Manager will maintain the database where data collected by member organizations is stored. An Outreach Coordinator will identify new organizations to add to the Collaborative. A Funding Specialist will pursue funding opportunities for the organization. A Board of Directors will also be created to oversee the Collaborative. Board members will be elected by member organizations and can come from funding organizations as well as community members living in the watershed.

Outputs will include quarterly meetings where member organizations gather to share projects that will require long-term stewardship or monitoring and identify possible areas for collaboration with other local organizations. A database where partners can share data will be created and maintained. Reports containing collected data will be shared with member organizations to help them determine effectiveness of activities and areas of prioritization for future projects.

Data collection could be made more consistent and uniform if members adopted a similar monitoring protocol. An example of a protocol currently used by a potential member organization is the monitoring protocol used by the Best Management Practice (BMP) Verification Program within the Clean Water Initiative Program (CWIP). CWIP is housed within the Vermont Department of Environmental Conservation and helps fund non-regulatory water quality projects across the state. The BMP Verification Program is a pilot program that was recently established to assess the success and needs of management practices that have been implemented using CWIP funding. Riparian buffer plantings are among the

management practices funded by this program. The BMP Verification team created a riparian buffer survey with input from state conservation partners to determine the health of planted buffers. The ArcGIS program Survey 123 is used in conjunction with the ArcMap Collector app to collect data in the field that is then stored directly in CWIP's database. Adopting a protocol like this one would be convenient because the system is already in place. The survey could be adjusted to add additional variables depending on the data needs of member organizations.

To help tackle the reality of racial inequity in our society and in the environment, the Collaborative will partner with the Peace and Justice Center, a social justice activism organization in Vermont, to participate in racial justice workshops at member meetings. Workshops led by the Center will teach members and staff of the Collaborative about how racial injustice shows up in their work and what steps can be taken to dismantle these inequities. Partnering with the Peace and Justice Center will also help the Collaborative cultivate other partnerships with organizations that are working to address racial inequities in the environment in Vermont. As a small organization, the Collaborative may not be equipped to take on this work on their own but through meaningful partnerships with organizations already doing this work the Collaborative can become involved in an impactful way.

In terms of financing, the Collaborative will apply for state grants, such as grants within the Clean Water Initiative Program. Private funding from donors may also be an option. Additionally, member organizations may have suggestions for other funding opportunities for the Collaborative. Representatives from member organizations should be able to participate on their own organization's time considering the opportunities to collaborate on projects with shared goals. Funds for stewardship work are often included in the budget for easement acquisitions so time with the Collaborative could be billed to their home organizations when applicable. Volunteer work will be a large part of the monitoring and stewardship of projects, especially for organizations that already have systems set up with local volunteer networks.

Lasting impacts from this Collaborative will include an increase in structured collaboration between organizations operating within the same watershed. There will be an increase in sharing data between member organizations to determine the effectiveness of methods and inform priorities of future projects. The Collaborative will also help guarantee the long-term stewardship and monitoring of these areas to maintain the effectiveness of the protective and restorative measures taken to improve water quality in the Lake Champlain watershed, long after project implementation takes place.

Lastly, in terms of contingency plans, the Watershed Collaborative will start as a pilot program in a single basin within the watershed if the watershed-scale is too large to pull together immediately. Increasing the number of positions within the core team may be necessary if there are too many tasks for the positions already outlined, which will impact the amount of funding needed for the organization. The Collaborative will look to start under the umbrella of a larger member organization if initial funding is hard to obtain.

Appendix

1. Lake Champlain Land Trust
2. *Phosphorus TMDLs for Vermont Segments of Lake Champlain* (Rep.). (2015). Boston, MA: U.S. Environmental Protection Agency
3. Lake Champlain Basin Program
4. Vermont Land Trust
5. Vermont Department of Environmental Protection Clean Water Initiative Program

OLIVIA LUKACIC has been working and living in New England her entire life and still can't get enough of the beauty of the area and the endless stonewalls that crisscross the forests. Originally from Massachusetts, she has now returned to her home state to work on a Master's degree in Environmental Conservation from University of Massachusetts, Amherst. After graduating from the University of Vermont with a dual B.S. in Environmental Science and Forestry, Olivia spent several years in mid-coast Maine working for an environmentally focused educational non-profit. She enjoys challenging herself in the outdoors with friends but also enjoys burying her nose in a book. A lover of questions and stories, she will probably ask you about your latest adventure or for your favorite recipe. Her essay, below, reflected her long term interest in the intersection of conservation and forestry.

The Logging Industry in Massachusetts: A Potential Companion to Large Scale Conservation

Introduction

The current state of Massachusetts and New England's forests is a direct result of previous land use history. The region has the ecological and climactic conditions to grow and regenerate forests as the predominant land cover, more so than almost any other region of the United States. Even with large scale clearing in previous centuries, Massachusetts is the 9th most forested state in the U.S. with 3.1 million acres of woodland, equaling 60% of the state's land cover[1]. Although it is important to remember that the makeup of the landscape today is not recent history. The native peoples of the Mohican, Nipmuck, Pawtucket, Wampanoag, Nauset[2] and other tribal entities had been living and using the land that is now the state of Massachusetts for thousands of years before white settlement.

During early European settlement, colonists cleared large tracts of the forest for building materials, wood heating, open space for agriculture and settlement, and other economic products[3]. For much of the 350 plus years of commercial logging in the state, ownership of land was tied directly to the forest products industry. Private landowners would harvest trees to then produce lumber, cordwood, and other products such as charcoal. This was sometimes the main source of income for families outside of urban centers[4]. As a result, the forest-based economy is one of the oldest economic sectors in the state. But a shift from utilization to conservation, as well as increased population pressures in the 20th and 21st centuries, often forced families to sell their land and avoid the increasing costs of ownership[5].

Today, for the 293,000 private woodland owners that own about ¾ of Massachusetts' forests, the interest and economic feasibility for harvesting their woods is not as strong as it used to be. Massachusetts and New England's ambitious conservation movement has had a profound impact on cultural and natural spaces being conserved.

However, it often seems like conservation is in constant conflict with other objectives for the land. Although the state's gross output from the forestry industry is around 3 billion dollars per year with roughly 17,000 jobs, the sector continues to decline. From loggers, to saw and pulp mills, to secondary manufacturing, this decline of the collective forest industry comes from cheaper foreign competition and plastic and steel replacing wood as raw materials[6]. This accompanies an often misguided and strong public discontent for logging as a threat to conservation and a contributor to climate change.

Although the industry is shrinking, the need for wood products in Massachusetts is still high. As of 2002[7], New England met less than 10% of its timber demands from management within the region. Therefore,

the need is being outsourced, often to areas where forestry practices are less sustainable. Local wood and wood products have the ability for a lower carbon footprint while also continuing to sustain rural economies.

Objectives

The proposed project aims to further understand and address the challenges and barriers in the logging and forest products industry in Massachusetts. Specifically, in what way can coordinate conservation planning work to keep the forest products industry going to support rural economies in the state. The development of a structure to bring together smaller parcel landowners in adjoining areas for coordinated forestry management planning and logging operations is the proposed aim of this project. This multi-faceted problem has impacts on sustaining rural communities, logging, conservation, climate change mitigation, and strategic planning and development. These have the potential to be worked on collaboratively with careful and creative management of social and ecological relationships. The objectives are as follows:

- Inventory and map historical and active sawmills in Massachusetts (1990's-2020)
- Survey active mills and loggers in Massachusetts to understand challenges and barriers to operation
- Meet with stakeholders including relevant industry, governmental, and private organizations
- Create a guide to quicken and ease the process for abutting landowners to create more wholistic harvesting plans

Project Approach

The topics of forests, conservation, and industry have a wide and diverse set of people and organizations. It is important to create a baseline for what work has been done and what work is currently being done to address challenges within each topic. To start, a mapping of (the decline of) active sawmill locations in Massachusetts was created with already available data. This work is detailed later in "Project Impacts and Limitations".

A survey will be sent to the 23 known and active sawmills in Massachusetts as well as to the licensed loggers practicing within the state. The goal of this survey will be to identify what structures or programs are needed to make coordinated landowner logging jobs economically and logistically feasible. It also aims to identify barriers and challenges that the sawmills and loggers are facing. This might include minimum acreage for jobs, understanding supply chains of land to logger to processing facility, and the potential for an increased role for biomass.

The success of this project will rely on the variety of stakeholders and organizations being able to share ideas and express concern. A stakeholder meeting (or series of meetings) will be organized to hear these viewpoints. From these meetings, previous initiatives will be identified along with successes and problems encountered. This will allow for a partnership or working group to be established from willing and able entities. Potential stakeholder meeting attendees include:

- Massachusetts Department of Conservation and Recreation (DCR)
- Land Trust community- Massachusetts Land Trust Coalition
- MA Forest Alliance
- New England Forestry Foundation
- Certified consulting foresters
- Master Logger members
- UMass Extension
- Wildlands and Woodlands working group
- Native Peoples tribal leaders

- Massachusetts Department of Energy

Finally, the result of the above objectives will be to create a guide and associated structures of support for private landowners. The guide will outline the tools and information necessary to coordinate forestry management on their individual woodlots with surrounding landowners to allow for feasible logging operations. This may take the form of a webpage and/or written publication. It will be important to have support from the groups involved in the stakeholder meetings as well as governmental organizations. The necessary level of legislative or incentive programming goes beyond the scope of this project but is critical to the success for landowners, the forest products industry, and rural economic sustainability.

The timeline for this project would be 1-2 years. A primary point person would need to have the funds to work on the mapping, survey, tool/guide creation, and general administrative work to gather individuals and run stakeholder meetings. Partners would be invited to initial meetings and would then opt in for further work and involvement in the process. These partners would need to identify funding sources for additional individuals work time.

Project Impacts and Limitations

This project is an ambitious attempt at re-invigorating the declining logging and forest products industry in Massachusetts. Although this is not a comprehensive plan that will guarantee success, the objectives will provide more data and ideas to continue momentum from a full community approach. With different perspectives on how we as humans should interact with the forest as well as different needs for the land and its available resources, it is important to look holistically at how to balance those beliefs and needs.

The first objective of mapping sawmills has already been completed as part of the development of this project proposal. Figure 1 below show the change in mill availability. It is important to note that there are no longer any pulp mills active in Massachusetts but there are several paper mills and biomass power plants throughout the state.

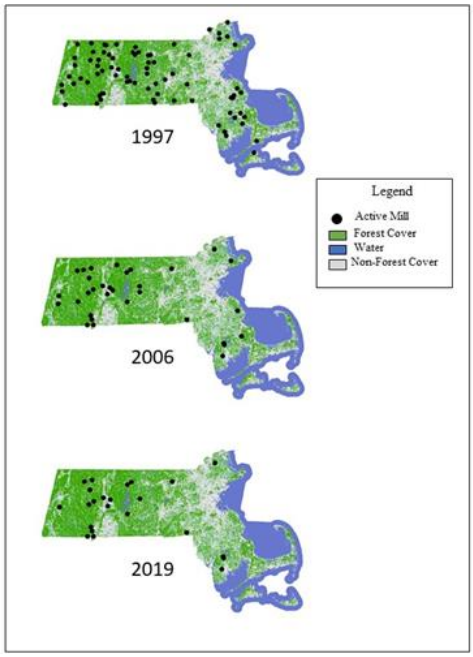


Figure 1: Active sawmills in Massachusetts from 1997, 2006, and 2019. The number of mills active in 1997 was 89, in 2006 the number of active mills was 32, in 2019 the number of active mills was 23. The data from 1997 was from an FIA survey. The 2006 data was from the Massachusetts Directory of Sawmills and Dry Kilns put together by the University of Massachusetts. The 2019 map was created by checking the active status of the 2006 list.

There are many challenges and potential pitfalls within the project context and beyond. Many of these problems are forward facing but there are also problems with the current and past state of the industry. Pulling together relevant stakeholders can be challenging, as is managing communication and relationships amongst groups that often hold opposing views. There is also a challenge in communicating with the public about how logging and a Massachusetts based forest products industry can help create co-benefits and be another layer to the values of the landscape.

Like other trade professions, the industry is having trouble finding the next generation of loggers and mill operators. The workforce is aging and with the industry in overall decline, it can be hard to get younger employees. With the decline of sawmills and the extinction of pulp mills in the state there is the concern that there is no place for the raw material to go within the state. Massachusetts does have a few paper mills still in operation and there has been a bigger push for biomass fuel, but the primary and secondary manufacturing stages need to be able to support wood coming off the land.

With increasing developmental pressure as highlighted in Mass Audubon's "Losing Ground" report[8], a one size fits all approach will not work in developing a future plan for the state. Reaching the Wildlands and Woodlands[9] goal of 60% forest land conservation by 2060 cannot happen through preservation alone. It will be important to balance critical wildlands with forests that can be used for recreation, timber, and non-timber forest products while allowing for conservation of that land in perpetuity.

RESOURCES

[1] Massachusetts Woodland Institute. 2018. Web.

[2] Native Land. *Native Lands Tribal Map.* Native-land.ca. 2015

[3] Foster, Charles H.W. et al. *Stepping Back to Look Forward: A History of the Massachusetts Forest.* (Harvard Forest, 1998)

[4] DCR. *Caring for your Woods: A Valuable Resource.* (Center for Northern Woodlands)

[5] Van Fleet et. al*. Reimagining family forest conservation: Estimating forest landowner awareness and their preparedness to act with the Conservation Awareness Index.* (Journal of Forestry, 2012)

[6] Northeast Forest Association. *The Economic Importance of Massachusetts' Forest Based Economy 2015.* (NEFA 2015).

[7] Berlik, Kittredge, and Foster. *The Illusion of Preservation: A Global Environmental Argument for the Local Production of Natural Resources.* (Harvard University Press, 2002).

[8] Mass Audubon. *Losing Ground: Nature's Value in a Changing Climate. (*Mass Audubon, 2020)

[9] Harvard Forest. *Wildlands and Woodlands: Broadening the Vision for New England.* (Harvard Forest, 2017)

ALANA LUTZ is a rising sophomore at Middlebury College, planning to major in Conservation Biology. She is originally from Chapel Hill, NC and grew up exploring the Southern Appalachians, about which she writes here. Alana was nevertheless eager to relocate to Vermont for college and experience the ecosystems of the Northeast. She is the conservation coordinator for WildMidd, a student organization that connects local youth to place-based environmental initiatives, and is currently involved with the creation of a Regional Conservation Partnership in Addison County, VT. In her free time, she enjoys backpacking, snowboarding, and hammocking.

The Eno-New Hope Landscape Conservation Plan

Overview and Next Steps

The adjacent Eno River and New Hope Creek watersheds are located in the Eastern Piedmont region of North Carolina and encompass parts of Chatham, Durham, Orange, and Wake counties. They are home to an array of biodiverse ecosystems that support a rich variety of plant and animal communities, including rare species. Thousands of acres of core wildlife habitat within this area have already been conserved by various land trusts, universities, public agencies, and other landowners. However, these existing protected lands face the threat of becoming isolated islands separated by roads and development, especially as this region of North Carolina experiences rapid growth.

The goal of the Eno-New Hope Landscape Conservation Plan is to prevent habitat fragmentation by conserving an intact habitat-corridor network across the entire landscape delineated by the Eno River and New Hope Creek watersheds. It specifically focuses on development-sensitive terrestrial wildlife species that are indicators of landscape habitat integrity. The Plan represents a collaboration between nearly twenty different entities in the watersheds, including private land trusts, state agencies, local governments, regional organizations, and interjurisdictional planning groups. The group conducted a landscape corridor analysis, reviewed existing policies and ordinances regarding land conservation, and developed a set of recommendations to guide future land use decision-making. The two-year project was completed in December of 2019 at a cost of $10,000, which was funded mostly by a grant from the North Carolina Wildlife Resources Commission.

First, the group used a GIS-based approach to identify and map priority habitat patches and least cost corridors between them. They based their work on Hall's Landscape/Habitat Indicator Guild Approach, which focuses on protecting a connected network of core habitat for guilds of indicator species that have similar habitat and movement needs and that respond in similar ways to habitat fragmentation. The group identified a total of 22 habitat guilds with 57 terrestrial wildlife indicator species in the Eno-New Hope project area, but selected three guild for the GIS corridor analysis. The results of the analysis highlight the importance of the New Hope Creek-Jordan Lake corridor and the Eno River corridor, as well as opportunities for connections between the two watersheds.

Next, the group conducted a review of planning and governing documents for each county and municipal jurisdiction in the project area to examine existing priorities, policies, and ordinances related to habitat and corridor conservation and provide a resource for interjurisdictional collaboration. Their findings demonstrate that each jurisdiction has, to some extent, recognized a need for protecting connected natural areas and can work within its existing policy framework to incorporate the GIS data from the

landscape corridor analysis. Further, many existing land protection priorities overlap with the priority areas highlighted in the corridor analysis.

Finally, the group developed a set of recommendations consisting of six objectives that focus on incorporating the protection of the identified habitat-corridor network into local and interjurisdictional land use planning and decision-making. Proposed tools for providing conservation corridors include constructing adequate wildlife crossing areas at critical points along roads and highways and using the Green Growth Toolbox created by the North Carolina Wildlife Resources Commission as a framework to incorporate conservation data into land use planning.

As for next steps, the data from the landscape corridor analysis is to be shared with land trusts and local government development planning agencies so that these groups are better informed and may adjust their land prioritization and decision-making processes accordingly. However, the project is otherwise seen as completed, and any further planning that might have taken place has been largely halted by the pandemic.

Simply providing information and encouragement is unlikely to spur rapid or comprehensive landscape-scale action, especially as local government interest in conservation fluctuates dramatically relative to other competing priorities. The landscape corridor analysis is an important first step to prioritize lands for conservation, but there is a great deal of untapped potential for an ongoing collaboration and a powerful landscape-scale initiative to protect the identified lands rather than simply providing recommendations for planning and development in the project area.

First and foremost, the vision for this connected landscape would benefit immensely from a strategic master plan for acquiring and protecting the high-priority lands identified in the landscape corridor analysis. Currently, the job of protecting the habitat-corridor network is left to individual land trusts and local government land conservation programs. An effective conservation plan would involve less reliance on local government action and a more emphasis on a targeted, collaborative strategy for land acquisition, such as the Tully Mountain Private Forest Lands Initiative in the North Quabbin Region of Massachusetts. This type of initiative would require a cost estimate for obtaining or protecting all of the highest connectivity value lands as well as a source of funding to meet this estimate.

To this end, the Eno-New Hope Landscape Conservation Group has the exciting potential to go beyond a short-term collaboration to create a formal, lasting partnership, similar to the Regional Conservation Partnerships found in New England. Like New England, North Carolina's Triangle area has a rich history and culture of conservation on which to capitalize on through large-scale collaboration, not to mention the academic resources of Duke University and UNC-Chapel Hill. A formal partnership with a strategic plan for land protection could also open the door for additional funding opportunities.

The project also needs a plan for long-term monitoring and stewardship of the habitat-corridor network. To measure the success of the project over time with respect to the goal of wildlife connectivity, wildlife movement must be tracked in order to determine if species are successfully using the protected corridors to move between habitat patches. This need for monitoring presents an opportunity to incorporate widespread community engagement in the project through citizen science and environmental education.

While the core value of this project is wildlife connectivity, there is such a wealth of co-benefits to humans of habitat integrity that there is an opportunity to broaden the project's goals and reach out to a much wider set of stakeholders, working with people whose voices are not typically heard in conservation. A more holistic community conservation approach is particularly important for this area of North Carolina, which does not have a strong history of working with minority communities in

conservation. For example, conservation easements continue to be biased towards long-term ownership, a preference that tends to exclude minority landowners.

A critical way to expand public support and extend the benefits of conservation to more members of the community, is to emphasize sustainable uses of some areas of land as assets rather than as preserves blocked off from human use. For instance, Orange and Chatham counties have large areas of high quality farmland threatened by high development pressure. North Carolina is a leading state in farmland loss. There is a great deal of overlap between this quality farmland and the habitat-corridor network identified by the Plan in the northern part of the project area, including large areas of farmland surrounding and buffering the network. This overlap presents a unique opportunity to permanently protect these working lands for the benefit of both underserved communities and wildlife as part of a community conservation approach.

Finally, it has been stated that one of the most important lessons learned from the Yellowstone to Yukon project, perhaps the largest landscape-scale initiative on the continent, is that it is crucial to establish or strengthen a regional identity through words and ideas that resonate. In order for the Eno-New Hope Landscape Conservation Plan to be truly effective, it needs a widespread base of public support across the project area. This goal for a more public-facing campaign to generate funding for land acquisition could be accomplished through the establishment of a trail that spans the two watersheds and follows the habitat-corridor network through its north-south backbone from Jordan Lake to Falls Lake. Alternatively, it could be effective to select particular species that are tied to the regional identity of the project area to use as the face of the initiative.

The Eno-New Hope Landscape Conservation Plan is the first of its kind to examine wildlife habitat connectivity in these watersheds on a landscape scale, and it's GIS corridor analysis and recommendations based on the planning review are a strong foundation for future conservation planning. However, there is a great deal of untapped potential for this collaboration of organizations to continue their work as a formal partnership, building on what they have accomplished to develop a strategic plan to protect the priority lands they have identified and steward those lands for generations to come.

References

Clary, M. 2011. *Voices of North Carolina Agriculture: Current Issues and Innovations in Farmland Preservation* . Duke University Nicholas School of the Environment. https://pdfs.semanticscholar.org/4d1c/cd06dee5cbc341af4120ad388378e013163b.pdf

Conservation Corridor. 2020. *Corridor Concerns* . Connectivity Conservation Specialist Group. https://conservationcorridor.org/corridor-concerns/

Shaw, R and H. Reed. July 20, 2020. Personal interview.

Tuttle, J., Massa, B., Munzer, O., Shaw, R., Childs, S., and J. Randall. 2019. *A Landscape Plan for Wildlife Habitat Connectivity in the Eno River and New Hope Creek Watersheds, North Carolina.* North Carolina Botanical Garden Foundation. https://ncbg.unc.edu/files/2019/12/EnoNewHopePlan_December_2019.pdf

OSCAR PSYCHAS is passionate about empowering young people to connect with nature, take environmental action alongside diverse community groups, and speak up for the future of our home places and the planet – the focus of his essay here. An environmental studies and geography major at Middlebury College, Oscar grew up in Gainesville, Florida and Accra, Ghana. He walked 280 miles from his house to Florida's state capital to support land conservation funding. Oscar co-founded WildMidd, a club that brings together Middlebury students with K-12 youth and local conservationists to lead local conservation and environmental education projects. With Jacob Freedman and ALPINE he founded the Wild Hometown Movement to start, support, and connect place-based, youth-centered environmental groups in communities around the world (see our website or our ALPINE page). The Wild Hometown Movement has founded 7 active youth groups in New England and Florida. This summer he is working as an intern with ALPINE to kickstart this movement in campuses across New England.

Partnering Under Resourced Youth with Ecosystem Resilience Efforts (PURYERE)

Summary:

This partnership will bring together the energy of young people and the expertise of conservation organizations to advance the restoration and climate resilience of Western Massachusetts forests. The program will work across environmental justice communities to engage K-12 students in internships, clubs, and summer programs that advance climate resilience in local forests and waterways. With the support of the Wild Hometown Movement, these programs will also connect young people with experiences in nature that foster personal development and emotional resilience, mentor them to understand the value of forestry work, and inspire them towards lifelong conservation leadership that will be crucial to sustaining the future of Western Massachusetts forests.

Report:

The rapidly escalating impacts of climate change present a severe threat to the continued ability of Western Massachusetts forests to sustain biodiversity as well as critical human needs such as water supply, timber, and recreation. Increased periods of droughts and extreme heat are expected to increase stress and die-offs in in tree species, and precipitate forest fires, which are historically extremely rare. More intense storms and floods will increase soil erosion and treefall. These stresses will make forests more vulnerable to pest species that are expected to migrate further north and upslope, such as the Emerald Ash Borer. While changes in forest composition are inevitable, the immeasurable ecosystem services of these forests can be preserved if resources are invested in science-based land management practices that promote resistance and resilience to ecological changes. This project would cater towards the unique needs of the Western Massachusetts region, which compared to the Eastern portion of the state is largely rural, characterized by large and less fragmented forested landscapes, and has historically been underinvested in. This project will address the following LSR Goals:

- Reduce the risk of uncharacteristic wildfires.
- Improve fish and wildlife habitats, including for threatened and endangered species.
- Maintain or improve water quality and watershed function.
- Mitigate invasive species, insect infestation, and disease.
- Improve important forest ecosystems.

However, the current pace and scope of ongoing and future management efforts is seriously limited by (1) a lack of human power and financial resources (2)a lack of collaboration between and within the

public and private sector and (3)a concerning disengagement of the larger population, particularly young people, from local forests and land stewardship efforts, particularly from the environmental justice communities that suffer the most climate risk and could potentially greatly benefit from leading such efforts.

This project will accelerate the pace of forest-based climate resilience efforts in Western Massachusetts forces through an innovative model that addresses these three needs in concert. The program will start and sustain initiatives in at least 6 towns that engage local young people in clubs, internships, and summer programs that address pressing management needs in town forests. Internship cohorts and summer or after school programs will be implemented by a host institution in each town including land trusts, Parks and Recreation departments, and youth empowerment organizations.

By creating a workforce of hundreds of young people working in town forests in key forested landscapes across Western Massachusetts, this project will enable a systematic expansion of critical forest management efforts not met by current initiatives. As seen in the measurable outcomes narrative, these projects are built around core climate resilience needs for local forests, including the removal of invasive species, adding forest debris, tree planting along waterway buffers, and the creation of erosion control barriers. A parallel goal of these youth crews will be expanding local access to town forests for recreation, particularly in environmental justice communities. Field projects in this category include trail clearing, adding signage and interpretative features. This initiative also seeks to educate students on the value of forests for recreation, health and climate resiliency.

This project is unique for enabling rich, multi-sector partnerships on a local and regional level that will enabling lasting collaboration towards climate resilient forests and communities engaged with forest stewardship. The Department of Conservation and Recreation (DCR) is in an ideal position to start these initiatives on a regional level given its statewide reach, existing collaborations with local partners, understanding of management goals, and managing of 250,000 acres of land. Each community would include the following partners:

- An actor who will introduce the initiative to local institutions to set up the initial partnerships: in most cases, this will be a Terracorps member and a staff member of the WHM hired specifically for this project. These actors will also ensure that the programs support and include student exploration, creativity, and leadership in line with the Wild Hometown Movement's goals.
- An organization that will provide a link for young people to local conservation projects. In some cases, this will be an implementing partner with a track record of king with local youth such as Greenagers and the Eagle Eye Institute. In other case, local organizations such as land trusts will be assisted to create such a space.
- Local institutions of higher education (see following sections)
- K-12 youth that participate initially through paid internships, classwork, and summer programs. Once an organization is established, they will be supported to lead year-round clubs
- Partners with an existing track record of working with Diverse groups of young people. The organization Eagle Eye will train college student mentors and implementing partners in working with these youth in a culturally sensitive way that allows respectful collaborations in context of local inequities and differences.
- Town forests, which have management needs alongside the advantage of being in many towns in western Massachusetts, would be the highest priority for management efforts. Youth groups would be convened by a combination of existing youth empowerment nonprofits and direct collaborations with academic institutions.

PURYERE is in partnership with the Wild Hometown Movement (WHM), an organization that works to start and grow a network of youth organizations that empower young people as lifelong environmental stewards and changemakers in their local communities. In particular, the project will center the WHM's innovative model of partnering local higher education institutions to support efforts by local youth. This movement has built a model with a successful track record across diverse communities that engages college students to forge connections with the natural areas and local community members while mentoring local youth and furthering local conservation goals. Deep involvement from college students as mentors and co-learners will support K-12 students because they can relate to their experiences as young people, and tap into the know-how and research capabilities of academic institutions. College students will form clubs that will work over the academic year to support the K-12 students and advance specific conservation projects, and also serve as interns and summer program counselors.

These college students will receive training in environmental education from the Wild Hometown Movement, along with the Eagle Eye Institute's environmental justice training. Crucially, this project will focus on young people from "environmental justice communities"—from low income backgrounds, racial or ethnic minority groups, youth that experience language isolation, or combinations of the three. With these criteria in mind, the project is built around 9 local partnerships in towns with significant environmental justice communities, each one centered in every region of Western Massachusetts. Research demonstrates that nature and environmental activities have significant and longlasting benefits on mental health, academic and career achievement, and positive community engagement. Youth from environmental justice communities can gain from engaging in nature-related activities and environmental efforts. These young people are often those most excluded from such activities due to systemic problems such as underinvestment, a shortage of paid early-career opportunities, and conservation groups that have had a history of excluding the interests and participation of these communities.

These programs will also instill a powerful appreciation of the role of forests, training and inspiring students to lead action that protects the future of the natural resources of their community. In one study, 80% of conservationists surveyed list youthful experiences in nature as central to their careers. However, these experiences are becoming increasingly rare for young people: the average American child is reported to spend 7 hours a day on screens and only 4-7 minutes in unstructured outdoor play. Without investing significant time, mentorship, and education to support the next generation of environmental and forestry professionals, the entire collective effort to protect and restore forests into the future is at risk. The Wild Hometown Movement has created a model that prioritizes not only using young people as assistants to existing work, but also supports them to be active leaders that direct these initiatives. The WHM's model will also support participating students to become lifelong environmental leaders through prioritizing close engagement with nature, mentorships with college students and community partners.

This project is grounded in measurable on-the-ground outcomes for advancing the climate resilience of Western Massachusetts forests, while also creating profound co-benefits for the vitality and health of conservation efforts and communities in these communities. This project represents an unprecedented investment in the ability of Western Massachusetts forests to adapt and thrive to the changing environmental conditions of the 21st century, grounded in proven methods for engaging the immeasurable energy, creativity, and of young people now and far into the future.

DANIEL SHERMAN is a rising senior at Harvard College. While concentrating in Biomedical Engineering, Daniel has long been interested in natural methods of combating climate change. Hailing from the urban center of Boston, Massachusetts, he has seen firsthand the rapid pace of urban development's consumption of forests and wetlands. This summer, he worked with the Harvard Forest to study carbon offsets and carbon credit markets as they pertain to expanding land conservation for the purpose of natural carbon sequestration, which he considers here. In his free time, he likes watching movies, playing piano, screenwriting, and photographing plants.

Land Conservation Potential in Communities in Massachusetts at High Risk of Development

Introduction

To find a specific location within Massachusetts that could benefit most immediately from a large-landscape level conservation initiative, those municipalities in Massachusetts with the highest rate of development were first identified. Out of 351 municipalities, the top 20 from highest rate to lowest rate (2012-2017) are as follows: Uxbridge, Ayer, Carver, Kingston, Plympton, Littleton, Plymouth, Shirley, Wareham, Holliston, Plainville, Dracut, Ashland, Hopkinton, Bellingham, Middleboro, Rochester, Shrewsbury, Marshfield, Norfolk.[1] Next identified were all those municipalities which are already designated as Municipal Vulnerability Preparedness (MVP) communities, and thus, have an established structure for seeking state funds to support green infrastructure projects. There are 158 Designated MVPs (FY17-FY18).[2] Plotting both groups above on maps and overlaying these two maps reveal that of the 20 most rapidly developing municipalities, 7 are also designated MVP communities, and 4 are adjacent to one another: Kingston, Carver, Wareham, and Rochester (see Figures 1-3 in Appendix 1 to this report).

Carver is bordered on the west by Middleboro (also spelled Middleborough) and on the east by Plymouth. Notable in Middleboro is the Rocky Gutter Wildlife Management Area, a protected 2,954-acre area. Located in Plymouth are the Myles Standish State Forest, a 12,029-acre protected area, and the Tidmarsh Wildlife Sanctuary, a 481-acre protected area. Meanwhile, the four towns of interest in this report do not have any conserved parcels of comparable size. Indeed, Kingston, Carver, Wareham, and Rochester only have 13.7%, 11.4%, 16.3%, and 21.7% of their total areas conserved respectively (see Figures 4, 14).[1] Meanwhile, BioMap2, which assigns priority value to specific 'critical natural landscapes,' crisscrosses through these towns over areas with no legal protection from development (see Figure 5). This report aims to investigate the nature of the stakeholders in these towns – the landowners and existing conservation groups as a means to develop a conservation action plan. This report also aims to explore the capacity for MVP programs in these 'under threat' communities to incorporate land conservation, vis-à-vis increased landscape interconnectivity, as a form of "green infrastructure" under the rationale that conserved land is often a more cost effective solution to climate mitigation, stormwater retention, water quality, and temperature moderation than otherwise engineered fixes.

Stakeholders

A parcel-level analysis was conducted to determine the nature of the land's subdivision, fragmentation, and development in the four towns (see Figures 6, 7). This analysis was taken further to uncover who exactly are the stakeholders (individuals, companies, land trusts, the municipality, the state, etc.) that own the largest parcels of land, and thus represent potentially dominating forces in affecting land use policies and decisions. Kingston, Carver, Wareham, and Rochester have 93.48%, 88.34%, 95.95%, and

76.63% respectively of their parcels amounting to less than 5 acres, indicating extreme breakup of the land (see Figures 8, 9). This is a systemic problem for conservation work throughout Massachusetts, but the potential for still un-conserved land is there. When viewed as a total percent of land per town, the sum of those <5 acre parcels equates to 36.95%, 18.65%, 29.07%, and 16.50% respectively. And as a percentage of the currently open and/or natural landscape, 79.20%, 86.29%, 77.62%, and 75.33% respectively remain un-conserved.

In analyzing the specific landowners (see Figure 10), certain patterns emerged. For example, the town of Kingston logically is the largest owner of land in Kingston. The second largest is a religious group, the Congregation of the Sisters of Divine Providence, which owns 400 acres of mostly forestland surrounded by small parcels of conserved land, but which is itself not conserved. With respect to Carver, however, the town is only the third largest landowner within itself – the first being A.D. Makepeace Company, a cranberry producer. Most of the top 20 landowners in Carver are cranberry growers. A.D. Makepeace is also the largest landowner in Wareham; although, a comparison of conservation owners with all landowners reveals that about 10% of their Wareham property is under easement. This allocation may signal that the company is amenable to conservation.

Image A. Sand excavation from neighboring hill for cranberry cultivation. Cranberry bog (foreground).

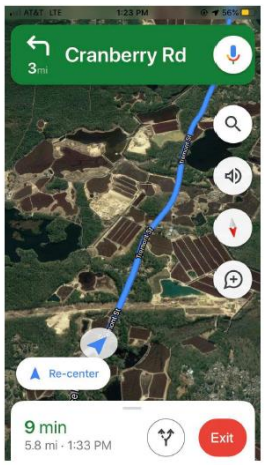


Image B. High density of cranberry production in Carver.

This same analysis was applied to conservation landowners to paint a picture of who the potential allies are (see Figures 13a, 13b). These landowners are both stakeholders in the communities and in the ideology of preservation and restoration. For the four towns, the largest protectors of land are either the town itself or the state government via the Department of Conservation and Recreation (DCR) and the Department of Fish and Game (DFG). Private land trusts that also hold significant acreage include Mass Audubon and the Wildlands Trust.

Another locally important player is the Southeastern Massachusetts Pine Barrens Alliance (SEMPA). Important funding sources and partners include the USDA's Natural Resource Conservation Service (NRCS) (at the federal level), the Massachusetts Department of Eco- Restoration (DER) (at the state level), and the Executive Office of Energy and Environmental Affairs (EOEEA) (at the state level).

Methods of Conservation: MVP and others

One of the reasons these four communities were chosen for this report was their designation as MVP communities (or in the case of Rochester, part of a regional partnership). The MVP program is a fairly recent addition to the portfolio of conservation finance resources in the state of Massachusetts, but its principal goal is to fiscally support communities that want to build green infrastructure or effectuate other methods of resilience as the impacts of climate change are realized in the coming years. Between MVP planning grants and MVP action grants, the benefit of a community already being 'designated' is its eligibility for action grants, which themselves are further subdivided into (1) Nature-based Solutions for Ecological and Public Health, and (2) Resilient Redesigns and Retrofits for Critical Facilities and Infrastructure. The MVP program has received $75M in funding from Governor Charlie Baker's 2018 Environmental Bond (worth a total of $2.4B).[3] Thus, the MVP is a novel, currently underutilized tool that should be mobilized in any conservation strategy in the state, but especially in regions such as these four towns with rapidly expanding housing and industrial development. Expansion of directly connected

impervious areas (DCIA) vis-à-vis concrete and asphalt will prevent stormwater drainage. Development of buildings with tarred rooftops and black highways will exacerbate (sub)urban heat islands. Removal of natural landscapes, which filter water and control nutrient runoff, will force currently unrealized financial burdens on towns as they are compelled to construct and operate new water treatment facilities. Simply conserving natural, green spaces is often a cost-effective way of ameliorating all these issues, which is the heart of why the MVP program's flow of money to conservation efforts needs augmentation.

Other potent sources of funding and/or legal support include, but are not limited to:

Mechanism	Explanation/Details
EOEEA	Via Conservation Partnership Program, Local Acquisitions for Natural Diversity (LAND) Program, Parkland Acquisitions and Renovations for Communities (PARC)
DFG's DER	Focuses on wetland restoration, stream flow restoration, and urban stream revitalization
USDA's NRCS	Via Healthy Forest Reserve Program (HRFP)
Community Preservation Act (CPA)	State wide fund financed through surcharges on property tax in adopting communities
Conservation Restrictions (CRs)	Saves money compared to a fee simple model and actually provides legal protection in perpetuity while preserving original ownership
2018 State Bond	$2.4B environmental bond
Chapter 61	Right of First Refusal for towns
Article 97	Protects in perpetuity land acquired by an EOEEA agency, such as the DCR or DFG, whether in fee or by CR
Land and Water Conservation Fund	Will be fully and permanently funded by the Great Outdoors Act of 2020, about to be signed by President Trump
Community Forests	Incentivizes forest preservation through easements that allow for sustainable yield harvesting or town ownership that monetizes tourism
Land Banks	Reinvests a percentage fee on real estate transfers into land acquisition
Carbon Credits	Perhaps: Via Afforestation/Reforestation credits for restoring cranberry bogs; or via Avoid Conversion credits for CRs with proven additionality
Ballot Measures	Tie water Quality and land conservation together in a referendum that would issue a bond to acquire land for water quality protection
US Fish & Wildlife Service (USFWS)	Via National Coastal Wetlands Conservation Grant Program (NCWCGP)
Endangered Species Act	Can Brute Force Endangered-species-motivated conservation (takes at least 1.5 years to get though USFWS)

Next Steps

Image C. Tidmarsh Wildlife Sanctuary

This area of Massachusetts is in the midst of an economic transition. Golf courses and cranberry bogs occupy large swaths of land in the target area, and yet both industries are in decline. Both are also prolific users of pesticides. The Tidmarsh Wildlife Sanctuary was a cranberry bog originally, and when the Schulman Family retired that enterprise, they were approached by housing developers. Instead, the Schulman Family chose a naturally restorative future for the 481 acres, which are now owned in fee by the Massachusetts Audubon Society and for which the Town of Plymouth also holds a conservation restriction (CR). Reciprocally, Mass Audubon holds a CR on the Foothills Preserve, 130 acres contiguous with Tidmarsh and owned in fee by the Town of Plymouth itself. Tidmarsh represents a working model for restoring previously cultivated land as well as generating societal value. The site has had over 35,000 visitors this year. The site has partnerships with the MIT Media lab to conduct sensor-based scientific research, and Tidmarsh's next steps include setting up an educational program for youth and working with local high schools on collaborative science projects. Already over 12 collegiate researchers are working with this land.

The cranberry industry in Massachusetts is in the midst of a transition. Since the early 1800s, Massachusetts has been synonymous with cranberry farming, but over the last 25 years, out of state bogs have surpassed Massachusetts output. Wisconsin, in 2016, was forecasted to produce 5.8 million barrels and Canada (mainly through Quebec), 2.6 million barrels. Massachusetts fell third with only 2.1 million barrels. Also, while 93% of the cranberries in Wisconsin are grown with a new hardier, plumper variety, only 50% of Massachusetts bogs have similarly converted.[5] This transition is a major opportunity for Massachusetts conservationists, for whom easing or acquiring this land should be of paramount importance before it is converted into malls, housing, roads, and other developments.

Economic cycles have a precedent for capitalization by conservationists. In 1988, the real estate market in Massachusetts was softening and by 1993, it had bottomed out. Boston Properties, one owner of real estate in the Walden Woods of Concord, Massachusetts, had spent over $8 million dollars in the land's acquisition, design fees, and public improvements. By 1993, the land was sold off for $3.5 million after the aggressive campaign of Don Henley, whose discovery of development plans for Thoreau's abode was completely by a chance watching of a CNN broadcast. The moral of this story rests with the power of media pressure, but more fundamentally with the power of economic downturns forcing distress on companies otherwise able to outspend or outlast a conservation effort.

The essence of this story can be emulated in this report's proposal not only to seek out cranberry bog farms, but also to seek out a collectively 1600-acre series of contiguous parcels owned by the Entergy Nuclear Generation Company. This land is in Plymouth, it is right next to the coast, and is at a higher elevation than the adjacent landscape. It is just north of the Tidmarsh Sanctuary, and, as of now, only 7 acres of it are conserved– a site called Cleft Rock Park.

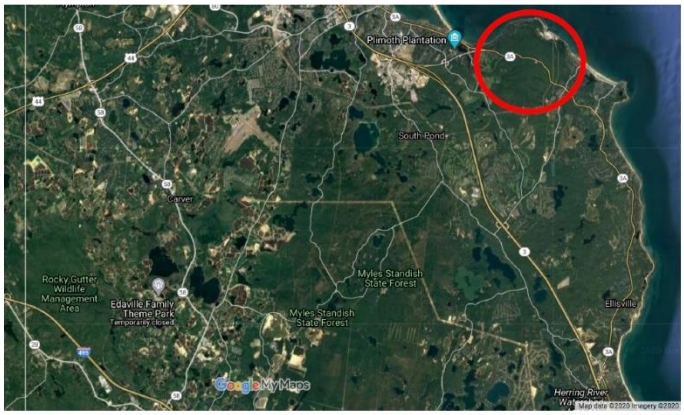


Image D. Entergy Nuclear Generation Company's land circled in red.

Entergy Corporation is a Louisiana based energy company, and its Nuclear subdivision currently operates in 6 states. The Pilgrim Nuclear Power Station was shut down on May 31, 2019 and sold to Holtec Decommissioning International.[7] The 1600 acres of forest around the decommissioning plant is undeveloped and uninterrupted save for two public water supply stations. As Entergy has relinquished its operations in Plymouth, acquiring CRs as soon as possible (through Mass Audubon, the Town of Plymouth, or a local land trust) would be the principal recommendation of this report. As it is surrounded by littoral and inland housing, it is logical to assume it is under imminent threat of development.

The overarching mission for conservation in the four towns of interest, as well as the contiguous towns of Plymouth and Middleboro, should be to connect Rocky Gutter with Myles Standish and Tidmarsh. Prioritization in a conservation action plan should be placed on the intersection of these connecting lands, BioMap2 priority critical natural landscapes (see Figure 15), and most affordable parcels per unit acre (see Figures 11, 12). The collective 15,500 acres of Rocky Gutter, Myles Standish and Tidmarsh, if connected with a few thousand more acres between their properties, could create a continuous 20,000+ acre large landscape with wide ranging environmental, social, and societal benefits.

Figures are available in the appendix of this report.

References:

1 Massachusetts Audubon Society. *Losing Ground: Nature's Value.* Massachusetts Audubon Society. 2020.

2 https://www.mass.gov/doc/municipal-designation-status/download

3 Governor's Press Office. "Governor Baker Signs Legislation Directing $2.4 Billion to Climate Change Adaptation, Environmental Protection, and Community Investments." Mass.gov. 2018.

4 L. Kras, personal communication, July 24, 2020

5 Salsberg, Bob. "Massachusetts Cranberry Bogs Are In Crisis, Growers Say" *The Associated Press.* 2016.

6 Canellos, Peter. "Publisher Sells His Walden Project Stake." *The Washington Post*. 1991.

7 Entergy Corporation. "Nuclear Fact Sheet." 2020.

Data:

The underlying datapoints of the following GIS maps, made publicly available through the Environmental Systems Research Institute's ArcGIS, were used in the generation of this report's images, graphs, and quantitative analysis:

• MassEOEEA. "NHESP BioMap2 Critical Natural Landscapes." Updated 2017.

• MassEOEEA. "Protected OpenSpace and outdoor recreation in Massachusetts, the best available data as of January 22, 2020." Updated 2020.

• MassGIS. "Assessor parcels for Massachusetts, as a feature service hosted at ArcGIS Online." Updated 2020.*

• MassGIS. "BioMap2 Critical Natural Landscape Components." Updated 2017.

All images and figures were created or generated by Daniel Sherman.

*Note: the parcel level data does not include ponds, highways, and a few tracts of unidentified land.

TAYLOR WYCOFF grew up in Brattleboro, Vermont, but is currently moving to Northampton, MA. In 2019, she graduated from Greenfield Community College with a degree in Environmental Conservation and in the fall, she will be transferring to UMass Amherst as a junior majoring in Natural Resource Conservation. Her first internship was with SPARCnet, a collaborative research effort of the eastern red-backed salamander under USGS Amphibian Research & Monitoring Initiative, which is her focus in the essay that follows. In 2018, she worked as a reviewer for the Vernon and Bellows Falls, VT fish ladders. Since May 2019, she has been working at the USGS Patuxent Wildlife Research Center in Turners Falls, MA. Their projects include SPARCnet, vernal pool surveying, newt mark/recapture to monitor the spread of chytrid, as well as the sampling of stream salamanders and mudpuppies in various areas of MA. Her goals are to get involved in a project that works with issues in sustainability and climate change. Her favorite activities are rock climbing, hiking, and swimming.

Land Management Strategies: Saving the Shenandoah Salamander and Beyond

Shenandoah National Park has a 300 year history which includes times of prosperity and riches, as well as times of discrimination and turmoil. The Northern Virginian park was established on December 26th, 1935, an idea created by Harry F. Byrd, a former governor of Virginia and leader of the democratic party of Virginia for forty years. Franklin Delano Roosevelt officially opened the park July 3rd, 1936, and the Civilian Conservation Corps (CCC) began building roads and recreational facilities. In pre-colonial times, there were thought to be many Native American tribes in the Shenandoah Valley, including the Catawbas, Shawnee, Delaware, Cherokees, and the Susquehannocks. The most widespread was the Siouans and the Iroquois. Settlers in the early 1600s came to change their way of living. In the 1700s, most of Shenandoah National Park was agricultural and logging land, and the tribes were eventually pushed out west. As time went on, approximately 450 settling families were living and making their livelihood in the Shenandoah Valley. When the Commonwealth of Virginia took over and deemed the land for public use, those families who had privately owned 1088 tracts were forced out and relocated in areas surrounding the park. Eventually, the land was given to the federal government and thus made it into the National Park system. The CCC then created the 105 mile road through the park known as Skyline Drive, recreation areas with campsites, cabins, and comfort areas. The long history of oppression, removal, and discrimination did not stop there.

There was also trouble, of course, with racism and segregation during slavery, the Civil Rights Era, and the Jim Crow Era. People of color, especially black people, were originally not allowed in the park. SNP was considered a haven for white people that was not to be infringed upon. Eventually, segregation was legally mandated in the park, and Lewis Mountain was deemed the only place in the park for people of color. Lewis Mountain provided a very restrictive area for African-Americans, which made for a limited experience and heinously unequal treatment. During the time of the Civil Rights Act in 1945, segregation was obscurely lifted by Harold Ickes, the Secretary of the Department of Interior at that time. That meant that POC who wanted to go to the park now still didn't know if they were allowed in the park, and were not informed until they inquired the NPS about it. This was a purposeful tactic to maintain segregation and prevent POC in what were very much still considered park areas for whites only. In order to establish trust and heal the wounds of racism, the NPS has acknowledged its past, and is taking steps to educate, recognize their wrongs, and attempt to heal wounds over time. Understanding the experiences of POC is essential to making SNP a safe and inclusive place for everyone, and they will need to continue acknowledging, healing, and educating in order to work towards true diversity. Historical landmarks and stories of pioneers in social justice are planned to be implemented throughout the park so that everyone can see its racist history and their efforts towards developing a more open and positive future.

Environmental justice is just one key piece of the work National Parks do that make a difference. There are also many people who are involved in the land conservation and stewardship of SNP. Shenandoah National Park is part of the Southern Appalachian Trail, and has 500 miles of hiking trails throughout the whole park, which makes it a very popular place for recreation. Shenandoah National Park was the first to reach 1 million annual visitors, and continues to have an average annual visiting rate of about 1.4 million per year. SNP is currently facing challenges due to climate change. According to the National Parks Conservation Association, they are part of the 96% of national parks with issues of severe amounts of air pollution. There are four categories that describe climate change in the National Park system: visibility (air pollution, health (human health), nature (ecosystem health), and climate (wildfires, glacier melt, etc.) These categories are ranked from least concern to highest concern. SNP is of the highest concern in all of these categories, except for human health which is ranked as moderate. Although the park currently consists of 200,000 acres of land, of which 80,000 acres is being protected designated wilderness, there is still such a problem with overuse and pollution that people are starting to complain that the normally vast sky views are being clouded by smog.

Among the high biodiversity of the park, which includes over 50 species of mammals, several resident and migratory birds, 26 species of reptiles, 41 fish species, countless insects, and finally, a plethora of amphibians, the focus of my proposed land management strategy involves the endangered Shenandoah Salamander (*Plethodon shenandoah*) which is endemic to the high mountains of SNP. I want to heavily expand on an active project within the Patuxent Wildlife Research Center which is under the umbrella of the United States Geological Survey. According to Evan H. Campbell Grant, the head of the Research Center, our goal is to use “a structured decision-making approach to natural resource management.” which means that in order to create a system that will in fact save the Shenandoah Salamander from extinction, each stakeholder involved will have to work together to acknowledge the financial, governing, and implementation aspects of how to monitor this species. They will also have to agree that the information obtained from the monitoring will be used to manage the land and make steps to conserve land and combat climate change.

My plan is to gather experts, contractors, citizen scientists, and students in order to monitor the Shenandoah Salamander, but in a broader sense, to give them tools to advocate for and encourage land stewardship and conservation to make a cycle of decisions that benefit both the environment and it’s human and non-human inhabitants. The project would be experimental, and would start at a small scale. Since there are many different and still large sections of the park, I would start in the mid-range of the Skyline Drive in Thornton Gap. This section is home to the Hawksbill trail, which includes the highest point of the entire park. Since this is a high elevation species, starting in the middle and spreading out to monitor, educate, and provide land conservation stewardship, is likely to make the most impact.

The first year of the project would involve planning and then contacting each of the organizations and individuals involved. This is not an exhaustive list, but organizations involved would be USGS, the Patuxent Wildlife Research Center, US Fish and Wildlife, the National Park Service, the Land Trust of Virginia, SPARCnet (which includes its own suite of Educational Agencies), Virginia Dept. of Game and Inland Fisheries, the Appalachian Trail Conservancy, the University of Virginia, the Smithsonian, and multiple citizen science and environmental education centers. The leadership roles in this collaborative effort would belong to the PWRC, USGS, and SPARCnet. PWRC started the monitoring process, and therefore would need to be the ones in charge of coordinating groups and scouting students and citizen scientists. SPARCnet would also have a large leadership role because they are already a collaborative research effort and have the expertise to make decisions on how this project could be an expansion of that. The governance structure would be put in place by the National Park System and USGS, because NPS owns the public land and USGS is largely responsible for the people they sent there. The VA Land Trust and Appalachian Trail Conservancy would also have to make decisions about who will be the

coordinator for making sure the correct appointed individuals are doing the required quota of work to achieve land conservation goals.

The next step in the process would be for the Land Trust agencies to reach out to families who historically owned land in the Shenandoah Valley and work with them to create conservation easements outside of SNP. A combination of tax incentives, rights to occasional hunting and fishing in/outside of the SNP area, access to participate in the monitoring project could be used in order to encourage continued and expansive land conservation that increases the amount of protected land surrounding the National Park. The National Park would also have the responsibility to carry out their plans to make the park more historically accurate as to the history of the native american ownership of the land, and give the same privileges to them the right to hunt (where permitted out of the park) and fish in perpetuity. Also give them an opportunity to be a part of the monitoring project, along with giving land reparations to indigenous tribes who first settled in the valley. Similarly, they would have to participate in some sort of reparations to African-American communities in the SNP area, the rights to hunting and fishing, an opportunity to work on the monitoring project, and transparency and education of its racist history.

The monitoring project of the Shenandoah Salamander is already in place by USGS and PWRC, and therefore would be taught to groups of volunteers and interns along with the history of Shenandoah National Park and the basics of land conservation. By learning how to do a monitoring project with a species that is relatively easy to work with, while also learning stewardship and leadership skills, these individuals will have tools to be leaders and spread their knowledge into new projects and organizations. The monitoring project would consist of 24 people: 6 groups of 4 who would have a range of skill sets. One would be a wildlife biologist, one would be a student contractor, another a citizen scientist, and lastly a junior/senior year high schooler or a college student would be put together and begin working on various sites of which some are already mapped. They would stay at available research cabins in SNP and would stay for up to 3 weeks to finish monitoring all of the sites. The findings would then be compiled into figures and models by USGS which would then be available to governmental agencies and for students and researchers who want to work on similar projects. Once the first group of researchers finishes their survey, there will be a meeting to discuss the changes that need to be implemented and ways to make the experience more valuable.

As complicated as this project may be, it encompasses an important range of goals that can be achieved. The monitoring portion of the project is essential because it provides the data and education for the people with less experience, and it creates a collaborative experience that benefits a very large and diverse group of people. The people in the monitoring group would be inclusive and would actively seek low-income communities, the communities in the area which were affected by racism and abuse of indigenous peoples, and students who want to be involved in land conservation. The land trusts would have a say in recommendations for monitoring positions, and would benefit from being able to recruit students to work for them. The government agencies would have access to an important database and have references for a more diverse group to work on future projects. Lastly, citizen scientists and the collaboration as a whole would provide a sense of community and be able to band together to reach a multitude of goals with a group of people who share the same interests.

Appendix 1: Figures for Daniel Sherman's essay

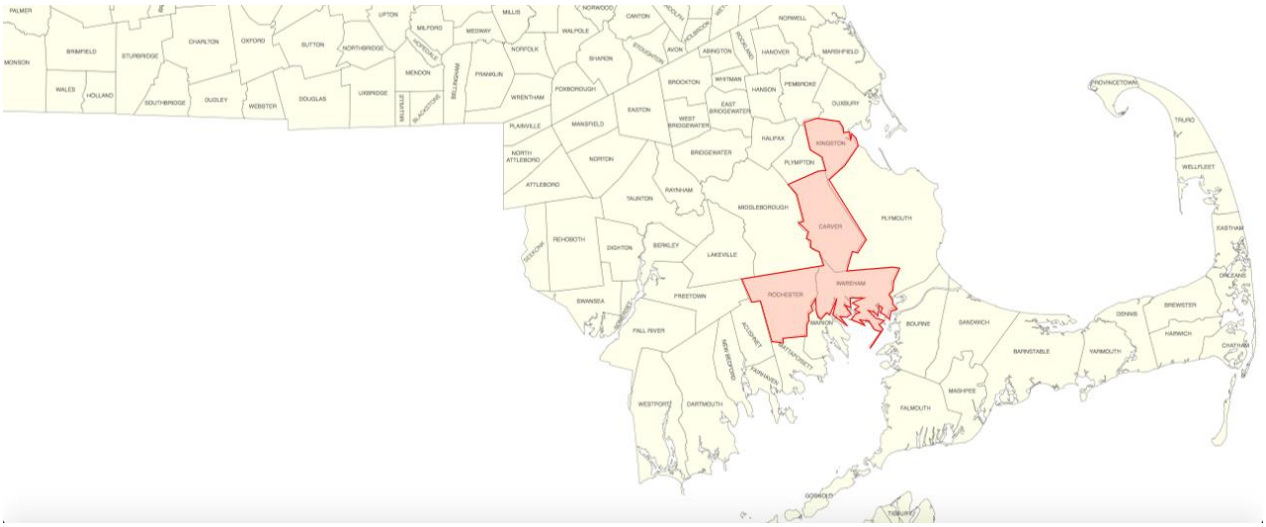


Figure 1. The towns of Kingston, Carver, Wareham, and Rochester.

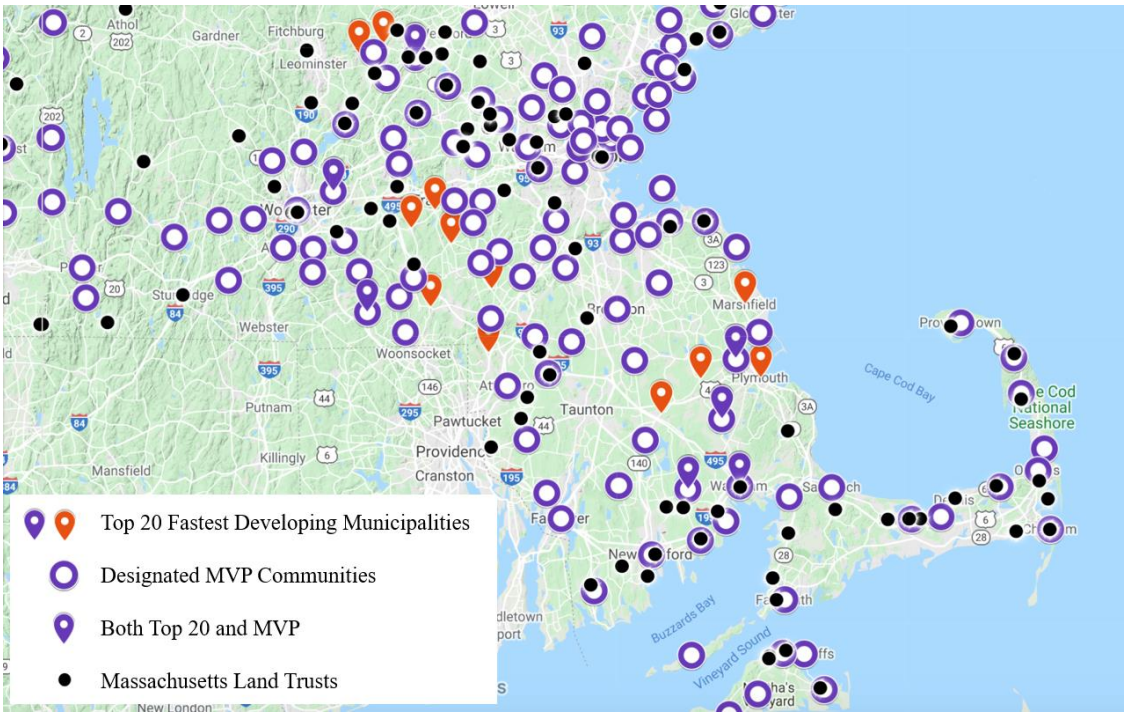


Figure 2. The distribution of the top 20 fastest developing communities in Massachusetts (source: Massachusetts Audubon Society); all designated MVP communities, a total of 158 (some not shown due to cropping) (source: Massachusetts EOEEA), the cross-referenced overlap of these two maps, and all Massachusetts land trusts (source: Massachusetts Land Trust Coalition). Note that of the seven purple pin icons, four are contiguous and are the communities identified in Figure 1. Also note that the black dots, identifying Massachusetts Land Trusts, were placed by the town name or address associated with the land trust, not necessarily its full geographic reach.

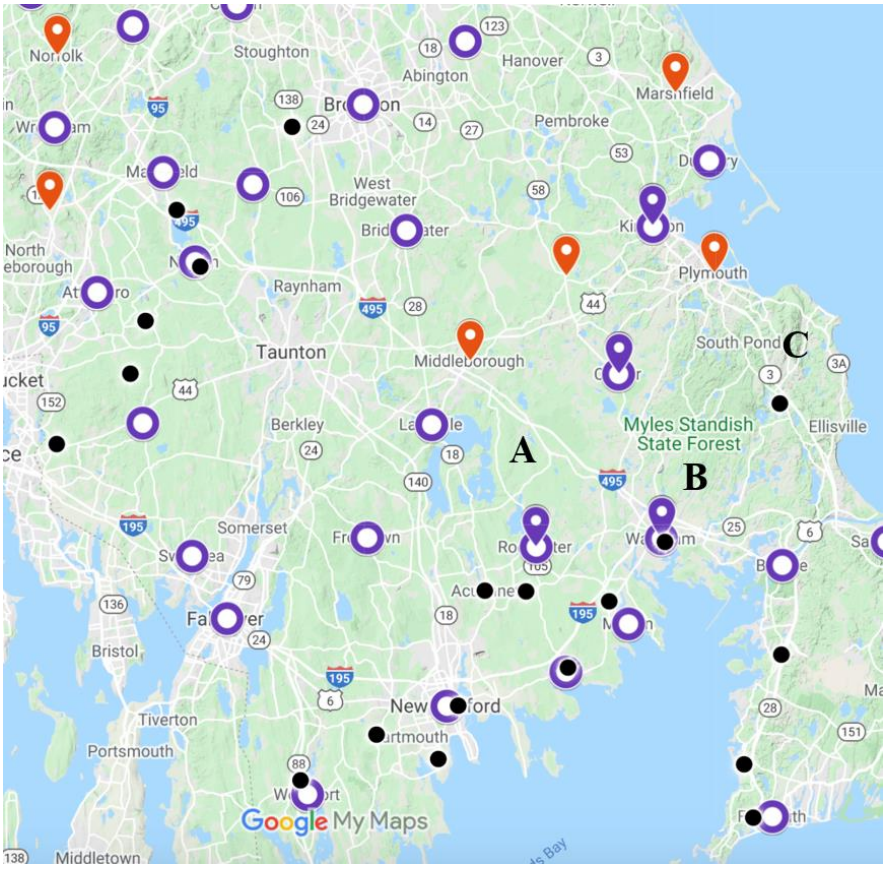


Figure 3. An enlargement of the area of interest from Figure 2. **A** = Rocky Gutter WMA. **B** = Myles Standish State Forest. **C** = Tidmarsh Wildlife Sanctuary.

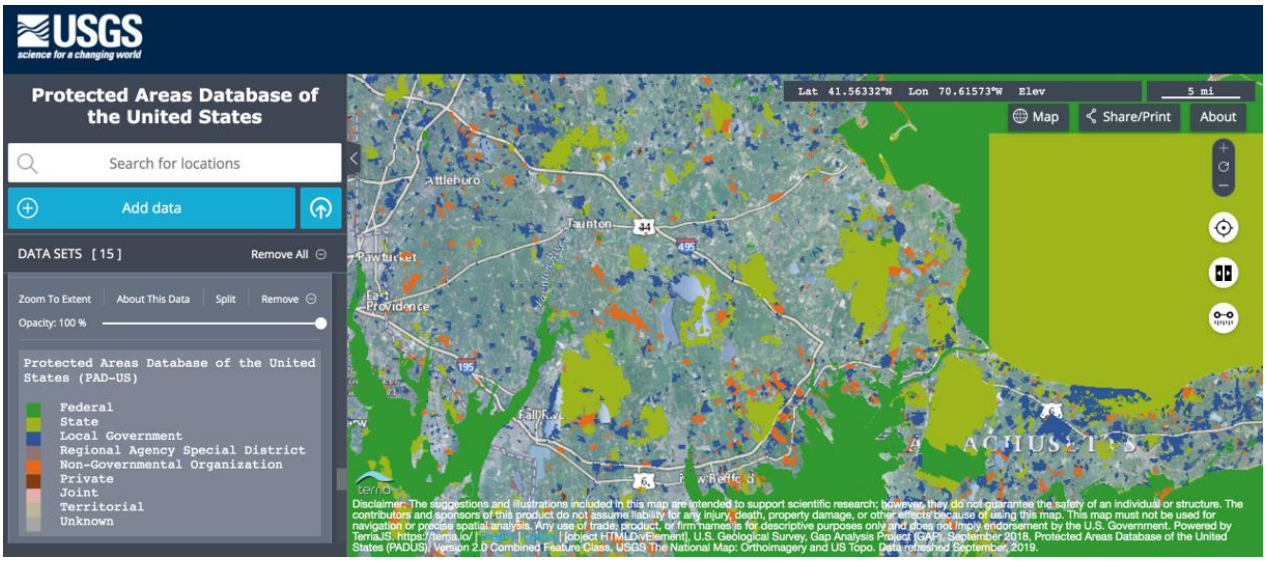


Figure 4. A breakdown of legally protected land in the area of interest by ownership class (source: USGS PAD). There remains significant space between the larger parcels of State protected land, which if conserved, would provide valuable corridors for wildlife as well as greater landscape interconnectivity. To demonstrate this strategy's efficacy in climate resiliency could accelerate state funding of easement creation and fee-based acquisitions.

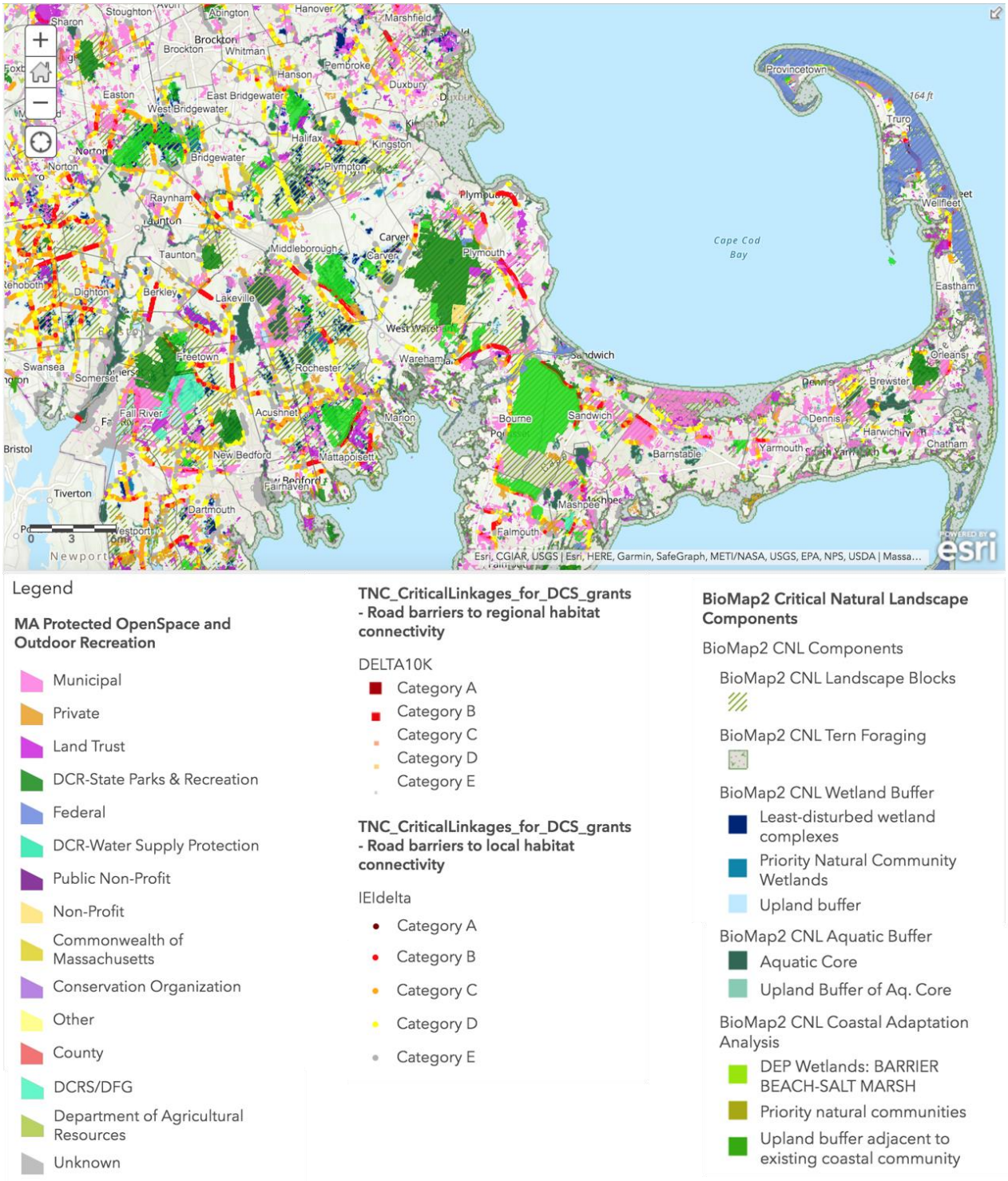


Figure 5. An overlay of currently protected lands (source: Massachusetts EOEEA), roads of particular significance in blocking wildlife movements (source: The Nature Conservancy Critical Linkages Projects I and II), and critical natural landscape regions (source: MassGIS). Created using ESRI's ArcGIS online platform, this map highlights both the significant work to be done permanently protecting the lands connecting large state conserved lands (Myles Standish and Rocky Gutter) and that much of this land is considered priority value for ecological reasons.

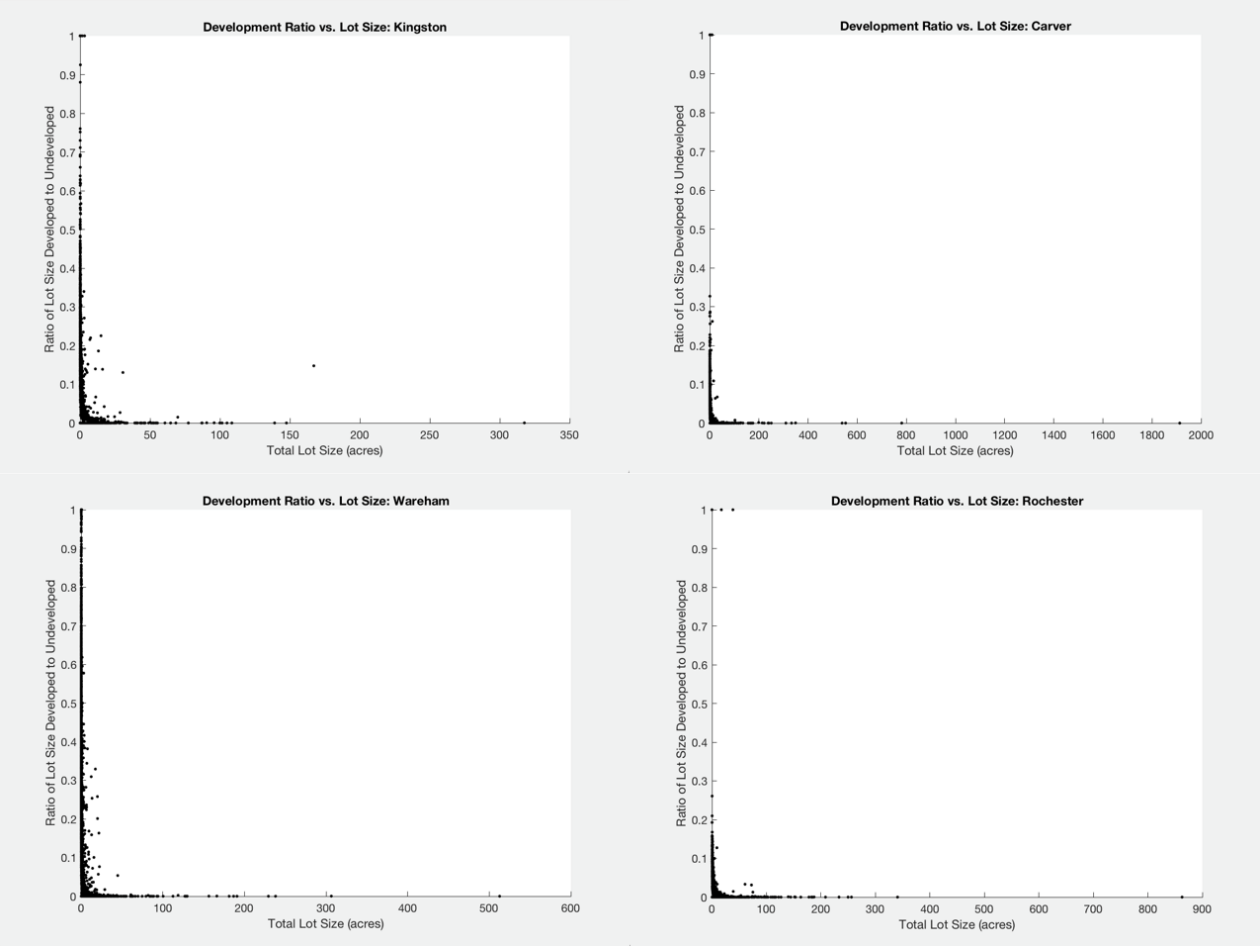


Figure 6. A comparison of the development ratio (i.e. the percentage of a parcel that is built upon versus open) versus the overall lot size of the parcel for all parcels in Kingston, Carver, Wareham, and Rochester each. It is clear from these scatterplots that Wareham has many more parcels, on which there is significant development, than the three other towns. This is consistent with Wareham's geography, which has a high perimeter to area ratio along the coast, and thus hosts a lot of tightknit developments along the water. Conversely, Rochester parcels appear to not have much development beyond 20% of their overall acreage.

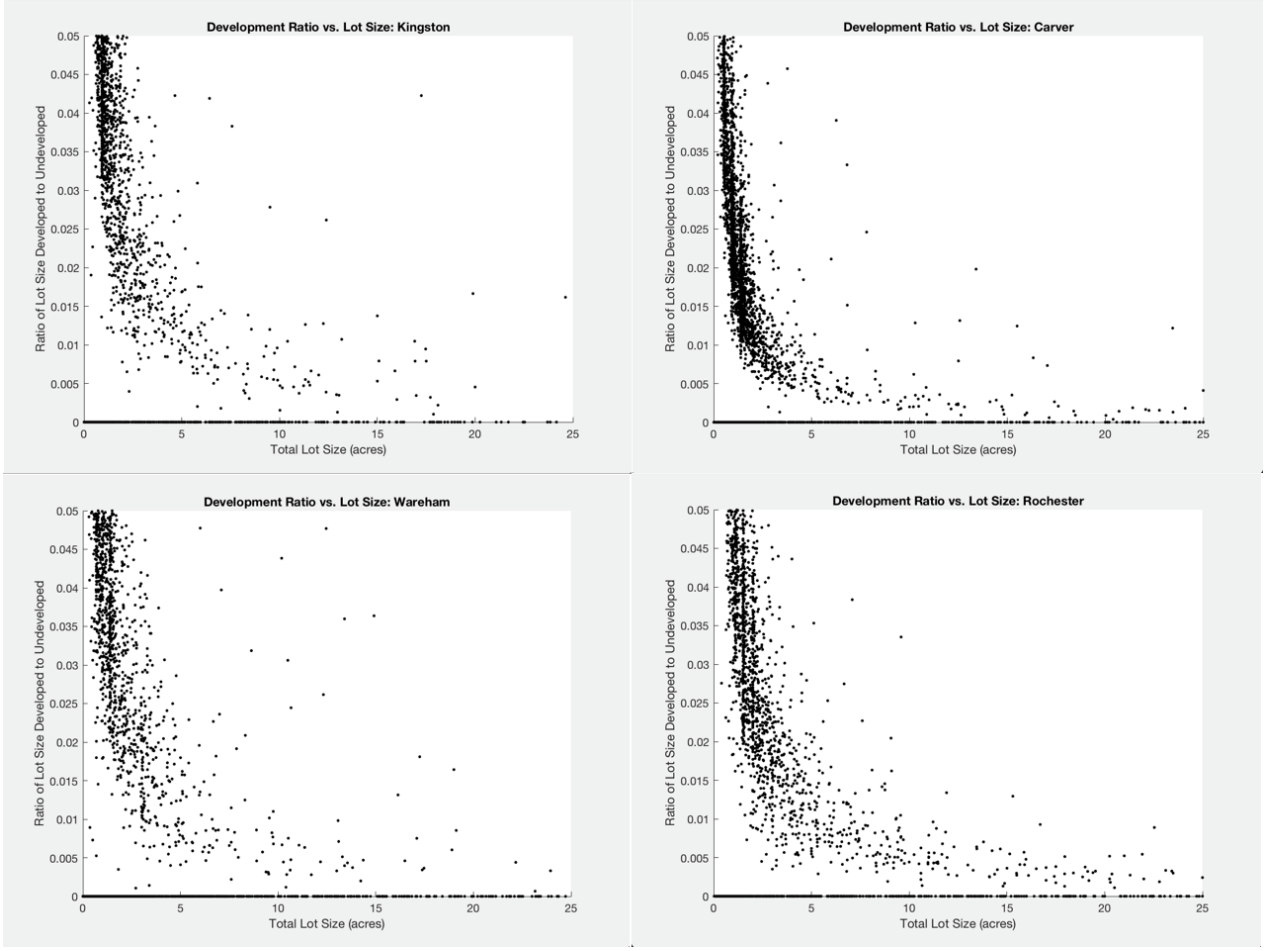


Figure 7. A duplication of Figure 6 scatterplots, but here zoomed in to no more than a 5% development ratio and 25 acres in lot size. The y-axis zoom is the sweet spot for conservation as there will not be a preponderance of development on the parcels. Since this report is focusing on large potentiality, refer to Figure 6 to see the concentration of parcels greater than 25 acres, which will also be the sweet spots for conservation efforts. Figure 10 deals with who the largest land owners are.

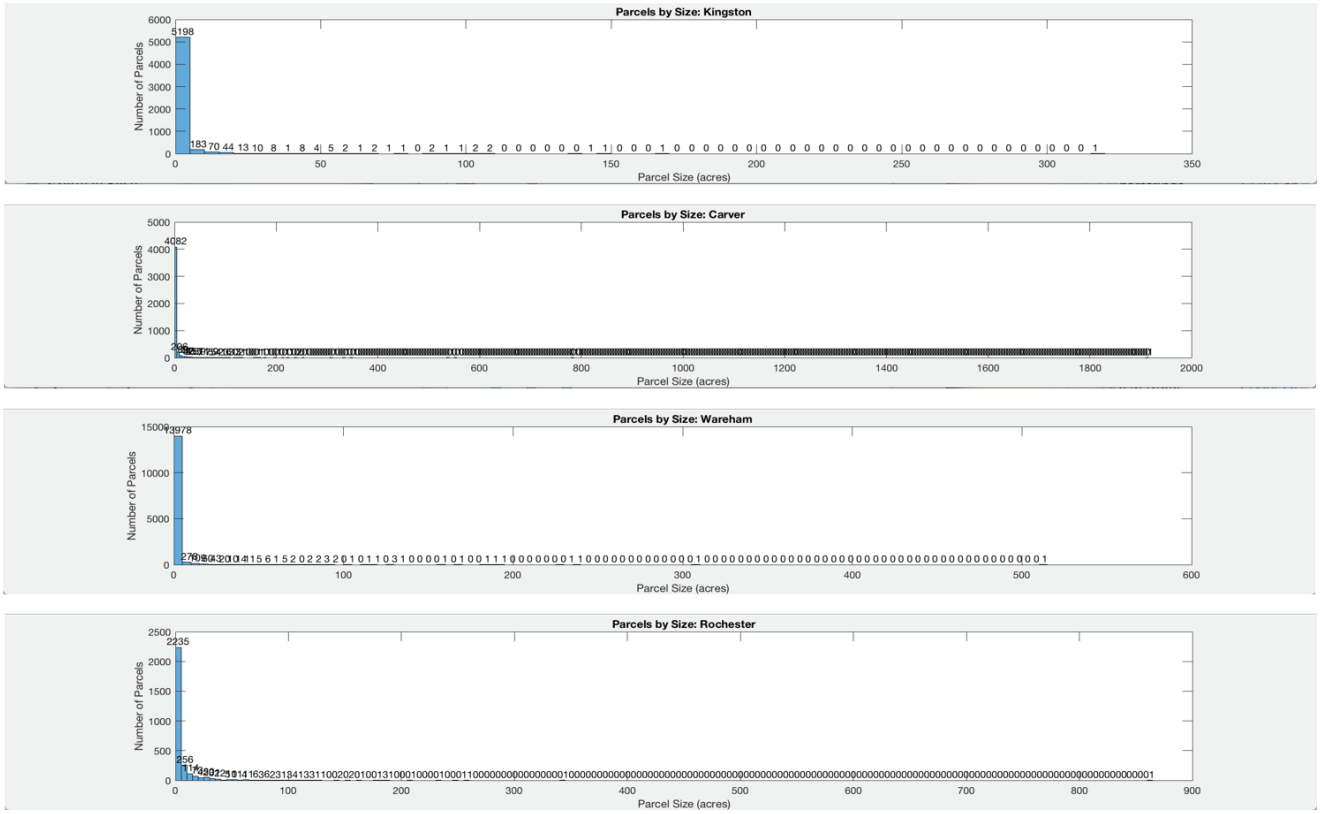


Figure 8. Histogram plots of number of parcels by lot size. These show the extreme parcelization in these four towns with the vast majority of properties being under 5 acres. Bin size is 5 acres. Note that y-axis scale changes in each plot.

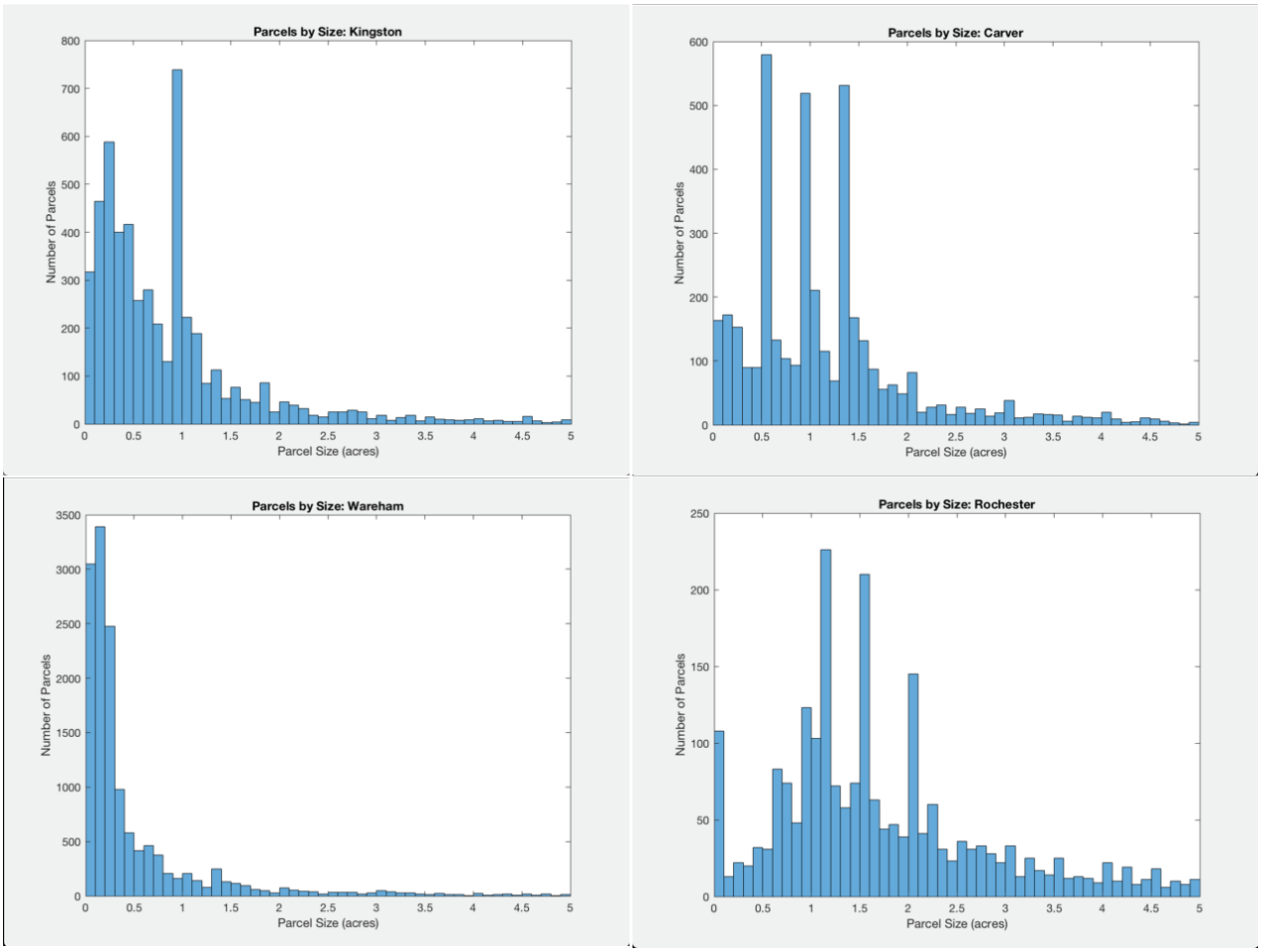


Figure 9. A duplication of Figure 8 histograms, but here zoomed in to no more than a 5 acres in lot size, for reader's benefit. These graphs portray the very steep decline in number of properties, as seen in Figure 8, actually occurs around 2-3 acres in size for all four towns. Bin size is 0.1 acres. Note that y-axis scale changes in each plot.

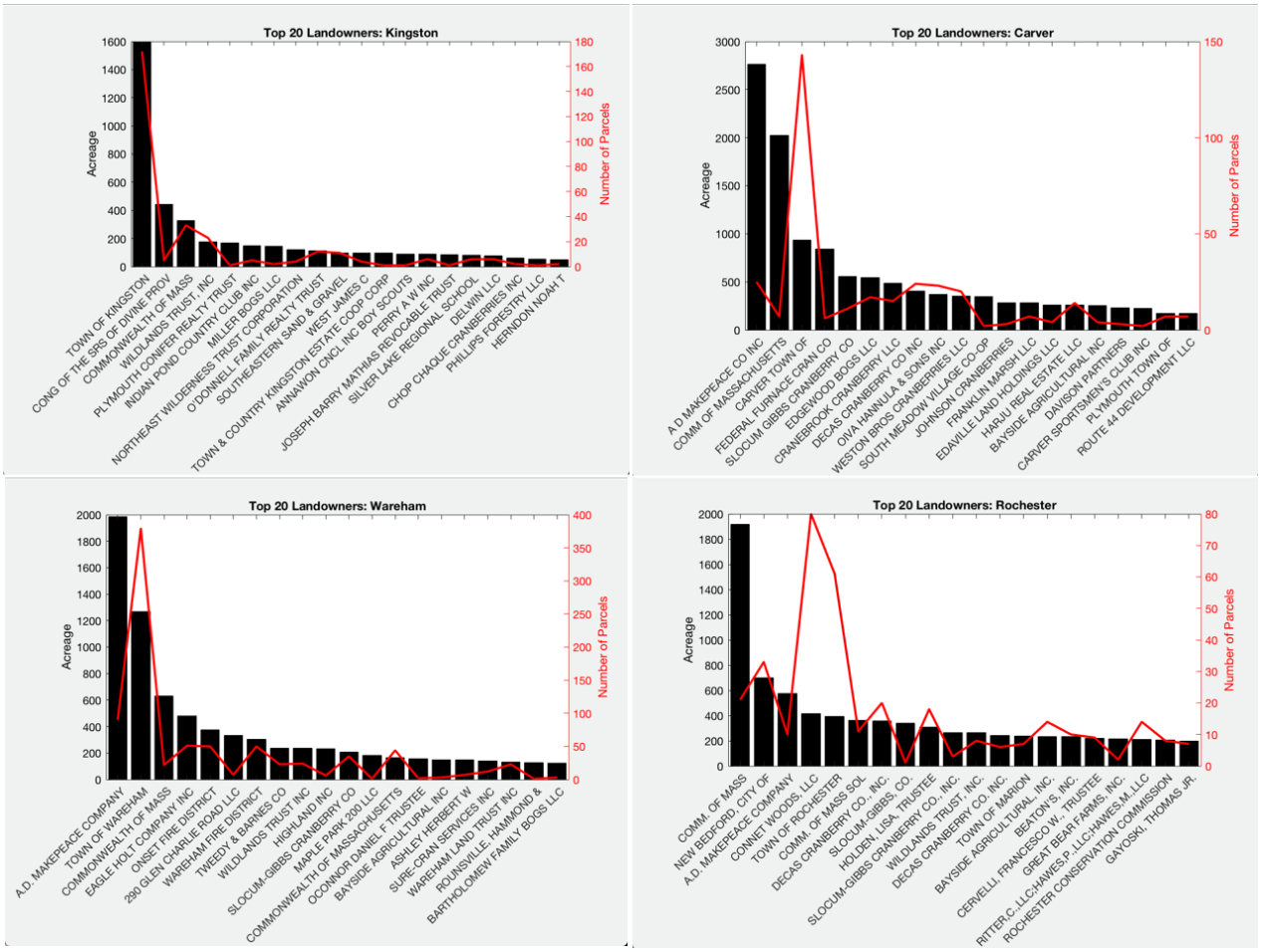


Figure 10. Charts of the top 20 landowning entities in each town by acreage, shown in descending order of acres owned. The red line indicates the number of parcels, between which their ownerships are split. The red line is a casual illustration of the degree to which landowners control contiguous blocks of land versus sporadically owned blocks. Combining these two datapoints not only reveals who the biggest stakeholders in the towns are, but also how useful they would be to explore for large, connected landscape conservation purposes.

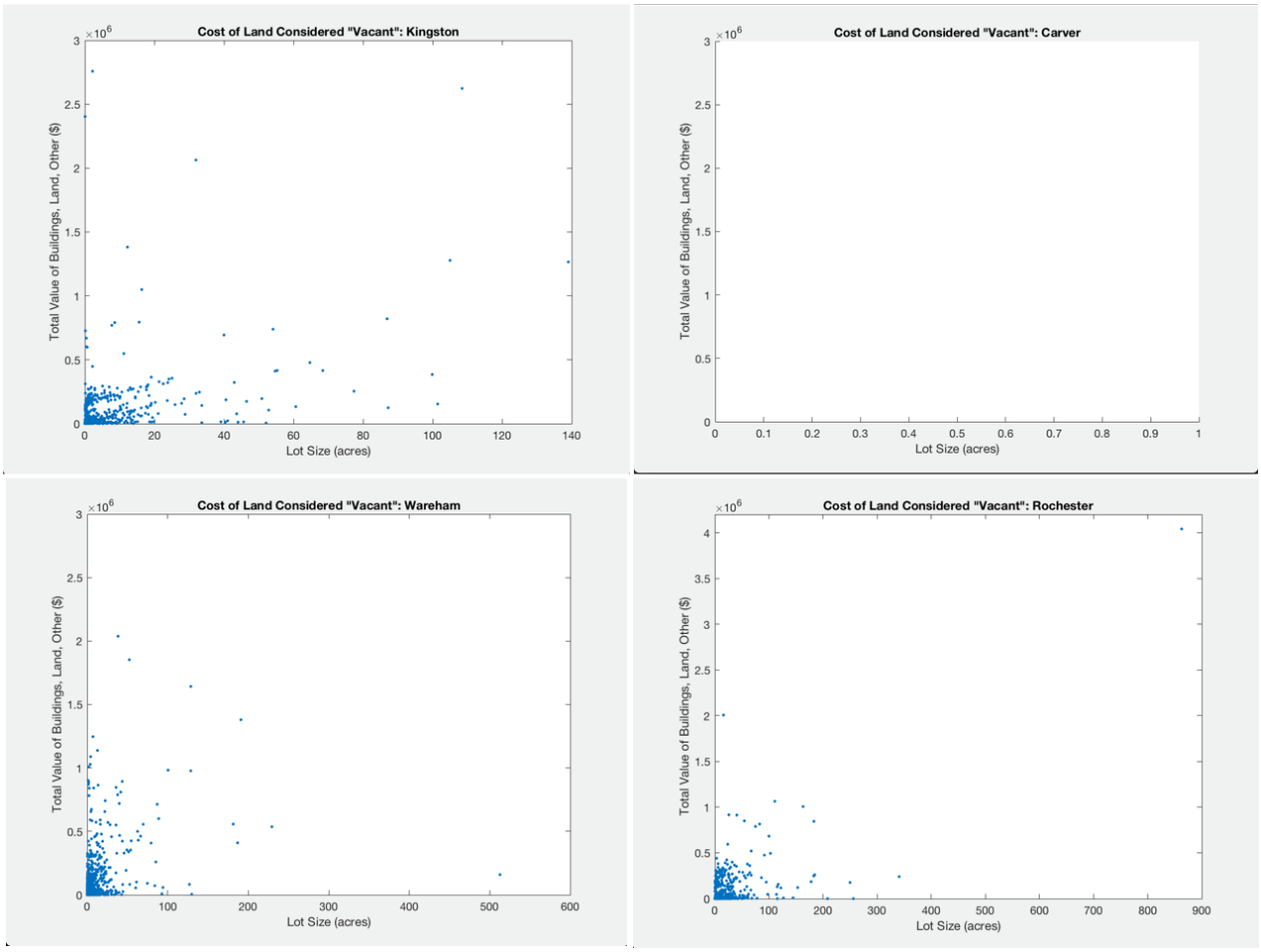


Figure 11. Distributions of the cost of parcels, designated as "Vacant Land" by MassGIS Assessor Parcels dataset, versus total acreage. Conservation should focus on datapoints as close to the x-axis as possible and as far right along it as possible. The dataset did not list any "Vacant Land" designations in Carver, and so that remains blank. Note x-axis scale is not uniform for each plot.

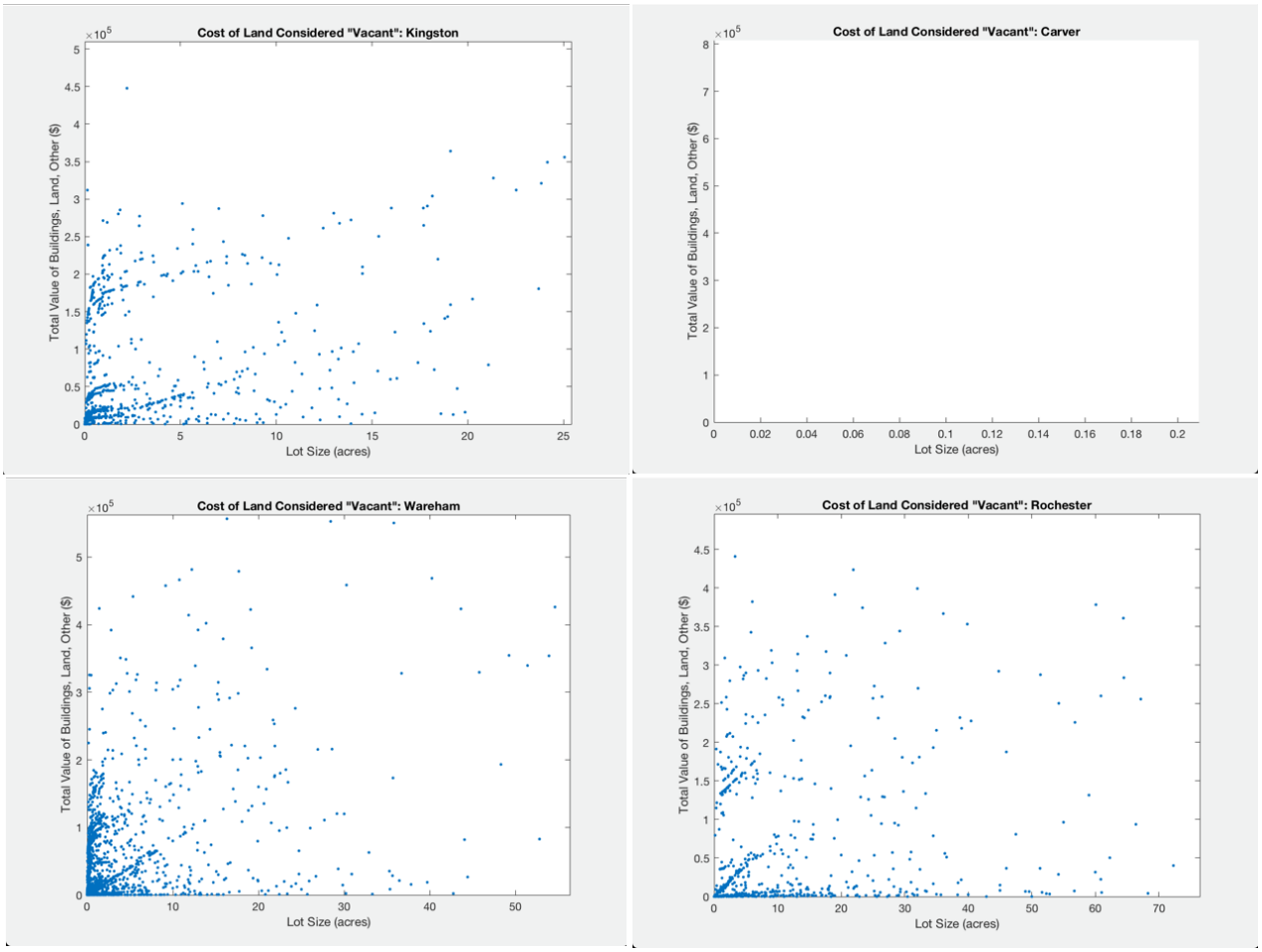


Figure 12. A duplication of Figure 11 scatterplots, but here zoomed in for reader's benefit.

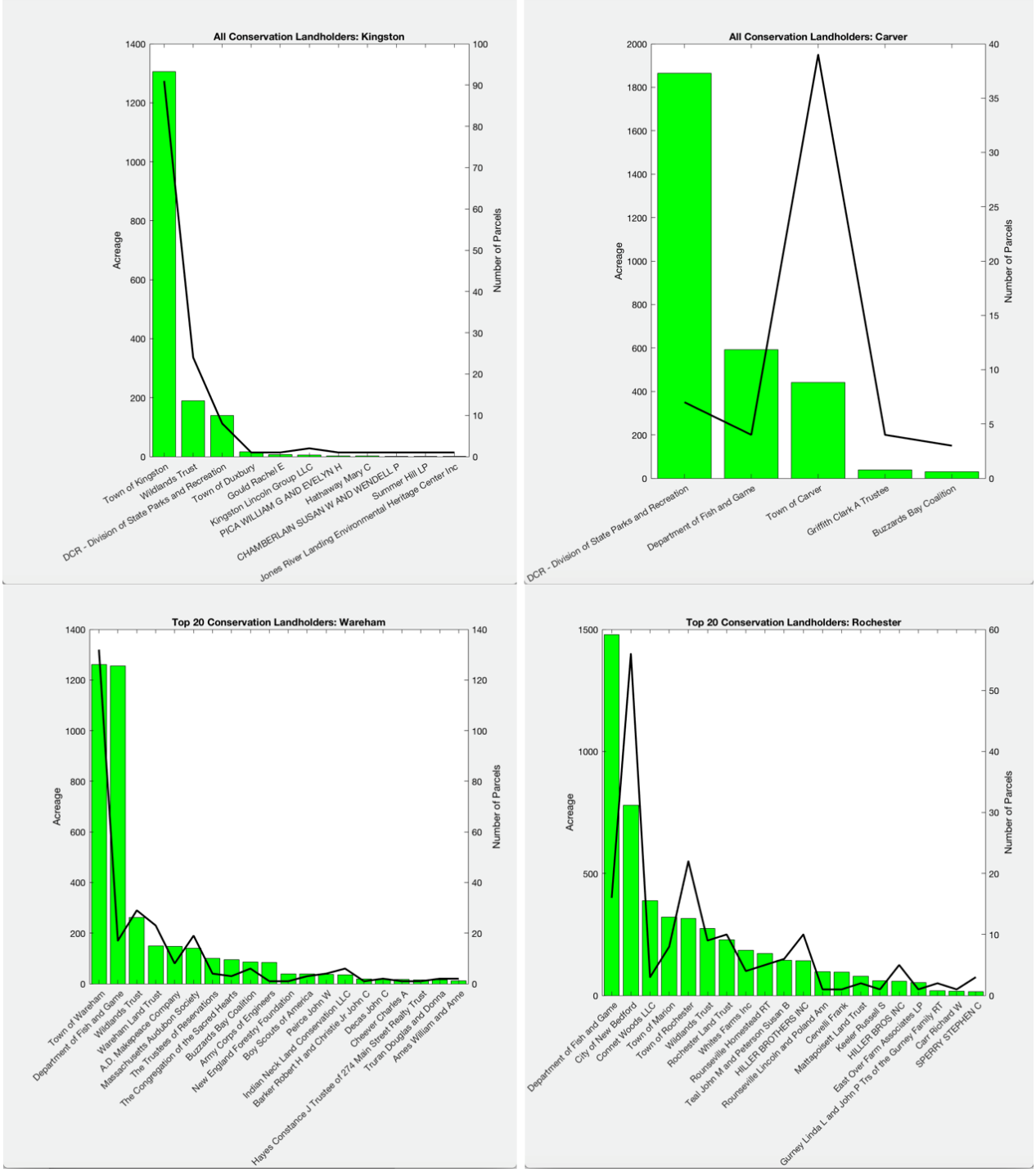


Figure 13a. Charts of the top 20 owners (or all owners if under 20) of conservation land in each town by acreage, shown in descending order of acres owned. The black line indicates the number of parcels, between which their ownerships are split. The black line is a casual illustration of the degree to which landowners control contiguous blocks of land versus sporadically owned blocks. Combining these two datapoints not only reveals who the biggest conservation stakeholders in the towns are, but who owns the most contiguous plots that new conservation work should attempt to connect.

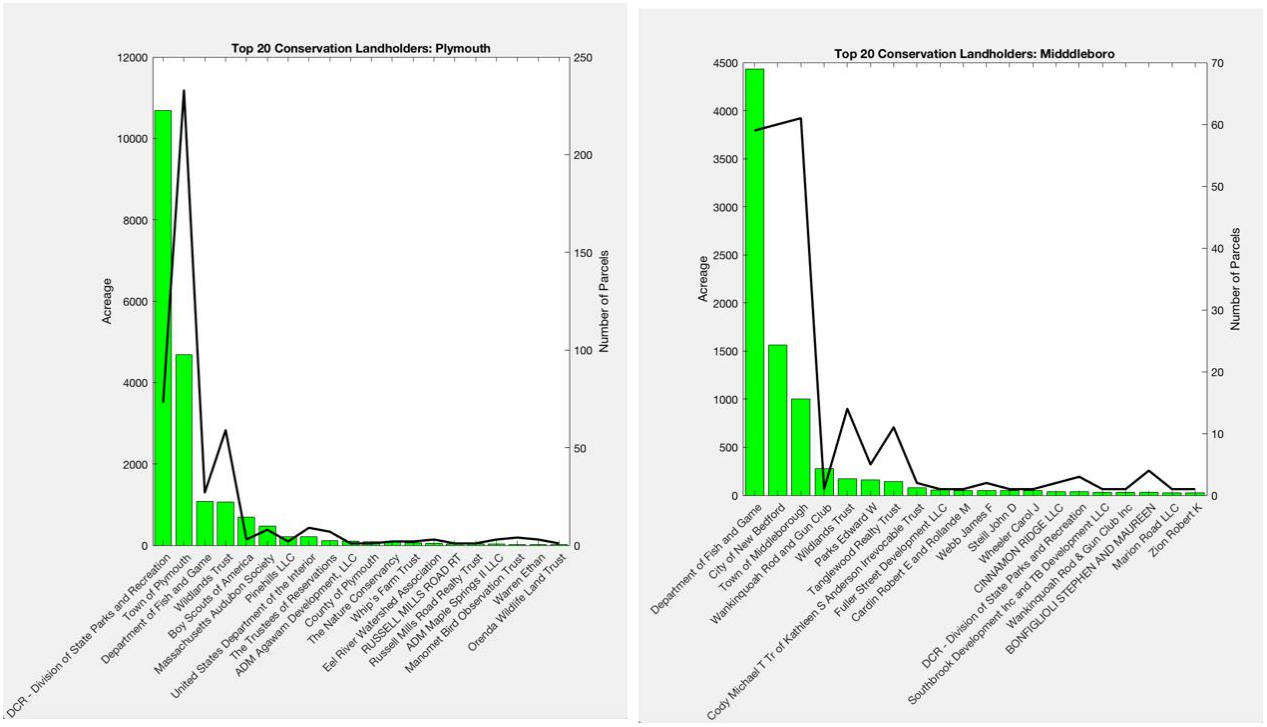


Figure 13b. Charts of the top 20 owners of conservation land in the towns of Plymouth and Middleboro respectively by acreage, shown in descending order of acres owned. The black line indicates the number of parcels, between which their ownerships are split. The analysis seen in Figure 13a was applied to Plymouth and Middleboro as these are the towns with the conservation blocks this proposal aims to connect.

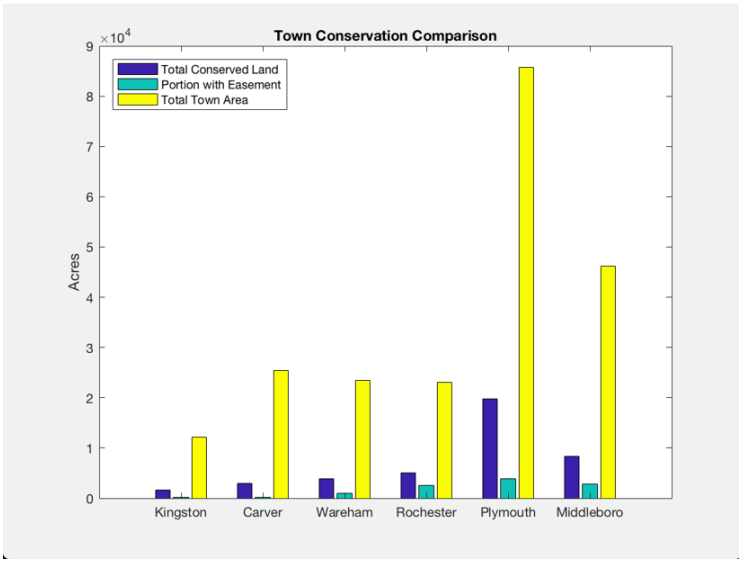


Figure 14. Cross township comparison of all conservation land by acreage, the amount of that land that has CRs on it, and the total acreage of each town. The towns of Kingston, Carver, Wareham, Rochester, Plymouth, and Middleboro have 13.7%, 11.4%, 16.3%, 21.7%, 30.2%, and 17.8% of their total areas conserved, respectively.

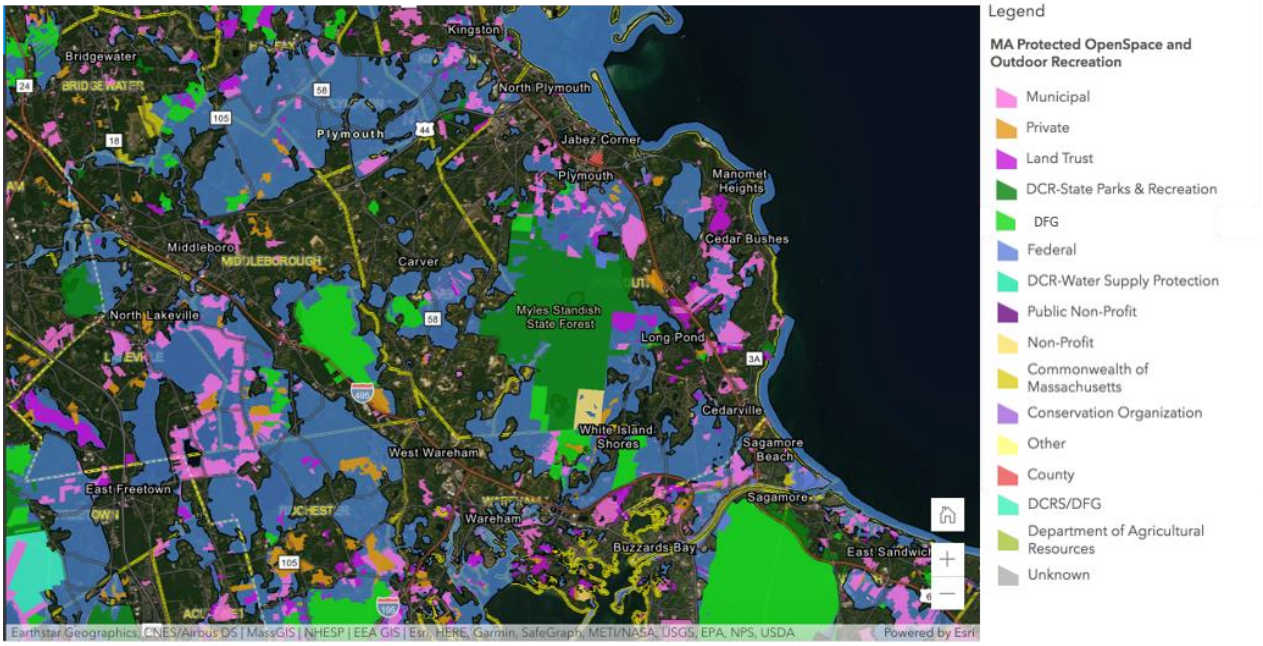


Figure 15. An overlay of currently protected lands (source: Massachusetts EOEEA) and BioMap 2 critical natural landscape regions (source: MassGIS). Created using ESRI's ArcGIS online platform, this map provides a geographical understanding of where priority should be placed. Strips of blue BioMap2 plots that connect Myles Standish and Rocky Gutter are of particular importance.