SUBURBAN WILDS

2023 Project Update – Year 2

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Selection of pictures from wildlife cameras in studied towns

Goals and Scope

The goal of this report is to provide an update to municipalities, organizations, and individuals participating in the Suburban Wilds research project—a multi-year interdisciplinary project that explores the social and environmental dynamics of white-tailed deer (*Odocoileus virginianus*) and other wildlife in suburban and urban communities in the states of Massachusetts (MA) and New York (NY). This report is intended to provide an update on our social and ecological research progress, describing key research activities completed or currently underway and discussing significant findings and results to date. The data and figures presented in this report are preliminary and should be understood as an initial look into the data and an update on the progress of the project thus far. Interpretation of these early results may change as the project continues and we accumulate and analyze more data.

Social Science Research Update

The social science team has continued to conduct research activities examining the social dimensions of deer management at state and municipal levels across MA and NY.

Municipal Deer Surveys

We completed analysis of data from the survey conducted in 2017 across all municipalities of MA, which examined town-level concerns about deer, managers' perceptions of residents' concern about deer, perceived changes in local deer populations, frequencies of resident complaints about deer, and information about local hunting-related bylaws. Using this data, as well as analysis of documents related to municipal deer management programs, our team has completed two manuscripts for peer-reviewed scientific journals. The first, entitled "Perceptions, concerns, and management of white-tailed deer among municipal officials," was published in 2021 in *Human Dimensions of Wildlife* (Edelblutte et al. 2021). In this manuscript, we examine variation in municipal-level concerns about deer and policies related to deer management across MA municipalities (see abstract, below). The second manuscript, which is currently in revision after an initial peer review from the target journal, combines this survey data on deer concern and management actions with socio-economic and land-use/land cover data. In this manuscript, we examine whether and how deer management varies across social and environmental characteristics and identify which characteristics drive municipal action towards deer management (Edelblutte et al. in review; see abstract below). We are also continuing to analyze data from a similar municipal survey conducted in 2019 in NY.

Hunter Surveys

To gain a better understanding of hunter decision-making and the role of hunters in deer population dynamics, we collaborated with MassWildlife to survey hunters about the 2022 hunting season in MA, complementing similar efforts conducted in previous years. We also developed and administered a survey to hunters licensed in NY about the 2022 hunting season. These surveys were used to gather information about deer harvest, hunter effort, location and access to hunting sites, and hunter satisfaction. Data collection is ongoing; we anticipate conducting data analysis and sharing results in 2024.

In-depth Interviews and Community Peer Review

We continued to conduct in-depth interviews with key actors engaged with discussions about deer management in MA. Between June 2022 and June 2023, we conducted six additional interviews in our MA case study towns. These new interviews complement 26 interviews and focus groups conducted earlier in the project. While prior interviews were mainly with municipal officials and town residents involved in municipal discussions about deer management, our recent interviews have focused on the experiences of staff members at state agencies and nonprofit organizations who are involved in deer management at a regional level, and thus offer insight into the goals and challenges of regional management and networks of information sharing across municipalities.

We conducted analysis of the qualitative data from our interview dataset, using NVivo software to iteratively code interview transcripts for key themes and concepts. Interview data was used to develop a draft manuscript examining how environmental policies spread across different communities. In this manuscript, we draw on the case study of suburban deer management in MA to discuss the role of deer and other nonhumans in processes of development of environmental management policies, and the mobility and transfer of those policies from place to place (Casellas Connors et al., in review; see abstract below). This manuscript is currently under consideration for publication in a peer-reviewed academic journal.

We used interview data to develop a draft manuscript addressing the debate over deer management in one focal town in MA (Anderson et al., in review; see abstract below). In March 2023, we facilitated a community peer review process in this focal town. Through this process, we shared our draft manuscript with members of the community, held a public event to facilitate discussion of the manuscript, and offered an opportunity for community members to offer feedback on our interpretations of the events and dynamics in the community as represented in the manuscript. Our goals were to ensure the accuracy of our representation of perspectives held by the community and afford the opportunity to share additional insights and raise concerns about the research process and findings. Drawing on insights gained from this process, we then revised the manuscript, which has now been submitted for consideration for publication in a peer-reviewed academic journal.

Resident Survey

Our team is currently analyzing the data gathered via a survey of residents in a focal town, conducted in spring 2022. We asked residents about their experiences with deer, their concerns regarding deer, their support for various municipal deer management approaches, and their involvement in community discussions about managing deer. We are currently preparing a report that will summarize the findings of this survey, as well as conducting statistical analysis to examine correlations between responses (e.g., whether concerns about deer and/or support for management approaches differ between those who are involved in decision-making processes and those who are not). We also plan to conduct a follow-up resident survey in late 2023 or early 2024.

Social Science Results

As noted above, the social science team has developed four manuscripts describing our findings to date, with one currently published and three undergoing peer review. Below, we include the abstracts of these publications. Full text versions of all final publications from the project will be posted to our project website as they become available.

Published Results:

Perceptions, concerns, and management of white-tailed deer among municipal officials (Edelblutte et al. 2021)

Abstract: *Municipal governments are emerging as important stakeholders in managing the populations and geographic distributions of white-tailed deer (Odocoileus virginianus) in urban and suburban areas of the Northeastern United States. To understand the variation in municipal-level concerns about deer and municipal policies related to deer management, we distributed a questionnaire to all 351 municipalities across the Commonwealth of Massachusetts in 2017* *(response rate = 74%) and collected data on local bylaws that influence hunting access. We found that concerns about deer vary across the state and some municipalities are taking action to manage increasing deer populations. In particular, our analysis established the importance of deer and deer management in the suburban regions of Massachusetts, while uncovering many local differences within similar suburban areas. The varying relationships between deer populations, public concerns, and municipal actions illustrated the complex role of municipal decision makers in shaping wildlife management programs.*

Preliminary Results:

From conversation to decision: social, political, and ecological dimensions of wildlife management (Edelblutte et al., in review)

Abstract: *In urban and suburban areas, the complex socio-ecological landscapes and diverging interests of stakeholders often makes wildlife management difficult. Here, we analyze how suburban municipalities in Massachusetts make decisions about the management of white-tailed deer (Odocoileus virginianus). We ask: what concerns and conditions prompt municipalities to explore local deer management? And why do some municipalities with deer concerns take management action while others do not? Combining statistical analyses of a municipal officials survey, qualitative analysis of policy documents, and semi-structured interviews, we find that landscape features, local levels of Lyme disease, and resident concerns about Lyme disease and other deer impacts prompt municipal governments to explore options for deer management. Further, our study reveals that small-scale politics are crucial in shaping management decisions. We thus illustrate the complexity of making decisions towards wildlife in suburban environments where the movement of wild animals intersects with human patterns of development and politics.*

Activating uncertainty: Scientific evidence and environmental values in wildlife management (Anderson et al., in review)

Abstract: *This paper examines the entanglement of science and politics through a case study of a controversy over hunting as a form of environmental management in a suburban town in the northeastern United States. Drawing on interviews with stakeholders, meeting observation, and media reports, we examine the justifications for and resistance to a municipal-level recreational deer hunting program. Our study reveals how participants activate discourses of science-based management and scientific (un)certainty (regarding deer populations, their impacts on forest ecosystems, and deer control approaches) to support arguments for and against hunting. In* *focusing on questions of science and rationality, the arguments of both opponents and proponents of the hunting program elide the varying human values, ethics, and emotions that underlie the deer management debate, even as they frame their positions as an act of care for the environment. In contrast to oft-cited cases where scientific uncertainty has primarily been deployed strategically by powerful actors, our analysis reveals nuance and complexity in the activation and mobilization of science and uncertainty in environmental politics and decision-making. As both hunting proponents and opponents appeal to the collection of further scientific data to resolve the controversy, we argue for greater attention to the ethical and emotional dimensions of this value-laden conflict.*

Policy Mobilities, Infrastructures, and Nonhuman Political Agency (Casellas Connors et al., in review)

Abstract: *Policy mobilities research explores how policies—particularly urban development policies—spread among sites around the world, mutate along the way, and take hold in distinct contexts. Methodologically, this research has focused on networks of actors, sites, and technologies through which policies move and transform. Despite the shared epistemology and inspiration from assemblage theory and science and technology studies, policy mobilities has primarily focused on human actors and networks, with little attention to nonhuman life. We build upon the ontological frame of assemblage theory and more-than-human geographies to incorporate nonhuman actors into our understanding of policy mobilization. We present a case study of suburban wildlife management programs in Massachusetts and discuss how human-nonhuman relationships undergird policy development, transfer, and change. Drawing insights from municipal surveys, in-depth interviews, and document analysis, we argue that nonhumans are active in the production of policy assemblages and the mobility of environmental policies. Deer, in particular, are lively actors entangled in the circulation of policies designed to manage social-ecological dynamics and processes that also include ticks, forests, bacteria, and many other nonhuman agents. Through this intervention to place the nonhuman into policy mobilities, we highlight the political agency of nonhuman actors, the materialities of policy mobilization, and the role of nonhumans in shaping relational networks.*

Ecological Science Research Update

During summer (May-August) 2022, we revisited each sampling location established in summer 2021. The purpose of these summer visits was to resample understory vegetation to build a more robust dataset. While conducting vegetation sampling, we verified that cameras were in working order and replaced malfunctioning cameras, downloaded pictures, and replaced batteries as needed. In addition to summer vegetation sampling, we conducted maintenance visits to each camera in January 2022 and January 2023 to download photos, replace batteries, and replace malfunctioning cameras.

Ornamental Browse Surveys

In the first year of this study, we surveyed deer browse on two common ornamental indicators, northern white cedar (*Thuja occidentalis*) and hostas (*Hosta* spp.). Our initial testing revealed that surveying these ornamental species from roadways was a faster alternative to forest indicator species. Additionally, our exploratory data analysis suggested deer browse impacts to ornamental indicators may correlate well with deer browse impacts to forest indicator species. Therefore, in summer 2022 we refined our methods to make sampling more efficient and expanded sampling efforts to conduct town-wide sampling in each study town.

Forest Measurements

Expanding on the previous report, we compiled four metrics of deer browsing, and two metrics of understory plant species composition and structure. The first browse index is the percentage of seedlings browsed during the current growing season. Because we only considered browsing during the current growing season, the percentage of seedlings browsed is an indicator of browse pressure during the summer sampling occurred. Second, we considered the average age of twigs on seedlings and saplings that within reach of deer. Twig age is an indicator of deer browse over the course of the entire year and gives insight into browsing that has occurred in approximately 5 years prior to sampling. Third, we considered the percentage of cedar trees browsed by deer. Cedar browsing reflects winter browsing pressure and can indicate longer-term browse pressure. However, since this is a new method, the amount of time it takes for cedars to respond to browsing is still unknown. The last browse indicator in the tables below is browsing pressure on hostas. Like seedling browsing, the percentage of hosta browse may serve as an indicator of summer browse but may be fundamentally different due to differences in risks associated with foraging near houses compared to foraging in wooded areas. There are two important caveats of the survey of landscape plants. First, the sample sizes are relatively small. Second, some landowners use deer repellents, temporary barriers (e.g., burlap in winter), or plant deer-resistant cultivars to discourage deer browsing.

In addition to the browse survey metrics, we compiled data from two additional vegetation measurements. First, we measured concealment cover at each camera site using a vegetation profile and the method described by Nudds (1977). Briefly, this metric is a measure of visual obstruction from 0-2m above ground level, and it is measured at a distance of 15m in each cardinal direction. Second, we measured understory vegetation coverage at each site. These measurements are based on nine $1m^2$ plots arranged in a 10m x 10m grid pattern around the camera. Combined, these two metrics give insight into understory composition and structure in each town.

Ecology Preliminary Results

This report includes preliminary results prior to completion of data collection and final analysis. Therefore, information presented here should be understood as a partial representation that may not completely capture the nuance of our data.

Ornamental Browse

During summer 2022 we surveyed 6,968 landscaped areas for cedar and hosta plantings. In total, we observed 1,181 landscaped areas with cedars and 2,364 with hostas. Overall, 38.7% of the landscaped areas with cedars and 6.3% of those with hostas were browsed by deer (Table 1). Deer browsed cedars most heavily in Lincoln, MA (77.8% of landscaped areas browsed) and least heavily in Clay, NY (17.0% of landscaped areas; Table 1). We observed signs of deer browsing on hostas most often in Sharon, MA (15.5%% of landscaped areas) and least often in Geddes, NY and Fenner, NY (0.0% of landscaped areas; Table 1). There was a considerable amount of variation in deer browse on both cedars and hostas within each study town; we present ornamental browse survey summary statistics and maps for each town in Appendix 1.

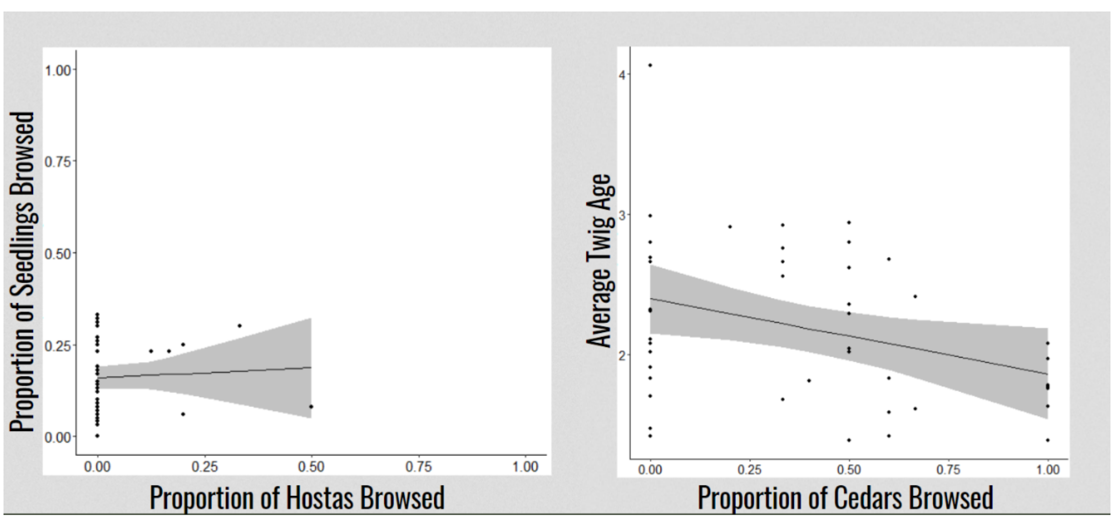
To explore our hypotheses that deer impacts to landscape ornamental indicators would be correlate with deer impacts to forest indicator species, we conducted a linear regression analysis. Specifically, we hypothesized that areas with a greater proportion of cedars browsed would have younger average twig ages of forest indicators, because both indicate long-term deer impacts. Additionally, we hypothesized that hosta browse and summer browse on forest indicators would be positively related because both are indicators of deer impacts during the current growing season.

In agreement with our first hypothesis, we found a statistically significant relationship between the proportion of cedars browsed and twig age (p=0.0285; Figure 1). Specifically, for every 10% increase in proportion of cedars browsed, average twig age decreased by 0.054 years (±0.02; 95% C.I.; Figure 1). In contrast with our second hypothesis, we found no statistically significant relationship between the proportion of hostas browsed and the proportion of summer browse on forest indicators (*p*=0.711; Figure 1).

Table 1. Summary statistics for landscape ornamental surveys conducted in the 11 study towns in 2022.

State	Town	Landscaped Areas Surveyed	Cedars Observed	Cedars Browsed	Hostas Observed	Hostas Browsed
Massachusetts	Pepperell	581	93	37.6%	197	4.6%
Massachusetts	Carlisle	377	60	58.3%	156	10.9%
Massachusetts	Lincoln	291	36	77.8%	74	8.1%
Massachusetts	Weston	385	70	25.7%	131	6.1%
Massachusetts	Sharon	586	86	55.8%	193	15.5%
Massachusetts	Easton	807	118	50.0%	280	12.5%
MA total	-	***3,027***	***463***	***50.9%***	***1,031***	***9.6%***
New York	Geddes	97	24	20.8%	21	0.0%
New York	Clay	1,042	223	17.0%	403	1.7%
New York	DeWitt	720	139	21.6%	224	6.7%
New York	Manlius	1,275	235	29.8%	528	3.2%
New York	Fenner	371	97	30.9%	157	0.0%
NY total	-	***3,941***	***718***	***24.0%***	***1,333***	***2.3%***
Total	-	***6,968***	***1,181***	***38.7%***	***2,364***	***6.3%***

Figure 1. Comparison of landscape ornamental browse survey methods to forest indicator browse survey methods

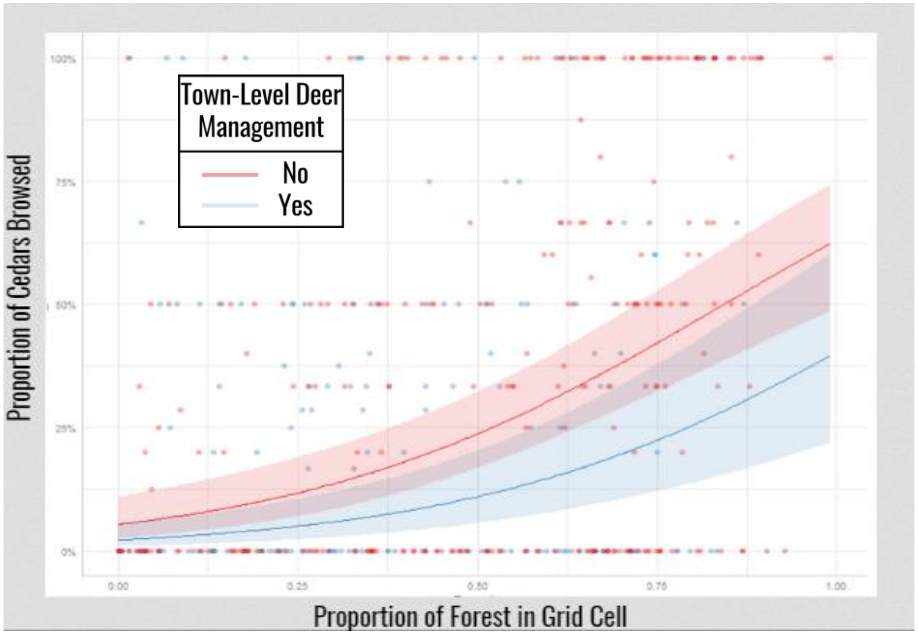


To further investigate the influence of landscape and management-related factors, on the proportion of cedars browsed, we developed and compared nine ecologically plausible generalized linear mixed effects models (Table 2). The model with the most support considered the percent of forest cover in a grid cell and whether that grid cell was in a town that had a deer management program (Table 2). Specifically, as the proportion of forest in a grid cell increased, the proportion of cedars browsed in that grid cell increased ($p<0.01$; Figure 2). Additionally, towns with deer management programs had less browsing on ornamental cedars compared to towns with no deer management ($p<0.01$; Figure 2).

Table 2. AIC model selection table for nine candidate models explaining the proportion of cedars browsed in a grid cell.

Model	K	AIC_c	ΔAIC_c	ω_i
% Forest + Deer Management	3	434.72	0.00	0.90
% Forest	2	439.76	5.04	0.07
% Forest + Deer Concern	3	441.69	6.96	0.03
% Agriculture	2	467.10	32.37	0.00
Deer Management	2	468.51	33.78	0.0
% Developed	2	469.66	34.93	0.00
% Developed Open Space	2	470.59	35.87	0.00
Null	1	470.63	35.91	0.00
Deer Concern	2	472.65	37.92	0.00

Figure 2. Model results from the top model for predicting ornamental cedar browsing.



Forest Indicators

In 2022, we continued monitoring forest indicators using the twig age method developed by Waller (2017). Twig ages remained relatively stable across years in most study towns (Table 3). However, differences between the percent of seedlings browsed across years differed greatly across years within most study towns, especially the towns in NY (Table 3). Overall, we think these differences are because sampling occurred earlier in the growing season in 2022 compared to 2021. The town with the greatest increase in twig age was Geddes, NY (Table 3). This difference is likely due to the addition of nine new field sites in Geddes between the 2021 and 2022 field seasons. In future updates we will investigate the influence of sampling date and other factors on the percent of seedlings browsed.

Table 3. Comparison of browse survey summary statistics in each study town and state.

Town	% Seedlings browsed 2021	Average twig age 2021	% Seedlings browsed 2022	Average twig age 2022
Pepperell	30%	2.39	5%	2.60
Carlisle	30%	1.90	17%	1.91
Lincoln	28%	2.48	18%	1.95
Weston	29%	2.34	20%	2.21
Sharon	37%	1.78	31%	1.52
Easton	24%	1.83	24%	1.51
MA Average	**30%**	**2.12**	**19%**	**1.95**
Fenner	22%	2.46	22%	2.00
Clay	37%	1.83	14%	1.96
Manlius	28%	2.35	11%	2.65
DeWitt	26%	2.00	12%	2.66
Geddes	58%	1.89	16%	2.78
NY Average	**34%**	**2.11**	**15%**	**2.41**

Concealment Cover

On average, total visual obstruction was similar across states, with average obstruction of 49% and 53% in MA and NY, respectively (Table 4). Town-wide visual obstruction varied considerably, and was greatest in Clay (mean= 72%) and least in Pepperell (mean=37%; Table 4). Interestingly, in all towns, average visual obstruction was greater from 1.5m-2.0m compared to the 1.0m-1.5m, which may suggest the presence of a browse line. However, this relationship may also be indicative of the structure of the vegetation of the Northeast. We plan to conduct these protocols in deer exclosure plots during the summer of 2023 in a subset of the study towns. Using the sampling technique within exclosures should help to clarify if it is a browse line or vegetation structure relationship we're observing.

Table 4. Comparison of visual obstruction summary statistics by height stratum, town, and state.

Town	Average visual obstruction 0.0m-0.5m	Average visual obstruction 0.5m-1.0m	Average visual obstruction 1.0m-1.5m	Average visual obstruction 1.5m-2.0m	Total average visual obstruction
Pepperell	42%	37%	33%	34%	37%
Carlisle	54%	43%	35%	40%	43%
Lincoln	62%	53%	43%	51%	52%
Weston	62%	54%	45%	51%	55%
Sharon	62%	44%	37%	40%	46%
Easton	74%	61%	46%	56%	59%
MA Average	**59%**	**49%**	**40%**	**45%**	**49%**
Fenner	61%	48%	40%	46%	51%
Clay	91%	78%	57%	58%	72%
Manlius	50%	38%	32%	35%	38%
DeWitt	50%	42%	39%	41%	48%
Geddes	61%	50%	48%	57%	54%
NY Average	**63%**	**51%**	**43%**	**47%**	**53%**

Understory Plant Species

Understory forb species richness was much greater in the NY study towns with an average of 62 forb species (range= 42-72 species) compared to average of 38 forb species (range= 32-50 species) in MA. Additionally, forb coverage was greater in NY (mean=42.0%) than MA (mean= 26.5%). On average, the proportion of forb cover consisting of native species was much greater in MA (mean= 95.3%) compared to the NY study towns (mean= 72.6%). This initial look indicates apparent differences between the understory vegetation in NY and MA. We will investigate possible reasons for these differences in future reports and publications.

Modeling Update

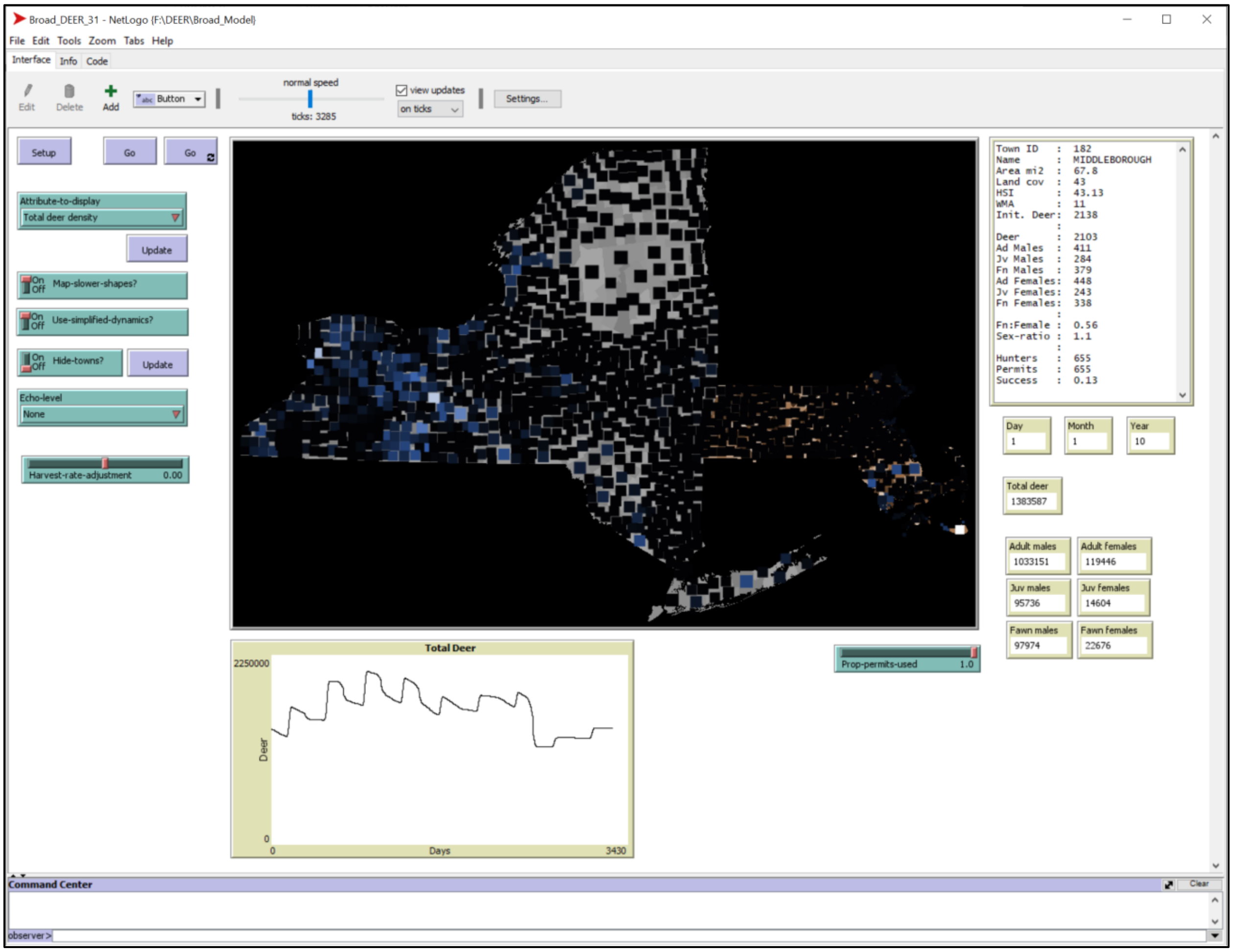
Our simulation efforts encompass three spatial scales and adopt an agent-based perspective for each. These efforts include: 1) a broad-scale application where agents are townships and other municipalities for MA and NY, 2) an intermediate spatial scale where several stylized townships are represented and deer and hunter agents interact with each other within and between towns, and 3) spatially explicit representations of deer and hunter agents in the 11 focal towns. We summarize activities for each below.

Broad-scale Application

To assess potential effectiveness of neighboring towns coordinating their management of deer control measures, we are preparing a NetLogo agent-based model that is at a broad spatial scale, with agents representing townships. The application is spatially straightforward, but agents include many attributes that allow for deer and hunter dynamics to be represented. Importantly, the model captures estimates of rates at which deer immigrate and emigrate from towns and how often hunters move between towns, and where they may hunt. In that way, we may simulate scenarios where towns collaborate on their management of deer and judge the effectiveness of that collaboration versus cases where towns follow isolated deer management practices.

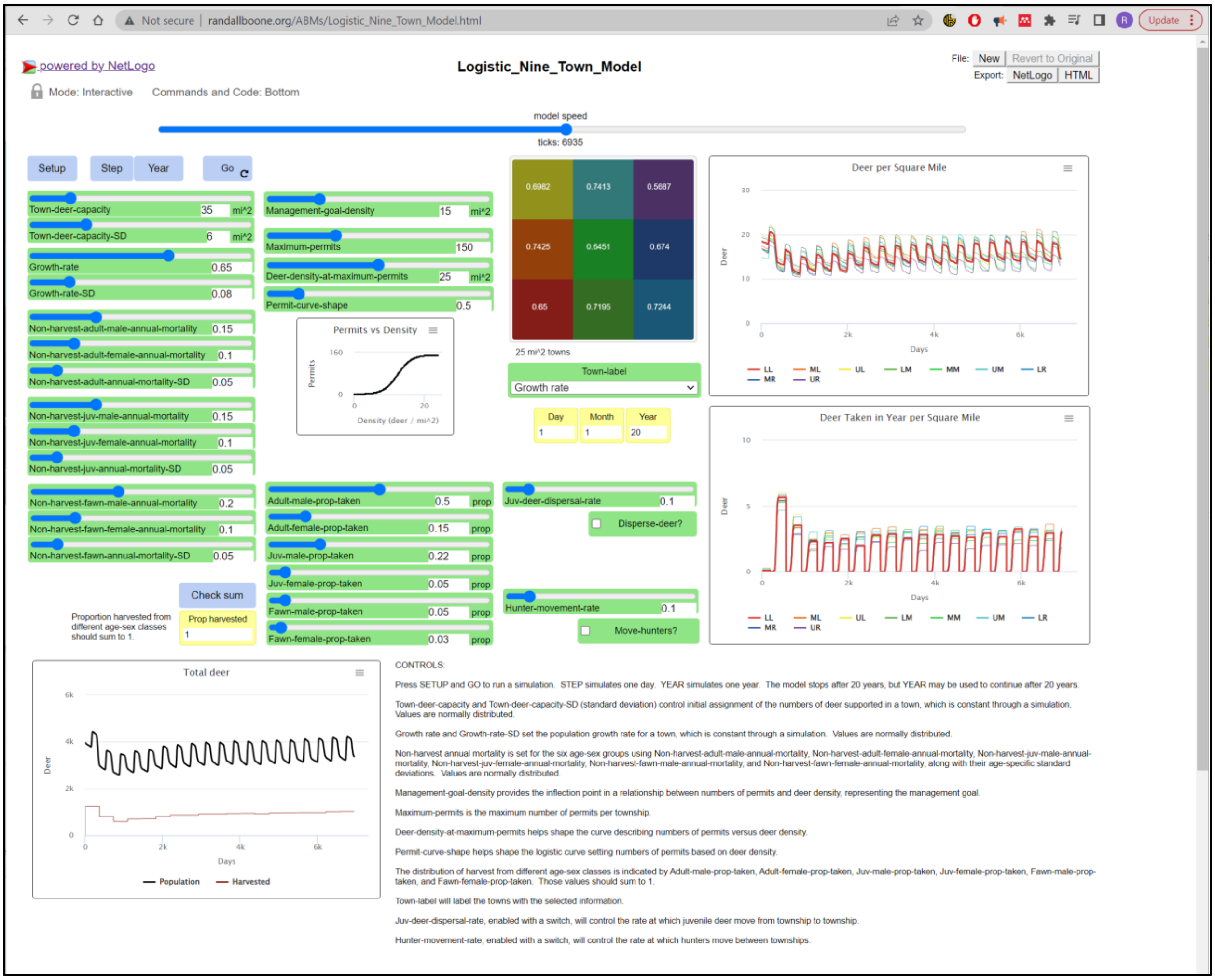
The broad-scale model includes three means in which deer dynamics and hunting pressure are represented. Two of those are in place or nearing completion. The first is adoption of best-available rates and other data from management reports from MA and NY. We used a habitat suitability index and wildlife management area (MA; 170,000 deer statewide) and statewide (NY; 1,200,000 deer statewide) estimates of total deer numbers to distribute initial deer populations across townships. Spreadsheets provided by state wildlife professionals in MA and NY allow for the estimation of total deer populations for towns, male:female ratios, harvest rates for different age-sex classes, numbers of permits, success rates for hunters, fawn:doe ratios, etc. for 2021. Information from MA was at times used to initialize towns in NY, and vice versa where required. Simulations yielded reasonable population dynamics (see Figure 5), but the variance in population sizes across townships was large. This was expected; the use of rates from a single year that are held constant and applied over a decade would not be expected to be in equilibrium, given that there is no density dependent feedback represented.

Figure 5. A desktop NetLogo interface depiction of the broad-scale model study area in NY and MA with relevant user controls for scenario-specific output.



The second approach includes density dependent feedbacks and emulates managers adjusting hunting pressure in response to deer densities. A separate tool was created in NetLogo Web (randallboone.org/ABMs/Logistic_Nine_Town_Model.html) that streamlined the number of towns represented and serves as a scratchpad to assess effects of different parameter values in a simplified setting (see Figure 6). That tool has been provided to team members to gain their insights.

Figure 6. A NetLogo Web interface depiction of the simplified broad-scale model encompassing relevant user controls and scenario-specific output.



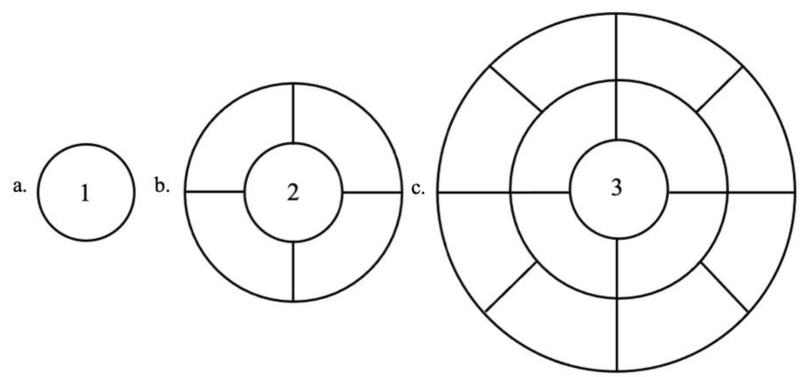
The third pathway is through modeling of population dynamics using physical and biological processes akin to those used by wildlife management agencies. For example, some modeling pathways used in the northeast incorporate snow cover and temperature in annual models of population change. We will do the same. We anticipate hunting pressure variability to be simulated using methods similar to those in the logistic representation, but other methods may be devised.

Intermediate Spatial Scale

The intermediate spatial scale model aims to address questions related to deer management theory. Specifically, the model seeks to answer how variable management coordination among towns impacts deer and hunter dynamics. This model simplifies the deer management landscape as much as possible to directly address theory, resulting in a homogenous environment with town management strategy as the only changing variable. This model serves as an intermediate placeholder to bridge the broad-scale and spatially explicit models, connecting them through underlying deer management theory.

Consisting of three spatial scales, the intermediate model consists of theoretical towns with the same areas, land covers, starting deer populations, and hunter densities. The first spatial scale focuses on evaluating the dynamics within a single town, where scales two and three seek to address the broader question of how neighboring towns and their management strategies impact each other (Figure 7). For scales two and three, we are testing “similarity thresholds” where surrounding towns have similar management strategies to the central town in increments of 25%. The management strategies being assessed in this model are hunting, sharpshooting, and no harvest. For example, one scenario includes the central town having hunting as a strategy, and the surrounding towns having no harvest (0% similarity). Conversely, another scenario includes the central town having hunting as the strategy, and all of the surrounding towns also implementing hunting (100% similarity).

Figure 7**.** This figure represents the three scales we will analyze in our intermediate spatial scale model. Scale 1 (a) contains a single township (n = 1). Scale 2 (b) has a shell of four additional neighboring townships (n = 5). Scale 3 (b) has two shells of additional townships (n = 13).



Spatially Explicit

The spatially explicit model focuses on addressing dynamics within our specific focal towns. At the finest scale of our model collection, each patch represents 30 meters of the dominant land cover type in that area. Including land use information relevant to deer and hunters, we created GIS layers of each town that depict locations of open water, forests, open land, wetlands, huntable areas, and development. We estimated huntable land areas based on state and local restrictions in conjunction with housing and road legal setbacks. Other estimates to parameterize the model came from state wildlife agency data, the literature, and expert opinion.

On the interface of this model, the user has the option to select which focal town to examine and what land cover layer to display. In addition, the user can choose to assess our town estimates (deer population, hunter number, sharpshooter density), or they can select theoretical numbers to analyze. One of the greatest benefits of this model is its ability to represent hypothetical populations on the realistic landscape so the user can investigate scenarios that may be infeasible in reality. Through this model, we are examining 1) thresholds of deer that must be removed to maintain stable populations, 2) land access and hunter density thresholds required to make impactful changes to local deer populations, and 3) hypothetical sharpshooter densities that have an effect on dynamics.

Community Outreach and Engagement

All members of our team have attended numerous town meetings, met with local residents, and met with staff at state wildlife agencies and local nonprofit organizations. Through such engagement, we aim to continue to build relationships with officials and residents, share data, and understand what questions and research topics are most important to wildlife and conservation professionals, as well as residents in affected communities.

Future Directions and Plans

Our efforts to understand the social and ecological dimensions of deer management will continue over the next year. On the social science side, these efforts include ongoing analysis of documents, survey data from residents, hunters and municipal managers, and interview data, with the outcomes of these analyses to be documented both in future project reports and in academic journal publications. We also plan to continue to conduct outreach and engage with community members to share our findings and facilitate ongoing conversations about the human dimensions of deer management decision-making in NY and MA.

On the ecological science side, we will continue to explore the browse indicator data. Additionally, we will continue to conduct analyses of vegetation in the study towns by analyzing and presenting results from understory and overstory vegetation sampling efforts. We also anticipate presenting data that is currently being gathered by the wildlife camera network established in 2021. Wildlife cameras will provide useful information about the deer and other wildlife species present in each town.

Our models will be essentially finalized in the coming months and incorporated into a dissertation and other products for outreach. Finalizing the tools will include reviewing and improving parameter estimation, sensitivity analyses, verification and validation, and using the tools in scenario analyses to address management questions. The products of our models will be 1) scientific learning tools and 2) simplified teaching tools to distribute to the public, our focal towns, wildlife managers, and other professionals.

We plan to distribute another annual report in spring/summer 2024 and a final report at the end of the project. We also intend to publish our findings in manuscripts to share our knowledge with the scientific community. We will make all reports and publications available through our project website (http://sites.bu.edu/urbanwilds).

Literature Cited

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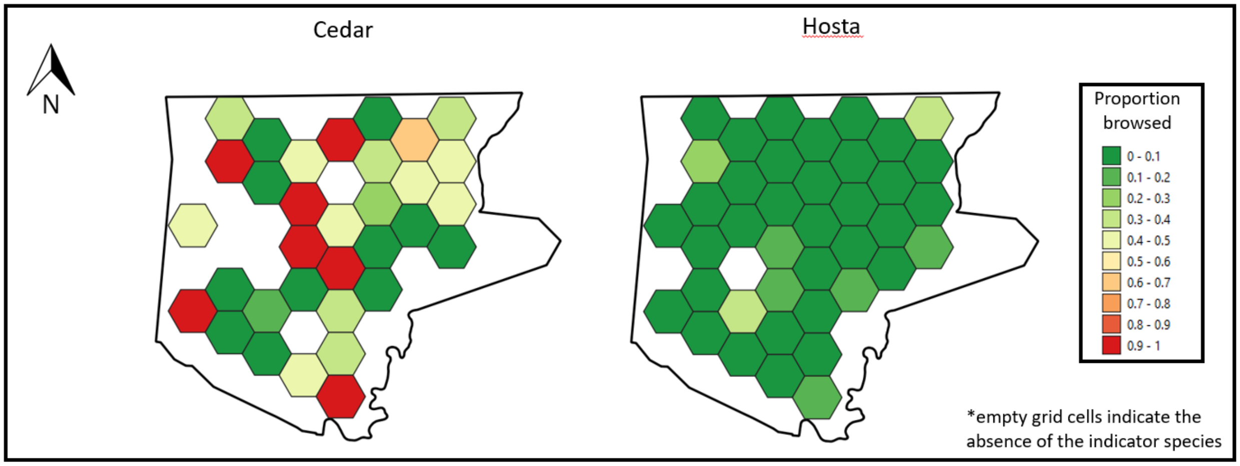
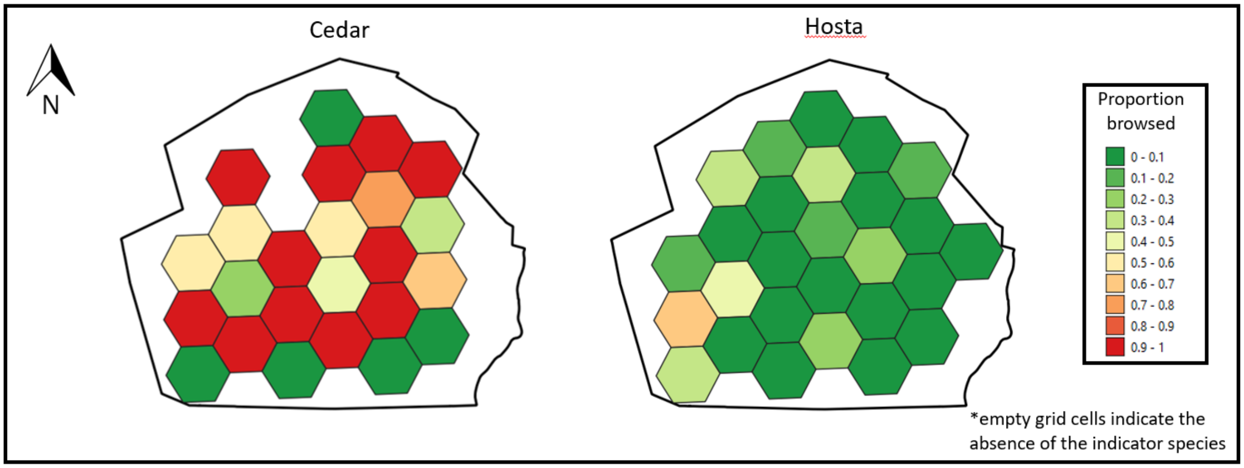
Appendix 1.

Pepperell



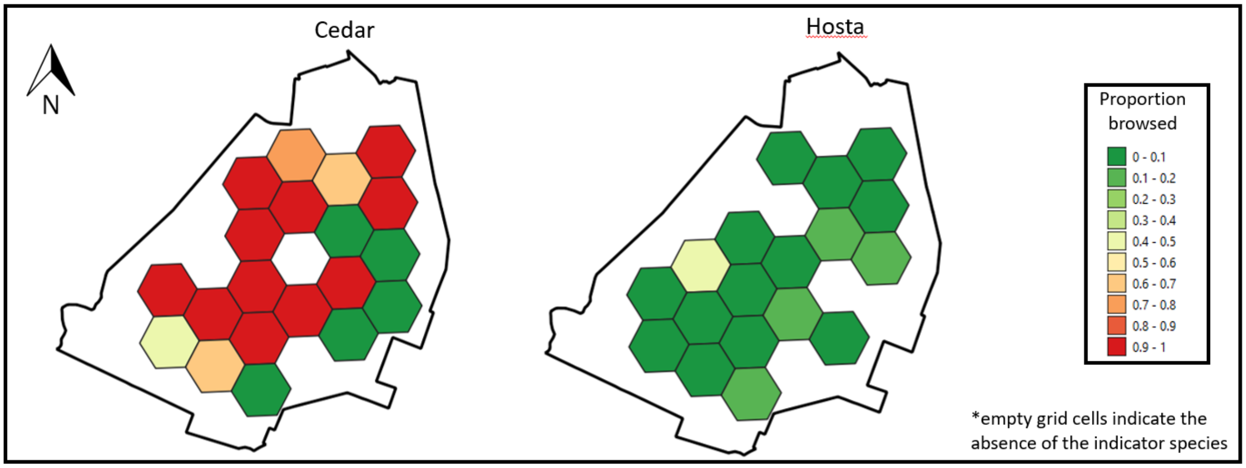
- Landscaped areas surveyed – 581
- Cedars observed – 93 (37.6% Browsed)
- Hostas observed – 197 (4.6% Browsed)

Carlisle



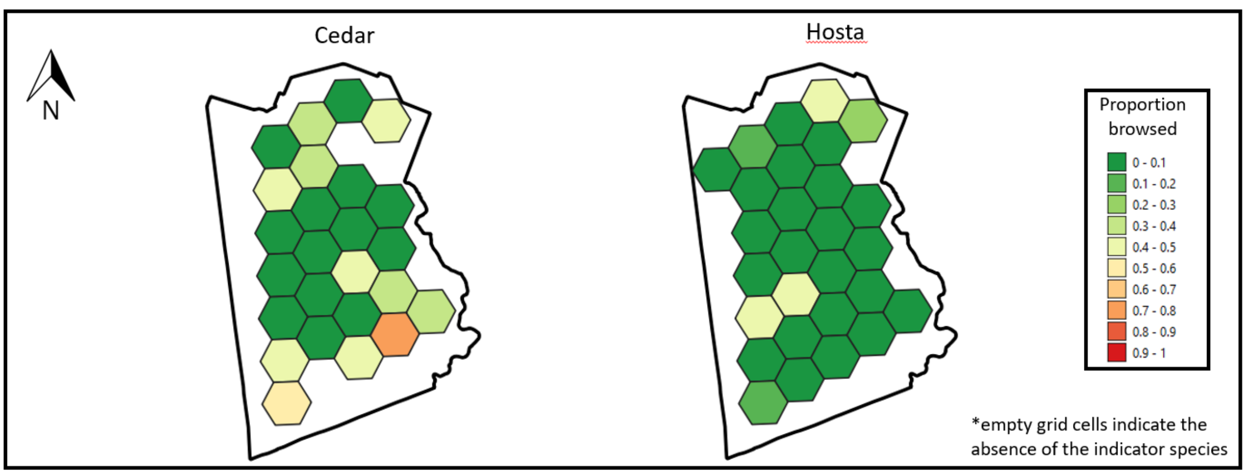
- Landscaped areas surveyed – 377
- Cedars observed – 60 (58.3% Browsed)
- Hostas observed – 156 (10.9% Browsed)

Lincoln



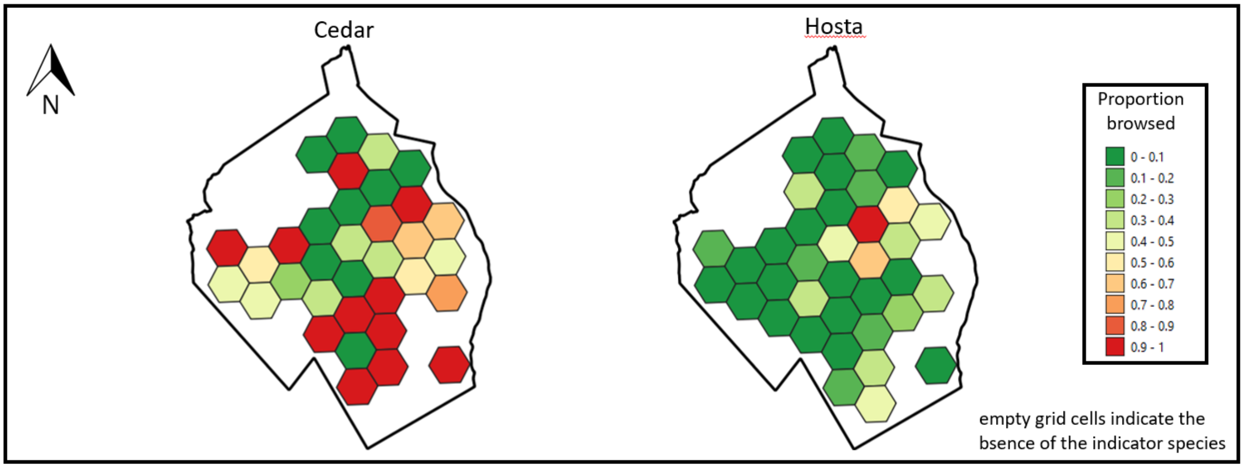
- Landscaped areas surveyed – 291
- Cedars observed – 36 (77.8% Browsed)
- Hostas observed – 74 (8.1% Browsed)

Weston



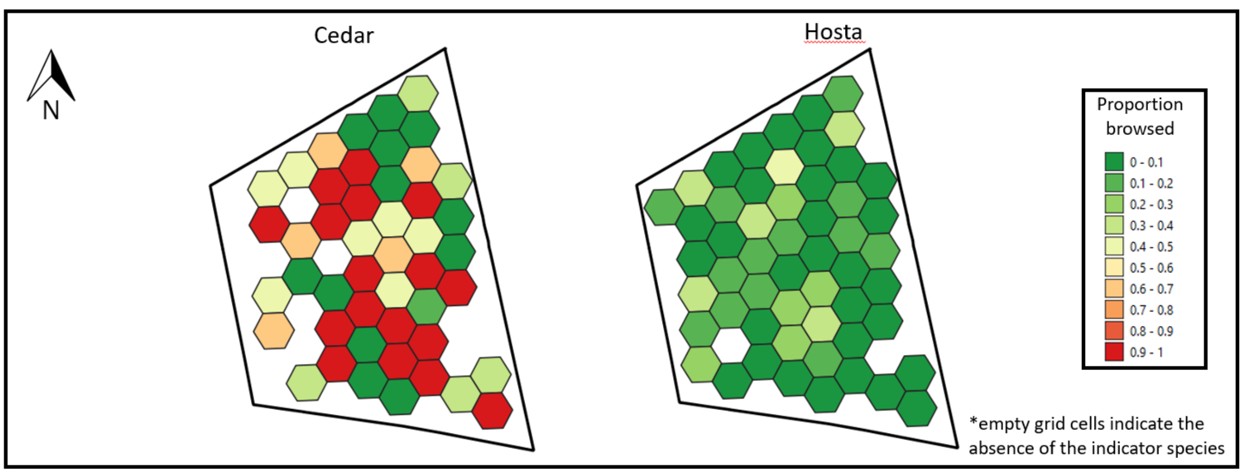
- Landscaped areas surveyed – 385
- Cedars observed – 70 (25.7% Browsed)
- Hostas observed – 131 (6.1% Browsed)

Sharon



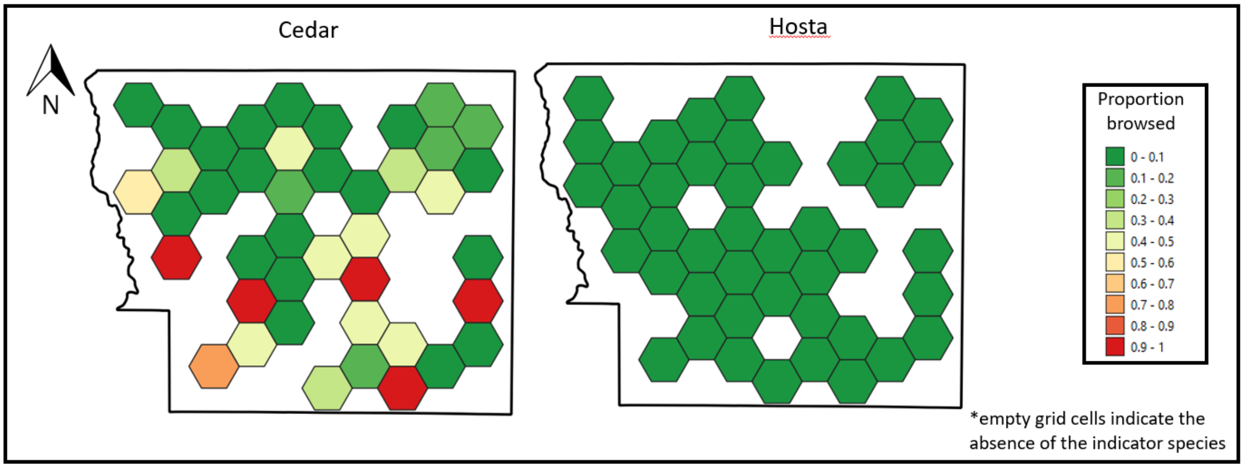
- Landscaped areas surveyed – 586
- Cedars observed – 86 (55.8% Browsed)
- Hostas observed – 193 (15.5% Browsed)

Easton



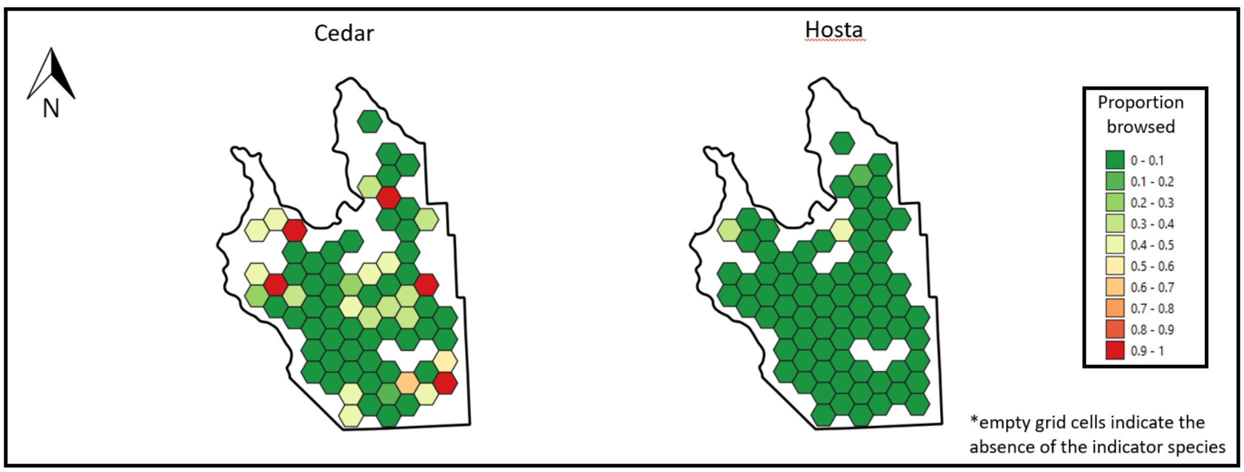
- Landscaped areas surveyed – 807
- Cedars observed – 118 (50.0% Browsed)
- Hostas observed – 280 (12.5% Browsed)

Fenner



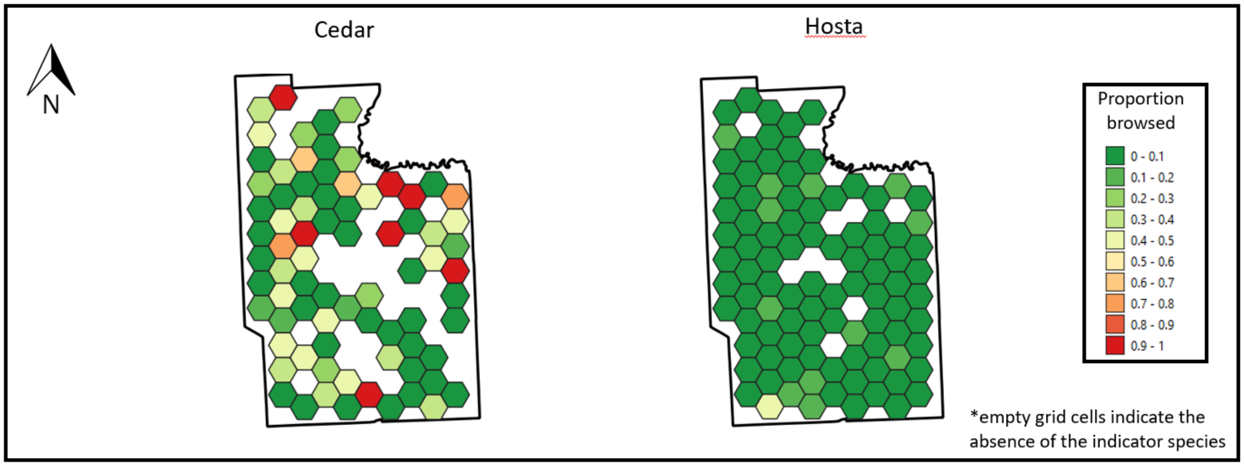
- Landscaped areas surveyed – 371
- Cedars observed – 97 (30.9% Browsed)
- Hostas observed – 157 (0.0% Browsed)

Clay



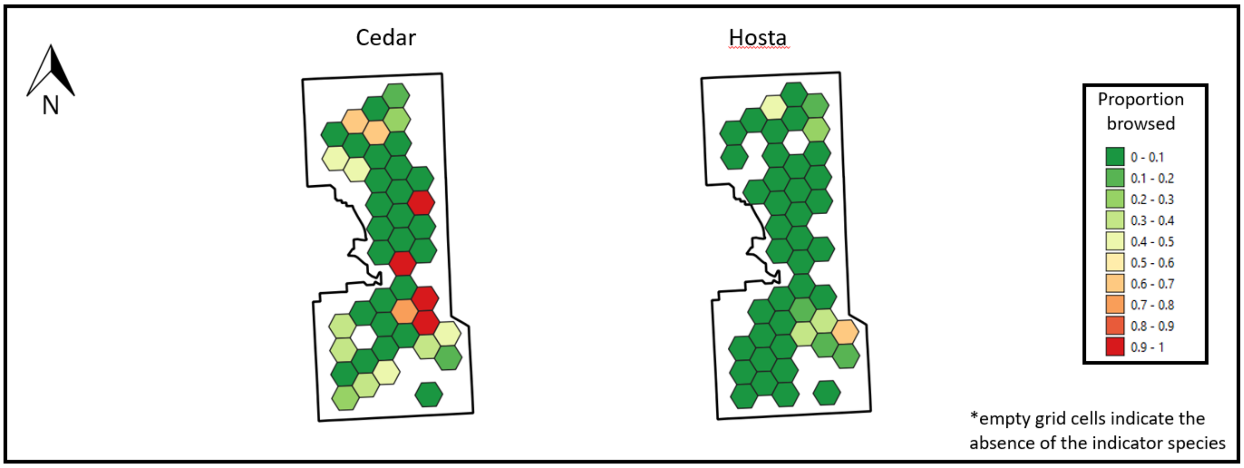
- Landscaped areas surveyed – 1,042
- Cedars observed – 223 (17.0% Browsed)
- Hostas observed – 403 (1.7% Browsed)

Manlius



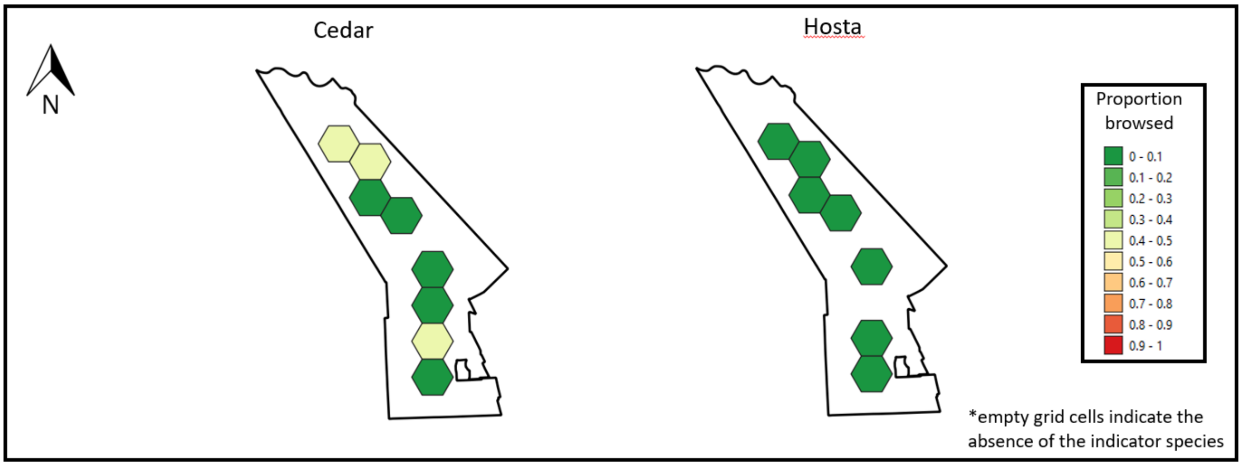
- Landscaped areas surveyed – 1,275
- Cedars observed – 235 (29.8% Browsed)
- Hostas observed – 528 (3.2% Browsed)

DeWitt



- Landscaped areas surveyed – 720
- Cedars observed – 139 (21.6% Browsed)
- Hostas observed – 224 (6.7% Browsed)

Geddes



- Landscaped areas surveyed – 97
- Cedars observed – 24 (20.8% Browsed)
- Hostas observed – 21 (0.0% Browsed)