



New York City Urban Field Station Science Plan

December 9, 2014

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I. Introduction

The New York City Urban Field Station: Meeting the Needs of a Dynamic Urban Forest

The mission of the New York City Urban Field Station is to improve quality of life in urban areas by conducting and supporting research about social-ecological systems and natural resource management. It began as a partnership between the USDA Forest Service Northern Research Station and the NYC Department of Parks & Recreation (NYC Parks). Since the initial development of this Science Plan, the partnership has extended to include the non-profit Natural Areas Conservancy as a key collaborator.

The NYC Urban Field Station engages in the following activities:

- Promotes environmental stewardship and ecological literacy (people’s understanding of ecology) to improve human well-being in New York City, the country’s largest and most diverse metropolitan area.
- Works with land managers to create innovative “research in action” programs that support urban ecosystems.
- Conducts comparative research and shares findings with decision makers and researchers in other metropolitan regions in the United States and around the world.
- Links to a growing network of U.S. Forest Service scientists and university partners who focus on urban research.

A Unique Partnership

As a dynamic municipal – federal partnership, the Urban Field Station acknowledges and embraces the tandem missions of the two agencies—NYC Parks and the USDA Forest Service. Operationalized via the USDA Forest Service’s Northern Research Station, the Urban Field Station also orients its work to that division’s core research themes.

The mission of the **USDA Forest Service** is to sustain the health, diversity, and productivity of the Nation’s forests and grasslands to meet the needs of present and future generations. The motto, "Caring for the Land and Serving People," captures the Forest Service mission. As set forth in law, the mission is to achieve quality land management under the **sustainable multiple-use management concept to meet the diverse needs of people**.

The mission of the Northern Research Station, a division of the USDA Forest Service, is to improve people’s lives and help sustain the natural resources in the Northeast and Midwest through leading-edge science and effective information delivery. Our work focuses on the pressing forest science issues relevant to this 20-state region.

Our research seeks to understand all elements of forests and related landscapes and is organized around the following five themes:

- Forest Disturbance Processes
- Urban Natural Resources Stewardship
- Sustaining Forests
- Providing Clean Air and Water
- Natural Resources Inventory, Monitoring, and Assessment

As part of the U.S. Forest Service’s Research and Development branch, the people of the Northern Research Station are passionate about our science and sharing it to make a difference. Our commitment to excellence means that we seek to:

- Serve the people in this region better,
- Link environmental health to community well-being,
- Sustain a diverse cadre of talent that responds rapidly to emerging issues and needs,
- Communicate the knowledge we generate to help develop an informed citizenry, and
- Interact effectively with universities, states, and other partners.

NYC Parks is the steward of the City’s approximately 29,000 acres of parkland, with the mission of building and maintaining the parks of the 21st century. The agency’s guiding principles are: increased greening, improved access to recreational and fitness opportunities, and using parks as a vehicle for community and economic development. As manager of almost 14 percent of the city’s land, NYC Parks must consider multiple uses and values, a diverse and changing human population, and a dynamic climate context. The Urban Field Station is nested within the division of **Forestry, Horticulture and Natural Resources**. The goals of the division, which oversee almost 10,000 acres of natural areas as well as street and park trees and green infrastructure include:

- Making NYC more resilient,
- Increasing public health,
- Bringing ecosystem services—clean air and water, reduced energy costs, storm protection, increased biodiversity, beautification—to underserved neighborhoods, and
- Building community engagement in and stewardship of natural resources.

Environmental programs within the division that inform the work of the **Urban Field Station** include creating, conserving and restoring ecosystems, managing and preserving diverse landscapes, and supporting an adaptive and informed management approach using tools including inventory and assessment, mapping, data analysis, and applied scientific research. Some programs are aimed at **conservation**, or the attempt to maintain particular characteristics of a system – such as structure, composition, aesthetic, and function. **Restoration** efforts, on the other hand, target degraded or altered landscapes that the Department seeks to restore either to a historic baseline or to some other state preferred over the current state. Though all restoration projects are unique, they often prioritize similar goals, including: native plant species; complex vegetation assemblages; closed canopies and vertical complexity in forests; increased stormwater interception and infiltration; erosion reduction and sediment stabilization; increased habitat diversity, quality, and connectivity; and more. Restoration projects occur across site types, including reforestation sites, afforestation sites, freshwater wetlands, streams, rivers, meadows, and salt marshes.

The work of the Urban Field Station is critical to the agency’s approach to Adaptive Management, an “iterative decision-making process where incremental measures are continually evaluated and rejected or improved” (NYC Parks Green Infrastructure Plan). Research, implementation, monitoring, and evaluation are key components of the adaptive management cycle (Fig. 1), which is kept alive through processes of consistent communication and iterative feedback of new information into management decision-making and planning. Thus, much of the inquiry required of adaptive management is **applied research** that is highly context-dependent and that immediately informs practices and policies, which must remain flexible.

Adaptive Management in NYC

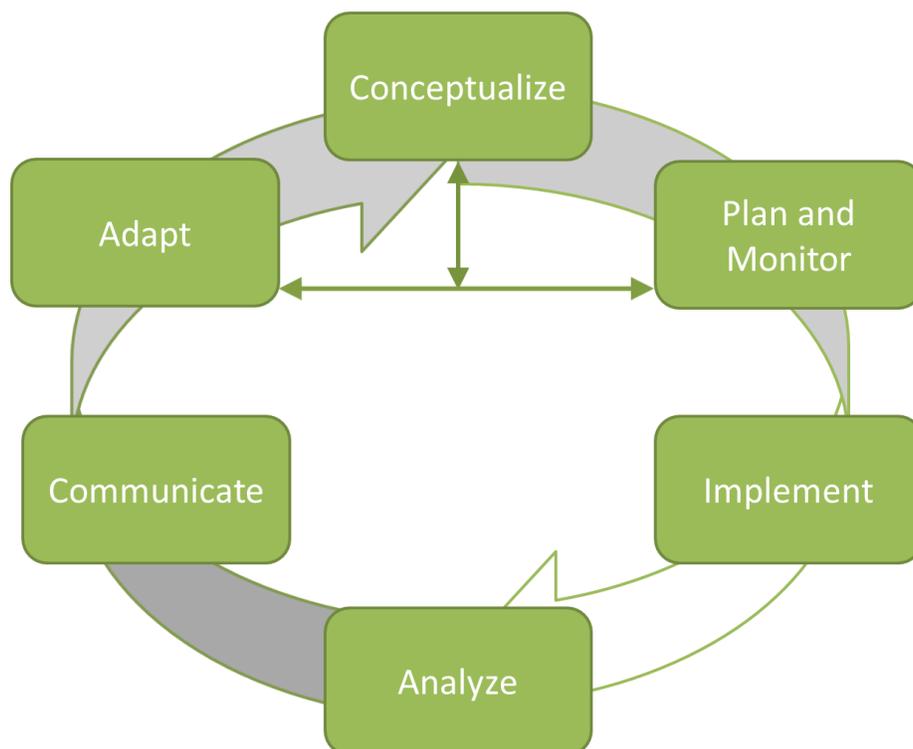


Figure 1: NYC Parks Adaptive Management Framework

Urban Natural Resources Stewardship in NYC

Urban Natural Resources Stewardship is defined broadly to include air, water, wildlife, trees, forests, and other natural features of the environment in urban, suburban, and urban-wildland interface areas. The term **stewardship** refers to the management, protection, and restoration of these urban natural resources. Urban Natural Resources Stewardship is much broader in concept than traditional urban forestry. In the Forest Service, Urban Natural Resources Stewardship is designed to be an umbrella for all the actions involved in caring for urban forest resources.

Similarly, while the term **urban forest** may often be understood as the collection of trees and woody plants in a city, local scientists and managers may instead use it to encompass the entire urban

ecosystem, including the abiotic and biotic features, human communities and the built environment, that make up the city. New York City’s urban forest is thus the many diverse plant and animal assemblages, the many successional landscapes, the matrix of human and non-human worlds, waterways and wetlands, grasslands and forested areas, streetscapes, grey areas, green areas, and all inhabitants of the five boroughs. The term *urban ecosystem* may also be used to describe the entire assemblage of green, blue, built, and human spaces that make up the NYC environment. It is critical to acknowledge the significant social component of this human-dominated and human-shaped system, and to remain aware of the diversity of sites. Just as the rural forest is also home to many plants and animals, to stands in different states of development, to swamps and meadows and edge habitats, so is New York City’s forest a complex patchwork of sites, communities, and features. Furthermore, New York City’s forest includes the nearly 8.5 million people who reside here, and the many more that work and visit the city every year. New Yorkers are key participants in the urban forest, and many of them are active as professional and civic stewards who help to construct and care for the urban environment. Thus, people, too, are very much a part of the urban forest (Fig. 2-3).

Many of the questions in this document have direct parallels in research that have been undertaken in traditional, rural forestry for over one hundred years. While the questions and methods are similar, we find that our answers are often radically different in the urban context. Our work is thus uniquely relevant in our city, and in the increasingly urbanized and urbanizing world.



Figure 2: NYC environment: biotic and abiotic elements



Figure 3: NYC civic stewards

2014 Science Plan

In the winter and spring of 2014, scientists, managers, and staff members of the Urban Field Station engaged in a collaborative process to do the following:

- Take stock of all research projects initiated and / or completed in the field station’s history
- Articulate priority research questions spanning the range of our work areas
- Prioritize pressing research questions
- Examine the other programs, initiatives, and tactics that bring meaning and value to our work

The goal of this collaborative and iterative process was to produce a living document that would provide both an account of efforts to date and a strategic guide for future research and programmatic work. Recognizing that political, social, and economic conditions are as dynamic as ecology, this document presents a summary of current work and a list of priority inquiries that are certainly subject to change. Nonetheless, we hope that it proves a valuable historical document and a flexible reference for all Urban Field Station staff as they engage in their work. Previous research envisioned in 2008 is also included in this plan.

This document was prepared by Gillian Baine, Fiona Watt, Erika Svendsen, Lindsay Campbell, Nancy Sonti, Novem Auyeung, Rich Hallett, Susan Stanley, Brady Simmons, and Michelle Johnson. Content

was generated through collaborative discussion and review with the entire field station staff and affiliates.

Attendees at the 2014 Science Planning meetings:

Novem Auyeung, NYC Department of Parks & Recreation / Natural Areas Conservancy, Research Ecologist
Gillian Baine, USDA Forest Service / NYC Department of Parks & Recreation, former Strategic Programs Director
Jeremy Barrick, NYC Department of Parks & Recreation, Deputy Chief of Forestry, Horticulture, and Natural Resources
Leah Beckett, NYC Department of Parks & Recreation, City Research Scientist
Sarah Bendit, Natural Areas Conservancy, Development Manager
Katerli Bounds, NYC Department of Parks & Recreation, Director of Forest Restoration
Marechal Brown, NYC Department of Parks & Recreation, Director of Horticulture
Lindsay Campbell, USDA Forest Service, Research Social Scientist
Sarah Charlop-Powers, Natural Areas Conservancy, Vice President
Nancy Sonti, USDA Forest Service, Research Ecologist
Helen Forgione, Natural Areas Conservancy, Senior Project Manager
Jennifer Greenfeld, NYC Department of Parks & Recreation, Deputy Chief of Forestry, Horticulture, and Natural Resources
Bram Gunther, NYC Department of Parks & Recreation, Chief of Forestry, Horticulture, and Natural Resources; and Natural Areas Conservancy, President
Rich Hallett, USDA Forest Service, Research Ecologist
Nancy Kohn, NYC Department of Parks & Recreation, Director of Green Thumb
Marit Larson, NYC Department of Parks & Recreation, Director of Wetlands and Riparian Restoration
Jacqueline Lu, NYC Department of Parks & Recreation, Director of GIS & Analytics
Brooke Mayer, NYC Department of Parks & Recreation, Conservation Corps Fellow
Morgan Monaco, NYC Department of Parks & Recreation, Director of Stewardship
Patricia Perone, NYC Department of Parks & Recreation, Assistant to the Chief of Forestry, Horticulture, and Natural Resources
Clara Pregitzer, Natural Areas Conservancy, Project Manager
Ruth Rae, NYC Department of Parks & Recreation, Associate Staff Analyst & Facilities Manager
Brady Simmons, NYC Department of Parks & Recreation, Research Ecologist
Susan Stanley, NYC Department of Parks & Recreation, Research Ecologist
Matthew Stephens, NYC Department of Parks & Recreation, Director of Street Tree Planting
Erika Svendsen, USDA Forest Service, Research Social Scientist, Co-Director of the Urban Field Station
Edward Toth, NYC Department of Parks & Recreation, Director of the Greenbelt Native Plant Center
Fiona Watt, NYC Department of Parks & Recreation, Co-Director of the Urban Field Station
Tim Wenskus, NYC Department of Parks & Recreation, Special Projects Manager

II. Science Themes: Current Work and Priority Inquiries

A. Tree and Vegetation Health, Vigor, and Mortality

Investigations of vegetation dynamics span many different urban forest site types and apply to diverse plant species and assemblages. The context includes a mix of land use patterns and urban designs in a temperate coastal city that is experiencing a changing climate. New York City's urban forest takes root in the public right-of-way (street trees, Greenstreets, and green infrastructure (GI) installations), as well as in parklands, natural areas, meadows, freshwater and saltwater wetlands, and over a range of other public and private lands.

Primary concerns and guiding questions include:

- I. How healthy is New York City's forest? What are the dynamics of growth and change?
- II. What are the impacts of weather patterns and other disturbances on the urban forest?
- III. How can we improve management practices to maximize tree and vegetation health and vigor?
- IV. How can we protect and mitigate risks within our aging tree canopy, and how do we manage large cohorts or generations given the history of tree planting and evolving tree planting practices?
- V. How can we plant and care for trees in the most cost-effective way so that they reach their maximum potential? How do we achieve the ideal "open grown" tree condition in the urban environment?

Priority inquiries:

- What planting practices optimize root volume for diverse species over the life of the tree? *
- What are the growth rates of urban trees in different site types?
- How long do urban trees live?
- What is the current mortality rate of street trees and other important vegetation, by species and size class? What accounts for hearty tree success?
- How well do constructed and enhanced GI sites maintain their ecological function over time? What are the vegetation dynamics in constructed GI sites?
- What tree species are most susceptible or resistant to wind damage?
- What makes certain plant and animal species more resistant to disturbance than others?
- What are the effects of road salt on trees? *
- What are the impacts of root zone disturbance (natural and anthropogenic – flooding, construction compaction, etc.) on tree health?
- How much water do trees of diverse species need from planting to maturity? *
- How can we best evaluate the structural integrity of landscape (park) trees? *
- What is the most effective and productive pruning cycle for encouraging tree health, improving structure, and reducing risk of storm damage? What are the effects of utility-related pruning?
- What are the best management practices for supporting a healthy level of genetic diversity in NYC's trees? *

* Throughout the document, an asterisk indicates this question that may be answerable with a literature review, or that the inquiry should be initiated with an in-depth literature review.

- How can we use remote sensing technology to map Urban Tree Canopy health, mortality, and species?
- *What are the impacts of Urban Tree Canopy and Green Infrastructure on Real Estate Values? With Austin Troy (UVM) or Simon McDonnell (NYU Furman Center). Envisioned in 2008.*
- *What are the water quality impacts of the NYC's urban forest? (i-Tree Hydro). USDA FS lead: Dave Nowak. Envisioned in 2008.*

Current work

- What are the effects of salt water on street tree health? Can we identify salt tolerant genetic material within target species?
- What are tree health and survival outcomes across MillionTreesNYC restoration sites and under a range of planting conditions and preparations? (Brady Simmons, 2009-present)
- What are the best urban tree health metrics for understanding / analyzing tree health and stress? (Rich Hallett, 2012-present)
- How successfully do constructed, native, urban forests sustain themselves; and how resilient are they to the invasion of non-native invasive plant species? (New York City Afforestation Project—Kissena Rich Hallett, Nancy Sonti, Novem Auyeung, w/Alex Felson and Mark Bradford -- Yale University. 2011-present)
- Can anthropogenic succession coupled with phyto-recurrent selection techniques be used to create an afforestation species palette that will achieve more rapid canopy closure and better growth resulting in reduced need for continued maintenance in large scale afforestation projects? (Hallett, Zalesny, Sonti, Brissette, Bradford, 2014)
- Can forest restoration efforts encourage the development of closed canopy forests and discourage the establishment of non-native invasive species? (Long-term forest restoration study in Pelham Bay Park, Bronx: Brady Simmons, Novem Auyeung, Rich Hallett, Nancy Sonti, 2010-present)
- What are the marginal costs of carbon abatement associated with tree planting relative to other strategies in NYC? (Carbon Abatement: US Forest Service Northern Research Station, 2011)
- Based on existing spatial analysis of NYC's ecology, where are the priority tree planting sites / areas in NYC, in terms of need and suitability? (UTC Prioritization: Jacqueline Lu, w/ Morgan Grove -- US Forest Service, Austin Troy -- University of Vermont, Jarlath O'Neil-Dunne -- US Forest Service, 2010-2011)
- What are the biological, social, and built environment factors affecting the mortality rates of young street trees planted throughout NYC? (Street Tree Longevity: Jacqueline Lu, Matthew Stephens, Erika Svendsen, Lindsay Campbell, Nancy Sonti, Lara Roman, w/ Jason Grabosky -- Rutgers, and Brian McGrath -- New School, 2010-present)

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B. Cycles of Disturbance and Recovery: Pests, Storms, Climate Change, and Human Impacts

Disturbance comes in many forms, varying in intensity, duration, and frequency, and affecting New York City's many resources and populations. Questions related to disturbance seek to plumb both the immediate effects of disturbance and the long-term implications of discrete events and sustained stressors. Cycles of disturbance and recovery are explored with the goal of understanding what constitutes socially and ecologically resilient systems. We intend for future work to include collaborations with similarly oriented institutes and entities, including the newly established Science and Resilience Institute at Jamaica Bay.

General guiding questions include:

- I. How do humans interact with and impact urban ecosystems? How do people respond to ecosystem change?
- II. What are the dynamics and implications of invasive and non-invasive species in urban environments?
- III. What are the effects of climate change (specifically extremes of temperature and precipitation, as well as changing frequency of weather events) on urban environments? How can we incorporate climate change projections into our work, including: coastal planning, designing natural areas, and setting restoration targets?
- IV. How do we plan, design, and shape policy in anticipation of disturbance?

Priority inquiries:

- How do public attitudes and perceptions toward urban trees and nature change in response to large storm events?
- How do we redesign systems and neighborhoods that have been vacated by human populations after disturbance (e.g. Staten Island shore post-Sandy)?
- How do plants respond to climate change at the landscape level? What is the potential for successful response via plant plasticity, migration, and physiological adaptation?
- What are the cumulative ecological impacts of many discrete human actions (such as recreational visitation, dumping, vandalism, paths, foraging, practices related to private horticulture, agriculture in parks) on natural areas? What is the carrying capacity of urban natural areas? How much visitation can be sustained while maintaining ecosystem function? *
- How are invasive plants, tree pathogens, and insects present and/or increasing in NYC? If they are increasing, at what rate? How effective are our current monitoring and management practices?
 - Where, and in what concentrations, are the host species for exotic invasive insects whose arrival in NYC is current or impending? How can we map these using remote sensing? Are there ecological and policy benefits to be gained from developing a city-specific invasive species list distinct from the state list? Do we have the data to do this?
- What are the impacts (adverse and/or beneficial) of invasive faunal populations (e.g., turtles, earthworms) on ecosystem health?

- What are the ecological and social values of "invasive" or "novel" plant species, and under what conditions are they acceptable in the urban environment? What novel species should cause concern and what future scenarios do models predict?
- What are the best management practices for growing, planting and transplanting species (as related to the goal of promoting native biodiversity)? *
- What are cumulative long-term impacts of higher frequency of storms in past several years on the health of natural areas?
- What is the value of natural resources in buffering against disturbance events? Specifically, how do hard and soft edges respond in extreme storm events?
- What are the impacts of sea level rise on New York City's coastal and freshwater wetlands, including their ability to keep up with Sea Level Rise, vegetation dynamics, etc.?
- What are the impacts of soil contamination on ecosystem health after flooding? (esp. in maritime industrial areas)
- How do physical conditions of the urban environment create stressors or buffer from stressors on wildlife (bees and colony collapse disorder)? Is the urban environment a refuge?

Current work

- How does disturbance serve as trigger for civic engagement and stewardship? How long does it last? (Svendsen, Campbell, Sonti, 2002-present)
- What are the effects of oil spills on urban ecosystems? (e.g. in Arthur Kill)
- Exploring Hurricane Sandy Flooding Impacts: What are the impacts of salt-water inundation on NYC's urban forest? (Rich Hallett, Nancy Sonti, Novem Auyeung. 2013-present)
- Integrated Phytoremediation Buffer Systems at Freshkills Park: How can plant species selection expedite ecological restoration goals?(Rich Hallett, Nancy Sonti, w/ Ron Zalesny -- US Forest Service, 2010-present)
- Living Memorials Project: What is the role of trees and open space in collective resilience after a disaster—how have communities, throughout the region and nationwide, responded to the tragedy of 9/11 through the design, creation, and stewardship of living memorials? (Erika Svendsen, Lindsay Campbell, 2002-present)

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C. Stewardship, Civic Engagement, and Governance

Urban Field Station social scientists have defined environmental stewardship as the practices of conserving, managing, monitoring, advocating for, and educating the public about their local environments (including water, land, air, waste, toxics, and energy issues). Civic stewardship, considered distinct from the public natural resource stewardship of government agencies like NYC Parks and the Forest Service, has been examined as a practice that can have material outcomes on the land, as a form of civic engagement, and as a phenomenon that has persisted over time. This civic stewardship emerges in diverse forms, across many site types and occurs in ever-changing social, economic, cultural, political, and environmental contexts. A range of actors engage in stewardship, including individuals, civic groups, private businesses, and public agencies—operating in a network structure.

Core guiding questions include:

- I. What triggers / mobilizes stewards to get involved and stay engaged?
- II. How do stewards function as land managers? What are the social and ecological impacts of stewardship?
- III. How does environmental stewardship relate to neighborhood dynamics and other cycles of change?
- IV. How do stewards act as part of governance networks?

Priority inquiries:

- Who participates in stewardship events, programs, and ongoing efforts? Who are the long-term stewards, and what strategies work to keep people engaged over the different stages of their stewardship tenure?
- What programs most effectively engage individual stewards and diverse groups, and which ones catalyze sustained community involvement (across different site types, land uses, and tactics ranging from passive information sharing, to environmental education, to hands-on activities)? How does stewardship persist or change over time?
- How do community gardeners function as land managers?
- How does community gardening function as gateway to stewardship on other site types?
- How can urban waterways be catalysts for civic action? When and how does this occur? (e.g. cross-neighborhood coalitions / Bronx River Alliance type phenomena.)
- What types of information and messages motivate different actors and reach diverse audiences (across age levels and diverse communities, both the public and within agency staff)? What is the relationship between information and stewardship behaviors?
- How do stewards function as data collectors and citizen scientists? How can managers effectively harness their capacities?
- What is the role of information technology in engaging stewards? Both via crowd-sourced data collection (e.g. TreeKit, bioblitz), Parks-initiated data collection (e.g. Tree Census), and disseminating information back to public (e.g. signage, apps, maps)?
- Does disturbance trigger increased civic engagement and stewardship? What is the role of community use, creation and stewardship of green space in recovery and resilience in response to disturbance, both chronic and acute?

- What aesthetic considerations or design features attract or dissuade people from engaging in stewardship? What designs and functions make the best sites for engagement?
- Under what conditions is stewardship sustained throughout the life of the natural resources, (e.g. participation in maintenance, not just planting/establishment)?
- How do we measure the impact of stewards on the landscape, over time? How, when, where, and on what site types (e.g. street trees, GI, wetlands, natural areas, gardens) are stewardship groups most effective in achieving desired land management and maintenance outcomes?
- What types of stewardship interventions on street trees are most effective in promoting tree health? (e.g. signage, compost, flowers, etc.)
- What the impact of participation in stewardship on the stewards themselves?
- How is stewardship related to neighborhood development; how does stewardship vary across neighborhoods and land uses; and what is the impact of stewards on their community, beyond the stewardship activity / site (temporal and spatial variability in stewardship participation according to social / economic / physical variables)?
- How do stewardship networks act as catalysts for urban environmental change? How do we support, sustain, and enhance existing networks?
- How have stewardship networks citywide responded to citywide plans and initiatives (e.g., PlaNYC, Green Infrastructure Plan, MillionTreesNYC)? How does stewardship shift or evolve longitudinally?
- How is urban agriculture perceived and used as a strategy for supporting communities and cities?
- How do bureaucrats serve as agents of change?
- How can social scientists conduct 'embedded research' on urban environmental systems?
- How does the governance of the urban environment shift in response to key transitions?
- How does the governance and maintenance of GI vary across different cities (e.g. Portland, NYC), with what implications for outcomes?

Current work

- How is urban nature politically, discursively, and materially constructed in the era of municipal sustainability planning? (Campbell, L., 2010-present)
- Living Memorials Project: What is the role of trees and open space in collective resilience after a disaster; and how have communities, throughout the region and nationwide, responded to the tragedy of 9/11 through the design, creation, and stewardship of living memorials? (Svendsen and Campbell, 2002-present)
- What motivates gardeners to form and participate in community gardens, and is this motivation persistent or changing over time? How do the use and social functions of community gardens change over time? How has garden membership changed over time, particularly in neighborhoods with changing demographics? (Svendsen, Campbell, and Sonti, 2003-present)
- Who volunteers to steward in the urban forest in NYC? Why do people volunteer to help plant trees in NYC? (Svendsen, Campbell, and Fisher (UMd), Russell (NJIT), Small (Columbia), Connolly (Northeastern University), Dexter Locke (Clark) 2011-present).
- Restorative Commons: Creating Health and Well-Being Through Urban Landscapes: a Forest Service edited volume exploring sites and programs that feature creative design, foster civic stewardship of natural resources, promote sustainability, and highlight the relationship between human health and the urban environment. (Campbell and Svendsen, 2009).
- Neighborhood Eco-topias: The role of storyline, design, and social networks in the creation of new open space and stewardship spheres of influence. (Svendsen, 2010)
- What is the impact of stewardship on street tree health? (Hallett, Sonti, Gowanus Canal Conservancy, Phil Silva, 2014)

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See www.stewmap.net for a complete list of STEW-MAP collaborators in other cities

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D. Ecosystem Services

As defined by the Millennium Ecosystem Assessment Report, ecosystem services are the benefits people obtain from ecosystems; and these include the categories of provisioning, regulating, and cultural services that directly serve people as well as the supporting services that maintain these first three sets of services. While initially conceived and articulated in conversations related to rural conservation efforts, ecosystem services are now increasingly examined in the urban context. In New York City, land managers have historically worked to support a range of ecosystem functions and resources qualities that can be viewed through the ecosystem services framework, including: habitat for wildlife, stormwater capture, water quality, carbon capture, climate regulation and air quality, aesthetic value, noise abatement, human well-being, and more. Though these services may be named individually, they tend to coexist in bundles in single places and across site types. In the urban system, land managers, including civic stewards, are key participants in producing, maintaining, and maximizing ecosystem services provided.

Core overarching questions include:

- I. What are the ecosystem services provided by the city's natural resources?
- II. How do we maximize ecosystem services across site types?
- III. How does the health of the ecosystem influence the ecosystem services provided? How do provisioning ecosystem services vary according to our management practices?
- IV. How do natural resources and management practices influence economic development, public health, and social justice?
- V. How does / can NYC's landscape function as a provisioning landscape?
- VI. What are the social and cultural ecosystem services provided by New York City's natural resources, and how can social meaning be factored into management and decision-making?

Priority inquiries:

- What ecosystem services do natural areas provide? Wetlands and bluebelts? Ornamental gardens?*
- How do we design restorations that optimize functional diversity to maximize ecosystem services and functions?
- How do our neighborhood greening investments (green roofs, street trees, GI) affect the thermal signature of adjacent areas over time? *
- How do we most effectively capture stormwater, now and in the future, across site types, and how do these efforts affect water quality and water chemistry?
- How do our green infrastructure projects support and complement grey infrastructure?
- How do we integrate salt marsh restoration and enhancements with upland systems?
- What is the relationship between natural resources and public health (considering all of our site types—gardens, parks, GI, street trees, natural areas, wetlands, and recreational open space)? How do we integrate natural resource benefits with public health and well-being?
- How can the streetscape and the urban forest at large be viewed and utilized as a productive landscape? What are the benefits and / or dangers of perceiving and using the resources in such a way? (includes foraging and other harvest considerations)

- How do GI efforts impact ground water vs. surface water?
- How can spatial analytics be used to inform GI planning in a direct drainage watershed? What parameters should inform modeling and planning for the installation of GI features on public lands? What are the possible, potential, and preferable sites for locating new GI?
- What are the trade-offs between loss of one natural resource and the creation of another in terms of ecological functions and conservation goals?
- How does the public value and understand constructed GI sites in the streetscape?

Current work

- What ecosystem services do individual trees, and the entire urban forest, provide? How do these services vary with the quality of the site / system? (i-Tree, FIA, InVEST)
- How do constructed green infrastructure installations function to aid in the city's management of stormwater, in terms of their capacity to moderate the flow and influence the quality of runoff? (Nandan Shetty, w/ Franco Montalto, Drexel University, 2009-present)
- What are the values, uses, and meanings of NYC's nature in its variable conditions? What are the social / cultural ecosystem services provided by a range of site types? (Forest Service Social Assessment, 2013-present)
- Monitoring Carbon Sequestration in "Natural Area" Reforestation Sites. (Rich Pouyat -- US Forest Service, w/ Matt Palmer and Kevin Griffin -- Columbia University, 2008)
- Urban Foraging: Who forages in New York City, where, for what plants, and why? (Marla Emery -- US Forest Service, Patrick Hurley – Ursinus College, Lindsay Campbell, 2011-present)
- Urban Foraging: What are the heavy metal concentrations in foraged material and is that material safe for human consumption. (Emery, Hurley, Hallett 2013-present)
- Integrating Grey and Green Infrastructure to Improve Health and Well-being for Urban Populations: What are the relationships between grey infrastructure, green infrastructure, and human wellbeing? (Erika Svendsen, w/ Mary Northridge -- NYU, Sara Metcalf -- University of Buffalo. 2011-present)
- i-Tree Eco: What is the structure and composition of New York City's urban forest, and what ecosystem services does it provide? (Rich Hallett, Nancy Sonti, Novem Auyeung, w/ Dave Nowak and Bob Hoehn -- US Forest Service. 2013-present)
- Carbon Abatement: What are the marginal costs of carbon abatement associated with tree planting relative to other strategies in NYC? (US Forest Service Northern Research Station, 2011)

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E. Wildlife and Habitat

Parks in New York City support a diverse array of wildlife species and habitat types. In recent years, large, charismatic species have been re-appearing in the city after long absences. The mechanisms that drive the presence and abundance of wildlife in our urban environment, however, are not well understood. Urban wildlife faces many challenges to survival, especially intensive habitat alteration, degradation, and fragmentation. To balance these anthropogenic changes, NYC Parks and other groups have been working to restore the City's forests and wetlands. More information is needed to determine which species benefit from ecological restoration in the long-term and how wildlife uses the parks (breeding, foraging, dispersal, etc.). Gaining a greater understanding of urban wildlife will allow us to make informed policy decisions, such as which species to encourage or discourage. A wildlife management plan for NYC (one does not currently exist) must address the animals that use our parks while also considering the multiple and competing social and cultural values of wildlife in a densely settled human habitat. **Several questions related to the inventory of various species and taxa have been included in the inventory and monitoring section.**

In thinking about wildlife, we must consider the many dimensions of human modification of the landscape as well as cohabitation. Key guiding questions include:

- I. How does wildlife use the urban landscape, and how do we manage habitat for wildlife conservation in a human-dominated environment?
- II. How do healthy ecosystems function as vital habitats, and how do we balance our landscape restoration and conservation efforts with the related wildlife management considerations?
- III. How do we incorporate multiple sets of values in managing for wildlife?
- IV. How do we ensure that our wildlife policies are integrated both with the city's work in public health and with our concepts of ecosystem health and function?

Priority inquiries:

- How does wildlife, including migratory species, use the landscape, and how do various species and populations impact the landscape (including feral cat communities, deer, coyote, rodents, etc.)?
 - How is the white-tailed deer population of New York City changing, with what effects on the city's ecology, and how do these population dynamics and ranges influence residents' relationship with urban wildlife and urban natural areas?
 - What is the carrying capacity of specific sites and of the city as a whole, for deer and for other species of concern? *
- What are the best management practices for encouraging pollinator populations, particularly on the edges of natural habitats?
- What is the appropriate role of predator species in the city? How do we encourage and / or manage predator populations?
 - How do predators affect plover productivity, in the Rockaways and in other areas?

- How do our natural areas and wildlife management practices impact the health of our aquatic wildlife populations?
- What is the public's perception of wildlife in the city?
- How does our Forever Wild policy affect habitat in the long-term?

Current work

- White-tailed deer management: What is the extent of NYC's deer population, where is their preferred habitat, and what corridors do these populations use in moving throughout the city? (NYC Parks, 2012-present)
- Monitoring Saltmarsh and Seaside Sparrow Populations: As a part of a region-wide study, how does habitat change affect saltmarsh and seaside sparrow populations along the Atlantic Coast? (NYC Parks w/ Allison Kocek- SUNY- ESF, University of Maine, Audubon, 2012-present)
- American Oystercatcher Monitoring: Monitoring populations to understand effects of habitat loss. (NYC Parks w/ NYC Audubon and Manomet Bird Observatory, 2012-present)
- Urban Vernal Pools: How do the populations of urban vernal pools compare to regional reference sites, and how can these relationships be used to guide management and restoration practices in NYC? (Susan Stanley, 2011-present)
- Effects of forest restoration on terrestrial salamanders. How do salamanders react to un-invaded and restored forest areas in NYC? Ellen Pehek and Susan Stanley. 2004-present
- Breeding Birds: How are NYC's bird populations changing? How can breeding bird populations be used as an indicator of forest and salt marsh restoration efforts? (Susan Stanley, Brady Simmons, Ellen Pehek, 1992-present)
- Biodiversity Assessment Handbook for New York City: (NYC Parks ecologists authored sections of the recently released Biodiversity Assessment Handbook of New York City, published by AMNH. Ellen Pehek, Susan Stanley, 2013)
- Odonates: What are the relationships between dragonfly populations and wetland health? (Susan Stanley, Ellen Pehek, 2012)
- Surveying Stream Salamanders: What are the effects of historic stream fragmentation and urban development on genetic and population structure of stream salamanders? (Susan Stanley, Ellen Pehek, w/ Jason Munshi-South, 2012)
- *New York Metropolitan Flora Project – Print and Online Interactive Keys for 25 county Metro Area: Cataloguing biodiversity of NYC's flora. (Helen Forgione, Mark Twery -- US Forest Service, w/ Gerry Moore -- Brooklyn Botanic Garden. Envisioned in 2008)*

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Selected References

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F. Ecosystem Health and Biodiversity

This research theme examines system-scale questions and extends across site types to examine the notion of health, quality, and resilience of New York City's environment and natural resources. It acknowledges the many biotic and abiotic factors that form the NYC environment, and it queries diversity, spatial and functional heterogeneity, and linkages across these. This theme may be further subdivided into more pointed considerations that explore the following overarching questions:

- I. What are the properties, conditions, and composition of NYC's soils?
- II. What is the importance of biodiversity in NYC? How do we support biodiversity, and at what levels and what scales is diversity an important component of the system (at the level of the genotype? Species? Genus? Other taxa? Ecological function? Other? At a site, neighborhood, watershed, and citywide scale?)
- III. What are the spatial characteristics of NYC's natural resources, at a city scale? What is the relationship between these spatial characteristics and ecological health, considering habitat clustering, connectivity, parcel size and shape, fragmentation, etc.?
- IV. How does urban natural resource management support water systems and aquatic biota in NYC?

Priority inquiries:

- What is the diversity of soil microbial communities across site type, including green roofs, restoration sites, and others? *
- What are the biogeochemical dynamics of soil in constructed GI installations (soil, water, vegetation)?
- What are the changes in soil biodiversity in manufactured (from commercial sources) vs. urban (construction debris and non-living) growing media?
- What fauna exists in different types of soils around the city across site type, in intact vs. manufactured landscapes?
- What are the benefits of diversity in the city's ecosystem, and at what scale?
- Is species or functional diversity more important for a resilient urban ecosystem? What is the value of redundancy in a resilient system?
- What should be the specifications for horticulture plantings that are proximate to natural areas, such that they serve as sources of soil and other biota?
- In order to achieve positive social and ecological benefits, what size do our park / natural area parcels need to be? How many do we need to have?
- To what degree is our urban ecosystem fragmented or connected? How does connectivity relate to ecosystem health at the city scale? Where are our ecological corridors? Where are areas of high / low connectivity? *
- How effectively do different site types (GI installations, green roofs, street trees, horticultural gardens, community gardens, parks) function as ecological corridors?
- How do parks and gardens function as green corridors for humans? How walkable is the urban ecosystem?
- What is the condition of our habitat forest edges, and how do public perceptions interact with ecological goals on the edge?

- What is the extent of habitat edge conditions in the city? What is the ecological quality of our edges? How do we improve the condition of the edge? How does public perception function on the edge, with what consequences for the social and ecological value of these spaces?
- What is the impact of stormwater runoff on wetlands and streams?
- What are the opportunities for managing stormwater on private property, including possible, potential, and preferable points of intervention? What is the level of community awareness of and willingness to invest in stormwater management practices, and how do these influence the opportunities for intervention? What is the state of “backyard biodiversity” in the Alley Creek watershed? Finally, how does this biodiversity (or lack thereof) and the community perception of private lot form and function influence the potential for stormwater management on private property?
- Under what conditions, and according to what designs, do GI installations strengthen ecosystem function, ease pressures on existing grey infrastructure, and support human wellbeing?

Current work

- Investigating urban soils: How can we characterize the unique structures and compositions of NYC’s urban soils? (Brady Simmons, Novem Auyeung, 2013-present).*
- In an urban ecological restoration context, how does variable organic content in soil affect the following dynamics in a seeded meadow: (1) rate and density of vegetation colonization, (2) native plant diversity, and (3) invasive plant density? (Marit Larson, Kathleen McCarthy, 2012-present)
- Greenhouse Study: How do native tree species perform in a variety of urban soils from sites around the city? (Clara Pregitzer, Nancy Sonti, Rich Hallett, 2012-present)
- How do soil properties vary across green infrastructure installations (vegetated systems for capturing and retaining stormwater runoff)? How do these differences in soil properties relate to differential plant health and stormwater capture? (Novem Auyeung, 2013-present)
- *Achieving Healthy Soils: Citywide Soil Biophysical Properties, Nutrient Cycling, and Soil Quality Index. Potential lead FS Scientist: Rich Pouyat. Envisioned in 2008.*
- Urban Waters Federal Partnership: a partnership aimed at improving coordination among federal agencies and collaborating with community-led revitalization efforts in order to reconnect urban communities with their waterways; improve our Nation’s water systems; and promote their economic, environmental and social benefits. (NPS, US Forest Service, w/ DOT, DEC, 2012)
- Integrating Grey and Green Infrastructure to Improve Health and Well-being for Urban Populations: What are the relationships between grey infrastructure, green infrastructure, and human wellbeing? (Erika Svendsen, w/ Mary Northridge -- NYU, Sara Metcalf -- University of Buffalo, 2011-present)

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G. Inventory and Monitoring

As a starting point for sound research and practice, the NYC Urban Field Station seeks to understand the location, extent, and condition of a variety of biotic and abiotic resources across the city, with particular attention to those that are rare and/or at risk and those that are found on NYC parkland. By conducting a range of social and ecological inventories and assessments, we seek to support the health of the NYC environment and to steward multiple long-term datasets that can advance scientific understanding and sound management practices. Cycles of inventory, assessment, and monitoring are core to the practice of adaptive management.

Though values and targeted species / communities / features may shift over time, key guiding questions for all inventory work include:

- I. How do we conduct inventories of diverse species, communities, systems, and features in order to map resources and establish baselines?
- II. What indicators should we monitor in order to assess the health of these populations, communities, and systems? *
- III. What species, communities, and habitats are rare, and at what scale should we conduct our inventories?
- IV. How frequently do we need to repeat our inventories or implement monitoring practices to understand change adequately over space and time? *
- V. How do we use our inventories to inform management?

Other overarching questions that apply to inventory and monitoring work include:

- What are the long-term datasets that we should maintain for New York City, and how should we manage and share them?
- How can we use other existing datasets to assess our resources (2010 LiDAR for streams, FIA for forest resources, etc.)
- What is the role of volunteer data collection in contributing to our inventory / assessment / monitoring efforts (including structured volunteer programs and independent civic science efforts)? *

Priority inventory and monitoring targets:

- FIA (U.S. Forest Service Forest Inventory & Analysis)
- Freshwater streams
- Freshwater wetlands
- Community gardens
- Amphibians and reptiles
- Bats
- Invertebrates
- Invasive plants and animals
- List priority plants and animals¹
- Green roofs (across jurisdictions)
- Green infrastructure sites

¹ Species/taxa under current monitoring: breeding birds, piping plovers and other shore birds, wading birds, colonial nesting birds, salamanders, odonates and frogs, winter waterfowl, and bats and deer (monitored collaboratively).

Current inventories

- UTC (urban tree canopy)
- i-Tree
- Street tree inventory
- Parks trees inventory
- Wildlife surveys (list species of interest)
- Rare plants (Greenbelt Native Plant Center holds seed stock and database)
- STEW-MAP (Stewardship groups and organizations)
- Park and Natural Areas users
- Salt marsh vegetation
- Natural Areas

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H. Evaluation of Management Practices and Programs

Monitoring of efforts and the evaluation of current practices and programs are key components of successful adaptive management. In seeking to understand the impacts of our own work, to adapt to changing climates and contexts, and to prioritize our efforts under conditions of finite resources, we must constantly reflect in a rigorous way on our own initiatives.

Key guiding questions include:

- I. What ecological targets, in terms of structure, function, and diversity, should guide our efforts? What is the appropriate lifespan of a restoration or management effort, and how much maintenance and human intervention is required? (Do we aim for permanence?)
- II. What are the most effective and efficient monitoring practices and methodologies, including pre- and post-restoration monitoring?
- III. How successfully do we meet our goals through a variety of management practices, and what factors contribute to our successes and failures?
- IV. How are the public's uses and values of resources considered in our management and planning?
- V. What are the underlying causes (social and ecological) of degradation, and how do we address these in our restoration efforts?
- VI. What are the impacts of our community programs, including education and trainings?

Priority inquiries:

- What are the ecological and social impacts and benefits associated with stream day-lighting?
- Do mitigation banks successfully lessen wetland destruction and loss?
- At what scale should we evaluate our restoration efforts -- Site? Watershed? System-wide?
- What are the social and ecological impacts of the street tree block planting campaign, including climate impacts, effect on growth rates, canopy effect, management efficiencies, risk mitigation, tree survival, economic changes, traffic calming, empowerment, social cohesion, public health, environmental effects, public perception of the urban forest and restoration, etc.?
- What are the impacts of our herbicide and pesticide use, and how can we effectively manage weeds without using herbicides?
- How do our restoration efforts support wildlife and faunal biodiversity?
- What are the short- and long-term outcomes of our environmental education programs? How does environmental literacy and experience influence the following: youth development, community development, student learning, support for our programs, and support for NYC's natural resources? *
- How effective are our in-house training programs in advancing sound management and maintenance practices?
- How does the Urban Field Station function as an example of 'experimental urban ecology'? How do we produce knowledge at the intersection of research and practice?

Current work

- Eco-Literacy Field Project Evaluation: An evaluation of internship programs that engage urban youth in sustained, hands-on education in urban forestry and ecology while enhancing their reading, critical thinking, work readiness, and problem-solving skills. (Lindsay Campbell w/ Trees New York, Harlem Link Charter School, Bronx Settlement Houses, 2007-2008)
- Million Trees Job Training Program research: What are the educational and employment outcomes of green job training and employment in the lives of the participants? (Lindsay Campbell, Erika Svendsen, Nancy Sonti, MTNYC, w/Bronx Youth Urban Forestry Empowerment Program, Nature Fieldwork Partnership with the Harlem Link Charter School, Green Collar Mentoring Series, 2009-present)
- MillionTreesNYC Surveys and Participant Evaluations: What are the outcomes of volunteer planting events and street tree provision through the tree request program on stewardship and public perceptions of the urban forest? (Ruth Rae, 2013)
- Deep Roots: how do various strategies of engagement and education under the MTNYC campaign effectively encourage tree stewardship among New Yorkers and strengthen the MTNYC tree care program? (Ruth Rae, 2012)
- East New York Farms! (ENYF) Youth Internship Program: What are the impacts and successes of a youth employment program engaging teenagers in sustainable food production, farmers market operations, and a curriculum based on food justice and food systems? (Lindsay Campbell, Nancy Sonti, w/ East New York Farms! 2013)

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I. Social and Site Assessments

Acknowledging the approximately 8.5 million people who live in New York City, and the many others who visit and work here, research efforts are guided by these core questions:

- I. How does the public understand, use, and value a variety of site types in the urban forest, including parks, gardens, community gardens, natural areas, and GI?
- II. How can an understanding of public perceptions inform more effective land management and maintenance practices and enhance the value of our urban natural resources to our city's communities?

Priority inquiries:

- How do people use, value, and perceive natural areas? How does public perception vary across site type and quality and maintenance of the site? How does the public outside of the city perceive urban natural areas?
- Who is using and thinking about the natural areas, and how can we engage them? How do we encourage diverse communities to use natural areas?
- How does the public perceive salt marsh restoration practices? *
- How does the public perceive and value parks and gardens? What do these sites mean to the public? How do people use or misuse parks and gardens? (Do they invite or exclude? Frighten or inspire?)
- What are the public's perceptions of native vs. non-native ornamental plantings?
- What are New Yorker's perceptions of beauty, and what is the role of horticulture in determining or interacting with these perceptions of beauty?
- How is a sustainable city constructed through non-rational modes of communication, feeling, and thought? What is the role of arts and creative practice in creating a sustainable city? What is the role of affect and feeling in creating a sustainable city?

Current work

- Legacies of the Dump: What are Staten Island residents' memories of the landfill, and their perceptions, fears and interests in using the future Freshkills Park? (Lindsay Campbell, Erika Svendsen, w/ David Klenosky -- Purdue University, Christine Vogt -- Michigan State University, Eloise Hirsh -- Freshkills Park, NYC Parks, 2010-present)
- Attitudes towards and Intentions to Visit Freshkills Park: How do neighboring community members perceive the site and its ongoing transformation; and what are their intentions to visit the future park? (Lindsay Campbell, Erika Svendsen w/David Klenosky -- Purdue University, Christine Vogt -- Michigan State University, Stephanie Snyder -- US Forest Service, 2010-present)
- Reading the landscape: A social assessment of community use of green space in New York City: What are the uses, meanings, and values of public greenspace in New York City? (Erika Svendsen, Nancy Sonti, Lindsay Campbell, Gillian Baine, Novem Auyeung, Michelle Johnson, 2013-present)

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J. Temporal Dynamics in the Urban Forest

A diverse, dynamic, and complex system, New York City's urban forest² changes in structure and composition over time. Examining change is key to our understanding of the entire system and to specific sites or site types. These inquiries rely on critical long-term datasets that must be established and stewarded as valuable resources, just as we manage the many natural resources in the city's urban environment.

Guiding questions include

- I. How do the composition, structure, and function of New York City's urban forest change over time?
- II. How does governance, use, management, and stewardship of New York City's urban forest change over time?
- III. How can we best measure, monitor, and analyze to understand New York City as a dynamic social-ecological system?
- IV. What are the major pulses and presses that driving temporal change in the social-ecological system? How do they vary across space, site type, and population?

Priority inquiries:

- How can we connect historical spatially explicit land-cover datasets to the current ecological assessment dataset to inform management decisions?
- How do the dynamics of vegetative recruitment and germination in natural areas respond to a changing climate?
- What are the conditions and factors influencing street tree growth, health, survival, and mortality? How do urban street trees—at the individual and species levels—respond to particular disturbances (such as the biological threats of Emerald Ash Borer and Asian Long-horned Beetle, and the meteorological threat of inundation that was caused by Hurricane Sandy)? What metrics allow for early detection of a tree's decline in response to these threats?
- How have NYC's forests changed over the last 80 years in their structure and composition? How do tree growth rates vary across sites and species?
- What is the evidence for salt marsh migration occurring in New York City over the last 5 years? What are the potential contributing factors to salt marsh retreat at NYC Parks & Recreation study sites?
- What geographic scale and time scale should we be planning for restoration? (20 year? 30 year?) What should be included in the plan?
- What are the historic and ongoing rates of salt marsh loss, and what are the causes? Which factors are most significant and how do they impact our restoration goals and strategies?
- What are the historic and ongoing rates of freshwater wetland and stream loss, with what causes? Which factors are most significant and how do they impact our restoration goals and strategies?

² As noted in the Introduction, we define New York City's urban forest as the many diverse plant and animal assemblages, the many successional landscapes, the matrix of human and non-human worlds, waterways and wetlands, grasslands and forested areas, streetscapes, grey areas, green areas, and all habitants of the five boroughs.

- How can we understand urban waterways (e.g. Gowanus Canal, Newtown Creek, Bronx River) as dynamic sites of urban environmental change (both as a driver of social change and an object of social forces)? How can interdisciplinary perspectives be brought to bear to help understand the transformations in this waterway and watershed? What can we learn from NYC waterways to help inform other waterway restoration and redevelopment practices?

Current work

- Street Tree Census
- i-Tree
- STEW-MAP
- How has land cover changed in New York City from 1980-present? How has stewardship changed over that same time period? Building footprint? How do these three variables relate? (Chris Small – Columbia LDEO, Dana Fisher – U. Maryland, Dexter Locke – Clark U., Jackie Lu and Kristy King – NYC Parks, Erika Svendsen, Lindsay Campbell, Nancy Falxa Raymond, 2008- present)
- Long-term Reforestation study
- Metroflora project
- SET – Wetlands analysis
- Community Gardens
- Young Street tree mortality study
- Long term forest reference plots

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III. Organizations and Initiatives

Funding/Staffing

- How can we best promote both the **research priorities** of the UFS as well as the **communications, marketing, and collaboration goals**?
 - What research areas are important to staff with additional scientists in order to move our science plan forward?
 - What non-scientist positions do we need to be able to move the UFS to the next level in terms of our supporting priorities?
 - How do we expand our capacity in order to do consistent and rigorous literature reviews? In-house librarian or research reference person? Literature review team?
 - Graduate level research fellows
 - Post-doc researchers
 - Outreach and partnership building
 - Liaison to other DPR divisions and other city agencies
 - Communications specialist
 - Data manager and/or Data committee
- How do we continue to engage interns, fellows, affiliates, and partners over the long term?
- What non-human resources are top priorities for supporting our work?
 - Data management infrastructure
 - TACCIAMO or similar data management resources
 - Facility maintenance increase
 - Publication design and printing budget
 - Web and social media development
 - Library and journal access

Policy and Regulation

- How can we best understand and influence the regulatory framework in which we operate? What do we do in the face of conflicts between science and policy?
 - Can research on foraging and the park rules about foraging in NYC co-exist?
 - Attendance at DPR meetings, cross-reporting between Urban Field Season and other Parks divisions

Internal Communication

- How can we be more effective communicators with each other, our colleagues? How do we more efficiently share knowledge and adapt to new research? How do we ensure that our internal communications effectively influence our policies and practices?
 - How can we be better informed about past work and what is the best platform for past and/or future data sets?
 - How do we define our own terminology, i.e. the meaning of the words 'restoration', 'forest management', 'ecosystem management', 'disturbance'?
 - How can we keep vital our core partnership (USDA FS and Parks)?
-

- How do we keep current on our colleagues' work? Can we establish a searchable database of our own work?
- How do we regularly engage in collaborative meetings (like the Science Planning meetings) to keep our work fresh?

Professional Development

- How can we enrich our professional experience? (Informal brown-bag seminars? Formal seminars, such as the Science of the Living City seminars?)
- What will make us more effective managers?
- How can we encourage good data management (the right technology? personnel? time management? funding?)
- How can we keep up with the data that is coming from other agencies, and how can we share this data to solve management questions?

External Communication

- How can we best inform other stakeholders--Parks Management & Operations, the public--about our programs and decision-making process?
 - How do we communicate to the public the value and functioning of green infrastructure?
 - How do we educate the public about wildlife management--whether piping plovers or deer?
- How can we be more effective marketers? How do we translate our work to the everyday New Yorker? How can we share data, results, and ongoing projects with the public and with other cooperators?
 - How can existing GIS databases inform environmental education efforts?
- How do we effectively communicate our science, practices, and needs to politicians?
- Can we fund a new communications staff person, or allocate current staff time to strategic communications tasks?
- How can we strengthen the Urban Field Station brand?

Deliverables/Output

- What should we be producing, either annually or other, to promote (both internally and externally) the work and importance of the NYC Urban Field Station?
 - The Science Plan?
 - One page fact sheets for key research projects?
 - Library of slides for presentations
 - single slide on UFS
 - single slide on ongoing research
 - single slides on what is known in a particular topic / lit review
 - what is NYC nature?

- Template for speeches
- Keep the Parks press office up to date: annual report by subject area, keep research current
- Parks monthly highlights – link these to the press office
- Joint website?

Current communications efforts and products

INTERNAL

- Monthly field station meetings for reporting progress, introducing new projects and opportunities
- Groupthink/informal brown-bag meetings: monthly lab meetings to discuss ongoing research and pressing questions

EXTERNAL

- Annual report: to summarize year's accomplishments
- Website
- Blog posts
- Academic articles
- Social media
- Presentations
- Seminars and special events

Science of the Living City

Seminars

The Science of the Living City Seminar Series, which convenes approximately once a month around the city and focuses on diverse and interdisciplinary topics in the urban environment, has many functions: (1) it sparks new professional connections and strengthens our existing partnerships; (2) it serves as a professional development / continuing education opportunity for our staff; (3) it engages the interested public and the broad scientific community. With the seminars, we can begin to answer some of our science questions and open dialogue about these ideas. We may also be reminded of the important, related work that others are also pursuing around the city. We can cultivate new and strengthen existing research partnerships with our co-hosts and attendees.

Fellowships

This first year of the Science of the Living City graduate level fellowship allows us to strengthen our research partnership with Yale School of Forestry & Environmental studies and to engage with emerging scientists and scholars in a mutually beneficial agreement. Students advance in their development and connect to professionals in the field; we expand in our capacity to address our priority research questions and projects.

Workshops, Trainings, and Symposia

These special events come up intermittently throughout the year and take many forms.

- Technical trainings and professional for agency divisions
- Co-sponsoring symposia (e.g.: Macaulay Biodiversity in Urban Parks Symposium; Yale Urban Ecosystem Services Symposium; MillionTreesNYC Symposium at the New School)
- Others special event opportunities that arise (e.g. on-site talks at Fort Totten and field tours)

Environmental Education

A variety of environmental education projects and programs allow the Urban Field Station to reach diverse audiences of many ages across the city. These programs may serve multiple purposes: as vehicles for communicating our new and ongoing research findings; opportunities for the personal, cognitive, psycho-social, and intellectual development for students; and gateways for learning that enhance support for our agencies' programs and resources.

Current and past environmental education efforts

- Wave Hill Woodland Ecology Research Mentorship: A mentoring program for academically high-achieving high school students from a number of underserved areas of the Bronx and Brooklyn that exposes them to both urban forest ecology and social-ecological research methods. (Nancy Sonti, Clara Pregitzer, 2013-present)
- Green Girls: A program on dragonflies for the City Parks Foundation's Green Girls summer environmental camp, which introduces disadvantaged girls to nature through working with female scientists. (Susan Stanley, 2009-present)
- New York City Minority Youth Environmental Training Institute: The UFS hosted an intensive, science-based, residential environmental education and environmental career development program for students from the National Environmental Hispanic Council as part of the 8th annual New York City Minority Youth Environmental Training Institute. (Erika Svendsen, Lindsay Campbell, 2013-present)
- Urban Soils in Restoration Sites Over Time: A hands-on field day at Alley Pond Park for graduate students from Brooklyn College, which initiated their semester-long urban soils class. (Brady Simmons, Clara Pregitzer, w/ Dr. Joshua Cheng -- Brooklyn College, 2012)
- Woodland Salamander Monitoring Project: The training and deployment of 285 middle school students from 5 schools to study terrestrial salamanders in six NYC parks and Black Rock Forest near Cornwall, New York. (NYC Parks w/Urban Park Rangers, Black Rock Forest Consortium, 2011)
- Bronx River On-Water Education Program: A research project focusing on social science data collection and verification for the STEW-MAP. (US Forest Service w/ Rocking the Boat, 2010)
- Bronx River Youth Urban Forestry Empowerment program with Trees New York

IV. Research Networks and Partners

The work of the Urban Field Station has often been crafted and conducted in collaboration with one or more partners in civic, municipal, and academic institutions within New York City and beyond. Many of these partners are actively engaged in related work on their own. In embarking on new projects and inquiries, it is critical to consider the current work, expertise, and capacity of our close partners and to explore further opportunities for collaboration. These partners have historically served the Urban Field Station in a number of ways: as sources of preexisting expertise, as project collaborators and advisors, partners in pursuit of grant funding, co-authors and contributors to product development, and outlets for communication and sharing specific and ongoing work of the field station. Our research, communication, and programming efforts should constantly strive to strengthen and reinforce these partnerships.

Core questions regarding our existing and potential professional networks include:

- How can we bolster our outside academic, government, and private entity partnerships? What institutions or researchers should we be reaching out to?
 - How can we partner with the DOE to incorporate UFS-relevant issues into their curricula and students' outdoor experiences?
 - How can the UFS partner with Parks' UPR?
- How can we strengthen the network of USDA FS urban field stations (and other sites)? What infrastructure/technology do we need in order to scale up our projects beyond NYC?
 - Can we create a joint fellowship program for urban field stations?
 - Will the Smart Forest project be a good model going forward?
- Should we be expanding our efforts to engage with the public for research and monitoring?
 - What crowd-sourced resources exist that could help such an effort? Data hacking?
 - How could or should we engage with civic science practices?
- What non-traditional partners might help invigorate the Field Station facility and enliven our work? (i.e.: in the arts and humanities)

Research Partners:

- USDA Forest Service, Northern Research Station (founding partner)
- New York City Department of Parks and Recreation (founding partner)
 - Forestry, Horticulture, and Natural Resources
 - Green Apple Corps
 - GreenThumb Community Gardening Program
 - Partnerships for Parks
 - Urban Park Rangers
- Natural Areas Conservancy
- American Community Gardening Association
- American Littoral Society – Northeast Chapter
- American Museum of Natural History (AMNH)
- Approach Design Office
- Black Rock Forest Consortium
- Brooklyn Botanic Garden
- Central Park Conservancy
- Cities and the Environment (CATE) Journal

- Citizens Committee for New York City
- The City University of New York (CUNY)
 - CUNY Institute for Sustainable Cities
 - Center for Urban Environmental Reform at CUNY Law
 - City College of New York – Spitzer School of Architecture
 - Macaulay Honors College
 - Mapping Service at the Center for Urban Research
- Columbia University
 - Department of Ecology, Evolution, and Environmental Biology (E3B)
 - Department of Sociology
 - Graduate School of Architecture, Planning and Preservation
- Cornell University
 - Civic Ecology Lab
 - Department of Natural Resources
- Connecticut Historical Society
- David Maddox, Sound Science
- Drexel University
- Drury University
 - Hammons School of Architecture
- Fordham University
- Forest ReLeaf of Missouri
- Gowanus Canal Conservancy
- GrowNYC
- Harlem Link Charter School
- Harlem River Working Group
- Horticultural Society of New York
- Hudson River Foundation
- Institute for Culture and Ecology
- Michigan State University
 - Department of Community Sustainability
- Million Trees NYC
- Municipal Arts Society
- National Park Service
 - Federal Hall National Memorial
 - Rivers, Trails, and Conservation Assistance Program
- The Nature Conservancy Regional Network
- NYC Audubon
- New York City Department of Health and Mental Hygiene, East & Central Harlem, District Planning Health Office
- New York City Housing Authority
 - Garden and Greening Program
- New York City Department of Environmental Protection
- New York City Office of Long Term Planning and Sustainability
- New York City Soil and Water Conservation District
- New York – New Jersey Harbor Estuary Program
- New York Restoration Project
- New York State Energy Research and Development Authority
- New York Tree Trust

- New York University College of Dentistry
- OASIS: Open Accessible Space Information System
- Parsons The New School for Design
 - Tishman Center for Environment and Design
 - School for Constructed Environments
- Paperwhite Studio
- Purdue University
 - Department of Health and Kinesiology
- Pure and Applied
- Rocking the Boat
- Rutgers University Department of Geography
- TILL Design
- TKF Foundation
- Trees New York
- Trust for Public Land
- Urban Interface
- Urban Natural Resources Institute
- Ursinus College
- United States Environmental Protection Agency (EPA), Region 2 – OPM
- University of Maryland College Park Center for Society and the Environment
- University of Massachusetts - Amherst
 - Department of Environmental Conservation
- University of Vermont
 - Rubenstein School of Environment and Natural Resources
 - Spatial Analysis Lab
- Voices of September 11th
- Wave Hill
- Wildlife Conservation Society
- Yale School of Forestry & Environmental Studies
 - The Bradford Lab
 - Hixon Center for Urban Ecology
 - Urban Ecology and Design Laboratory
 - Urban Resources Initiative (URI)

Research Networks: local, regional, and national

- The Green, the Grey and the Human: an interdisciplinary research team including Mary Northridge of the NYU College of Dentistry and Sara Metcalf of the State University of New York at Buffalo
- MillionTreesNYC Research and Evaluation Subcommittee
- NSF RCN-SEES for Urban Sustainability: Research Coordination and Synthesis for a Transformative Future
- Open Spaces, Sacred Places: The Tom and Kitty Stoner Foundation
- PopTech: A global community of innovators
- ULTRA-EX: Understanding the Dynamic Connections Among Stewardship, Land Cover, and Ecosystem Services in New York City's Urban Forest
- Urban Ecology Collaborative: a multi-city network of researchers and practitioners
- Urban Waters Partnership: Bronx and Harlem River Watersheds
- Vibrant Cities: A National Call to Action