5 Mixed methods analysis of urban environmental stewardship networks[1]

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5.1 INTRODUCTION

The set of organizations associated with governance of urban ecological processes has shifted since the 1970s (Weber 2000; Kempton et al. 2001; Horton 2004; Corburn 2005; Andrews and Edwards 2005; Svendsen and Campbell 2005; Kramer 2007). In this time, local urban environmental stewardship groups have become an important part of the regular management of natural systems in cities (Shabecoff 1996; Svendsen and Campbell 2005; Ernstson et al. 2008, 2010a; Connolly et al. 2013; Fisher and Svendsen 2014). Environmental stewardship groups include a wide array of organizations that work to conserve, manage, monitor, advocate for, and educate their friends, neighbors, and representatives about a range of quality of life issues (Fisher et al. 2007). These groups may be informal or formal, and may include large non-governmental organizations (NGOs) and small community associations that work on environmental issues (see Fisher et al. 2012). A 2005 report from the United States Environmental Protection Agency (EPA) recognized the essential role stewardship groups play in the social infrastructure of urban sustainability. The report stated, 'We believe environmental stewardship offers great potential for solving some of our most challenging problems and that it can help galvanize collaborations with a broader range of stakeholders' (US EPA 2005, p. i).

The growth of urban environmental stewardship is primarily a product of a renewed push toward civic engagement around local environmental issues (Sirianni and Friedland 2001, ch. 3; Fisher et al. 2011). However, because urban environmental stewardship groups work within networks of state and non-state organizations and across multiple scales (local to global), they are essential for efforts to increase the capacity of cities to respond to uncertainty introduced by climate change and to manage urban ecosystem services (Adger et al. 2005; Bulkeley and Betsill 2005; Lebel et al. 2006; Biermann 2007; Daily et al. 2009). Emerging studies have begun to examine whether stewardship groups working across scales and in multiple sectors allow knowledge and resources to be redirected in a coordinated fashion, thus leading to more flexible and adaptive urban environmental governance systems (Ernstson et al. 2010a; Connolly et al. 2013). Also, studies have examined how community structure within networks and local levels of engagement may create uneven management of local ecosystem services (Heynen 2006; Swyngedouw 2005).

However, our knowledge of how the growing set of stewardship groups affects urban environmental governance is still emerging. Both the increased interactivity and the new power relations embedded within urban environmental stewardship processes impact the capacity for cities to serve as points of intervention in environmental processes. As

a result, a more detailed understanding of the structure and function of stewardship groups within urban governance networks is needed. The structure of networks can be quantified and mapped, but the function stewardship groups serve within governance processes requires a broader qualitative understanding. Specifically, questions around how stewardship organizations build their legitimacy, trust, and credibility require different types of information – and hence different methods of data acquisition – than questions focused on the number, type, and location of organizations relative to ecological resources. Clearly, these questions are related. When efforts to answer them are effectively integrated, the multiple ways in which urban environmental stewards might increase our capacity for sustainability and social-ecological resilience in a rapidly urbanizing world can be better understood. As a result, stewardship is representative of the need within the field of environmental studies to embrace a robust model of mixed methods research.

While mixed methods approaches to research have been accepted practice within the social sciences for several decades (Tashakkori and Teddlie 2003), the rising demand for cross-disciplinary analyses of socio-environmental processes has necessitated a renewed examination of this approach within environmental studies. Urban environmental stewardship is one area where it is clear that neither a quantitative nor qualitative approach can provide a full understanding. Rather, the typologies and relationships identified by quantitative data are essential to structuring qualitative data collection strategies in such a way as to lead to specific knowledge of how stewardship groups affect governance systems by carrying information and resources across sectors and scales. In short, stewardship is an issue within environmental studies that demands a mixed methods approach in order to understand the social-ecological implications. This chapter demonstrates one way in which such research might be structured.

5.2 URBAN ENVIRONMENTAL GOVERNANCE AND STEWARDSHIP

The focus upon human interactions with ecological processes has increasingly led the field of environmental studies toward an interest in urban environmental governance. Derived from analyses of public management at all scales, governance theory is an organizing framework that conceptualizes the multi-scale shift away from prior top-down state-centered approaches toward more interactive policymaking processes (Rhodes 1996; Jordan 2008; Gustavsson et al. 2009). This shift involves the state working along with private sector and civil society organizations in order to negotiate and mediate between divergent viewpoints and interests (UNDP 1997; Stoker 1998; Stren 2003). While the shift toward governance as a mode of public decision-making has been observed at all scales throughout the world (Brenner 1999), 'it is at the local level that universal norms for good governance meet the messy reality of competing interests and priorities' (UN-HABITAT 2000, p. 197).

Reflective of the messy reality involved with urban governance, non-governmental urban environmental stewardship groups sometimes work against public and private sector interests as political advocates and sometimes work with these same interests as on-the-ground labor to preserve various ecosystem services such as air and water filtration, habitat connectivity, and human recreation (Grove et al. 2005; Fisher et al. 2007, 2012;

Svendsen and Campbell 2008; Connolly et al. 2013). They do so in locations ranging in size from neighborhood blocks and waterfronts to watersheds and estuaries to entire cities and regions. As a result, in densely populated urban environments, stewardship has become an increasingly complex process. Thus, stewardship networks have emerged as a social response to the demands for integrated knowledge of local and global conditions, coordination across scales, and strong connections among an array of social actors.

The New York Restoration Project (NYRP) is one urban environmental stewardship group that is exemplary of recent trends in the field. This group partners with public sector agencies, private sector donors, and local community residents to maintain and upgrade park spaces, community gardens, street trees, waterways, and other ecological resources within New York City. As well, NYRP relies upon neighborhood-based civic voluntarism as a key resource to support its activities. As is the case with most groups working as urban environmental stewards, civic engagement and environmental management are not distinct activities – the two realms are linked in all aspects of their work and NYRP is one of hundreds of such groups in New York City. The sites where these groups work are seen by volunteers as important for their neighborhoods in the sense that the natural resources within them aid human health and well-being (Campbell and Weisen 2009).

The connection with civic engagement that NYRP reflects makes environmental stewardship an especially interesting lens through which to view human–environment interactions. While many scholars have observed an apparent withdrawal of Americans from political and social life, urban environmental stewardship seems to be an ascendant activity with a strong civic engagement component (see Almond and Verba 1963; Smith 1994; Putnam 1995, 1996, 2000; Eliasoph 1998; McPherson et al. 2006). For example, recent stewardship research surveyed 506 groups in New York, New York, 163 groups in Baltimore, Maryland, 144 groups in Seattle, Washington, and 370 groups in Chicago, Illinois (see Fisher et al. 2012; Romolini et al. 2013; Westphal et al. 2014). Most of these groups have formed since the 1970s and have been increasingly active within their cities. These groups demonstrate that stewardship comprises a uniquely local and expanding source of civic voluntarism motivated not only by abstract notions of environmental conservation, but also by more concrete notions of enhanced quality of life (Cox and Bower 1998; Shandas and Messer 2008; Svendsen 2009).

Our knowledge of how local urban environmental activism works as a countertrend to declining civic engagement in the United States is still emerging (Putnam 2000, ch. 9), as is our knowledge of stewardship on the international scale. In addition to studies in the United States, stewardship networks have been examined in Stockholm, Sweden (Barthel 2006; Colding et al. 2006; Ernston et al. 2010a), the United Kingdom (Holt et al. 2012), Cape Town, South Africa (Ernstson et al. 2010b), Australia (Carr 2002), and Nova Scotia, Canada (Conrad and Daoust 2008). The growing literature in this area points toward the need to develop robust methods for analyzing stewardship across a variety of contexts.

5.3 MIXED METHODS RESEARCH IN ENVIRONMENTAL STUDIES

The field of environmental studies – positioned as it is across the humanities, natural sciences, and social sciences – inherently engages with an array of approaches to

understanding social and environmental phenomena. The focus on human-environment interactions that defines the 'second environmental science' and environmental studies more broadly highlights the need for integration of data generated as a result of the methodological preferences within various epistemologies (Stern 1993; Ivankova and Kawamura 2010; Symonds and Gorard 2010). This position is not unique to environmental studies. Rather, an array of physical and social science researchers have worked across the methodological divisions defined by debates over qualitative and quantitative paradigms that have often kept analysis of human and ecological systems separate. For example, this approach has characterized a portion of the research on coupled human and natural systems, sustainability, social-ecological systems, anthropogenic climate change, vulnerability, risk, and common-property resources (for example, Turner et al. 2003; Rosenzweig et al. 2008). While the interactions between social and ecological systems have led researchers toward integration of various types of data, the dominance of quantitative methods within certain fields remains a challenge to such approaches (Morgan 2007).

Biermann (2007) highlights the link between the cross-disciplinary complexities associated with 'earth systems analysis' and the need for mixed methodological approaches to understanding 'earth systems governance'. He argues that the governance and institutional analysis associated with questions of environmental sustainability cannot be adequately addressed by 'computer-modeling, quantification and epistemological uniformism'. Rather, he proposes that the methods common to the physical sciences are lacking in their capacity to incorporate humans into coupled human and natural systems. The approach of the physical sciences should, for Biermann, be blended with others that 'follow the internal logic and particular theoretical, epistemological and methodological approaches of the social sciences and the humanities' (2007, p. 328). Indeed, a number of large grant-funding entities focused on sustainability research including the United States National Science Foundation and the United States Environmental Protection Agency reflect this need through requirements for cross-disciplinary research designs and teams.

Biermann points toward the fact that urban earth systems governance is not an 'intransitive object' of study (the function of which does not rely upon our knowledge of it). As Bhaskar (1978, ch. 1) comments, whether Newton explained the tides or not, they would still turn. However, this 'intransitive' condition does not apply to social-ecological processes. Urban ecosystem services, for example, are dependent upon how we build our cities, a condition dependent at least in part upon our knowledge of how cities affect the environment. As a result, urban environmental stewardship is built upon an iterative spooling of knowledge about existing conditions in cities, actions to shape those conditions, new knowledge, and so on. Understanding how this integrated aspect of social and ecological conditions in cities works requires information about how knowledge gets transferred to action within governance networks and how that action affects ecological conditions. Therefore, the classic epistemology of scientific inquiry which frames knowledge as a collection of facts about intransitive objects is inadequate. Rather, because the ecological conditions that stewards seek to affect and the stewards themselves cannot be separated, data appropriate to a variety of objects of study is needed.

Through continued engagement with cross-disciplinary research, the field of environmental studies is well-positioned to leverage the primary benefit of mixed methods

analysis: the capacity to triangulate across various types of data, including quantitative and qualitative. The mixed methods paradigm is premised upon the notion that the biases inherent to any single method of data collection can be counteracted through the use of other types of data that do not contain those biases (Jick 1979; Cresswell 2005). Similar to Biermann, mixed methods researchers argue that neither qualitative nor quantitative methods are sufficient for most research problems (Tashakkori and Teddlie 2003; Ivankova et al. 2006). However, these authors assert, when the research design strategically integrates the data collection and analysis process across qualitative and quantitative methods, the result is often a more robust set of findings that can account for interactions between coupled human and natural systems. The challenge, though, is to truly integrate the research steps in order to avoid a disparate set of disconnected analyses (Greene et al. 1989).

Triangulation of findings across data sources can be accomplished through a number of mixed methods research designs (Creswell 2003; Tashakkori and Teddlie 2003; Onwuegbuzie and Collins 2007). Two of the most common employ a concurrent or sequential strategy of qualitative and quantitative data collection. A concurrent strategy in the context of urban environmental governance involves collecting data on social and environmental processes at the same time and then integrating the results into a single output. One example of the concurrent method is found in Hofstede and colleagues' (1990) study of organizational cultures. Their study uses in-depth interviews of selected informants to understand how tasks, structure, and control characteristics relate within 20 organizations. They also use quantitative survey data from a stratified sample of organizational members in order to understand trends across organizations. They combine these data in the analysis phase to explain the source of differences in organizational cultures.

A sequential explanatory study design, on the other hand, involves developing findings in one domain – usually quantitative data is collected first – and then verifying or expanding those findings through collecting data in the other domain (Ivankova et al. 2006). Seawright and Gerring (2008) demonstrate a common use for the sequential method. Using data on gross domestic product (GDP) and levels of democracy for numerous countries, they demonstrate how 'large-N' quantitative case selection methods can be used to identify typical, diverse, extreme, deviant, and influential cases. Qualitative methods are then used to develop explanations for why certain cases fall where they do in the typology. In both concurrent and sequential modes of mixed methods analysis, the most important quality of the research design is that quantitative and qualitative data directly inform one another.

In order to accomplish an integrated understanding of urban environmental stewardship systems, this chapter presents a combined sequential and concurrent strategy for mixed methods data collection. The socio-spatial dynamics that shape organizational networks of urban environmental stewardship require concurrent collection of data focused on the organizations and the environmental conditions that those organizations work within. This first round of concurrent social and spatial data is generally quantitative. It identifies human-environment trends and key actors in the stewardship network. Once identified, these key actors are better understood through qualitative interviews. We now turn to a detailed examination of a combined concurrent and sequential explanatory study design for analyzing the urban environmental stewardship system in New York City.

5.4 THE CASE OF NEW YORK CITY

New York City is one example where urban environmental stewardship groups have grown rapidly in number, size, and visibility in recent decades. As a highly urbanized area with strong development pressures and a dense civil society, New York City is a particularly interesting case to examine relative to the problem of building adequate environmental governance structures. By the mid-nineteenth century, the city had rapidly developed into a major metropolis and a dense civic sector formed to advocate for quality-of-life issues such as tenants' rights, labor rights, community development, public art, urban design, and environmental protection (for example, Cordero-Guzman 2007).

More recently, our research shows that urban environmental stewardship in New York City has evolved over three stages since the 1970s. Between the beginning of 1970s and the beginning of the 1990s, much of the work on the local environment in New York City was linked to community development efforts designed to help the city and specific neighborhoods recover from the effects of disinvestment and fiscal crisis that resulted from the political, economic, and demographic shifts of the 1960s. By the 1990s, the base of organizations that formed during the turbulent prior two decades were working on community gardens, parks restoration, and water quality issues. As a result of continued efforts these groups established a stable political and economic position in the decades following the 1960s, setting the stage for growth in the system of urban environmental stewardship.

The second phase of stewardship activity was marked by economic expansion in New York City. As the economy recovered, pressure for more developable land drove city agencies to hand most of the 'In Rem' properties, which had been claimed for unpaid taxes, over to private developers. This step also led to battles over garden space, privatization of parkland, and development around waterfronts. These battles served to galvanize many of the early stewardship groups and force them to become a more cohesive citywide effort.

Finally, in the contemporary period of environmental stewardship in New York City, stewardship organizations have leveraged the political power developed in prior historical phases to gain standing in the decisions made by government agencies. They have increasingly become specialists utilized by public agencies in the environmental management process. Currently, environmental stewardship is a central part of the ongoing efforts to maintain quality-of-life in New York City that began in the nineteenth century. For example, stewardship of local ecosystem services plays prominently in New York City's current long-term sustainability planning initiative known as PlaNYC 2030.

5.5 ANALYZING URBAN ENVIRONMENTAL STEWARDSHIP SYSTEMS

In order to begin to understand how the urban environmental stewardship system carries knowledge and resources across sectors and scales in New York City, a group of researchers led by the Northern Research Station of the United States Forest Service developed a census of roughly 3000 stewardship groups. From this database, a concurrent strategy of collecting quantitative survey, demographic, and environmental data was developed. The

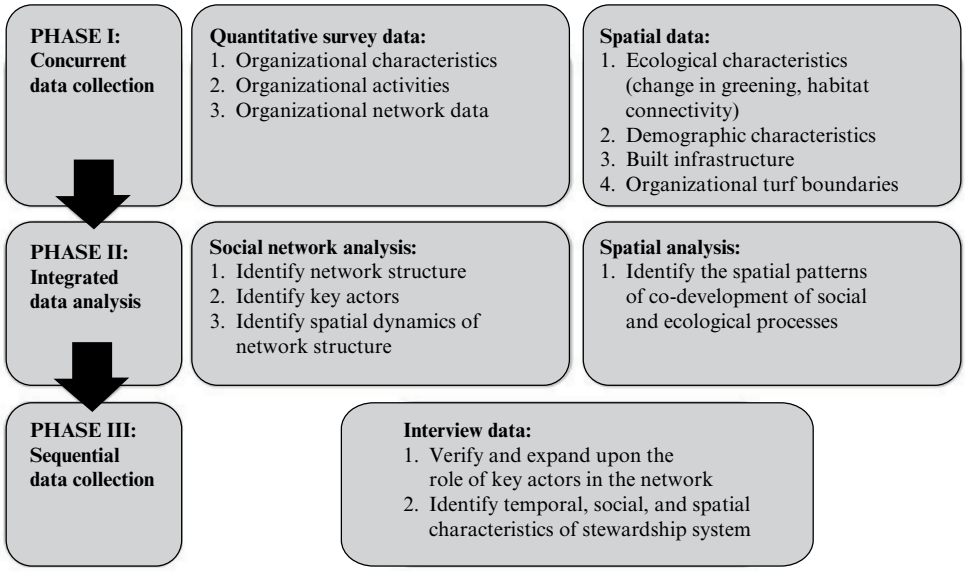

Figure 5.1 A three-phase sequential mixed methods data collection model was used to analyze organizational dynamics in the urban environmental stewardship system of New York City. The strategy included concurrent collection of survey and demographic/environmental spatial data in Phase 1

surveys distributed during this phase also contained a qualitative component. Once the survey and spatial (demographic and environmental) data were gathered, the first analytic phase involved combining these data in order to understand how spatial attributes structure stewardship activities. This analytic phase also involved analysis of the quantified structure and characteristics of stewardship networks. Next, in a sequential mixed method model, the network data were used to identify important actors within the network. These actors were then treated as distinct cases for further qualitative analysis. Figure 5.1 demonstrates the data collection model and the sections below provide greater detail about each step.

5.5.1 Survey Analysis

A critical element of the first phase of stewardship mapping is to enumerate the population for sampling. In general, the project focuses on civil society organizations, including both formal non-profits and groups of friends or associates that serve any of the following stewardship functions: conserving, managing, monitoring, advocating for, or educating their friends, neighbors, public officials, or the general public about the local environment (Fisher et al. 2007). Previous studies of local environmentalism have found that national directories of non-profit groups represent local groups inadequately (Kempton et al. 2001; Andrews and Edwards 2005; see also Brulle et al. 2007), so it is necessary to compile a list of local stewardship groups from other sources.

To develop the New York City sample of civic stewardship organizations, all of the

public agencies and non-profits that work at the citywide or borough-wide scale (there are five boroughs in New York City) on issues related to the environment and natural resource management were approached with a request to utilize their lists of organizational partners. Using multiple sources to compile the list of organizations reduces the likelihood that there are biases in the data based on any particular source (see particularly Brulle et al. 2007). A snowball sampling method was also used, whereby each of these large-scale data providers was asked to suggest additional potential data providers within the city, until saturation was reached (for a full discussion, see Fisher et al. 2012). This approach was applied to capture the core network of stewardship groups that are connected to the citywide environment and natural resource management community.

Once the individual databases were gathered in New York City, we applied several criteria in constructing the sampling frame:

1. *Location*. Groups outside the five boroughs of New York City were removed, although we did include groups located in New York City whose reach was regional, national, or international.
2. *Organization status*. Individuals without a group affiliation were removed.
3. *Civil society actors*. We excluded all public agencies, private businesses, and quasi-governmental entities such as local community boards from the survey responses (although not from the network).
4. *Complete addresses*. Groups with incomplete mailing information were removed from the sample.

With the sampling frame defined, a survey was designed as the primary method to learn about groups in our population sample. The New York City survey was administered both online (using SurveyMonkey, free online survey software) and via the US mail, with a standardized recruitment text, over an initial period of about six months. Whenever possible, email was the preferred method of contact. If an organization did not have an email address or the email address was determined to be invalid (that is, 'bounceback' messages were received), organizations were then contacted via the US mail. In New York City, all organizations received reminders (up to three) at intervals of two weeks via email, and one postcard reminder after one month via US mail. All organizations with a valid telephone number in the database received follow-up telephone call reminders over the course of the six months. In addition, a description of the study was included in local newsletters and 'listservs', and 'e-blasts' from some of the key project data providers for establishing the initial sample.

The survey protocol was divided into three sections in order to collect descriptive, geospatial, and social network data:

1. *Descriptive*. This section included questions soliciting information about the history and size of stewardship groups, their structure, and activities.
1. *Geospatial*. This section included questions about the specific boundaries of stewardship sites and territories for each group.
1. *Social network*. This section included questions about how specific groups or organizations are tied to others through funding, information exchanges, or partnerships.

The bulk of the questions on the survey protocol collected information about the type and location of stewardship work conducted and the structure of each organization, including organizational ties. Questions included the year the group or organization was founded, issues they work on (including non-environment focused activities like youth development and faith-based initiatives), and whether or not they employ paid staff. Responses to these questions yielded descriptive information about the scope and variability of groups. This data is the foundation for understanding how stewardship works across a city and region, and may be compared with data from other organizational studies.

Descriptive respondent data from the surveys were utilized in the process of mapping network dynamics and analyzing spatial trends to discover which neighborhoods or local areas were more or less connected in terms of stewardship capacity and potential. This integrated data analysis phase was designed to address questions such as: are there overlaps or gaps between groups and their corresponding turfs? Where are areas devoid of or lacking in stewardship activity? How does social network connectivity affect stewardship capacity? These questions are critical to assess alongside spatial information regarding demographics, urban green space, and environmental processes in order to represent a more complete picture of long-term natural resource management than would be possible in a one-dimensional analysis. In all, the survey and spatial data are the foundation of our efforts to understand stewardship turf as geopolitical space, changing and shifting over time in response to all manner of perturbations. Each stewardship polygon created from the survey data to display areas where groups work represents a certain degree of political power, sociocultural services and values. Thus, the social and environmental forces that shape stewardship are ripe for future research in environmental studies.

5.5.2 Spatial Analysis

Spatial analysis describes a range of techniques for understanding spatial patterns. These techniques include exploratory, descriptive, and statistical measures of the relationship between geographic entities (O'Sullivan and Unwin 2010). Because many disciplines generate geographic data, spatial analysis has the potential to serve as a point of integration – a common language of sorts – across social and ecological research. In line with this potential, spatial analysis (combined with social network analysis described below) was an important aspect of our integrated data analysis strategy (phase II).

Within the survey, the stewardship territory or 'turf' of each stewardship group was assumed to be spatially different than the footprint of municipal land use and property jurisdictions. This assumption arises from the fact that stewardship happens at multiple spatial scales across a city or region. Some stewardship activities, such as monitoring or restoration, are site-specific although the sites may range in size from a building rooftop to a many-thousand-acre nature preserve. Even at the neighborhood scale, a group may care for a block of street trees yet will also attend to an area along the waterfront and play an active role in a community garden around the corner. Other activities, including education or advocacy, may be carried out in a broader service area – for example, across a particular neighborhood or citywide. Therefore in any given circumstance, a group may care for a site or a cluster of sites that have a unique and particular geospatial footprint.

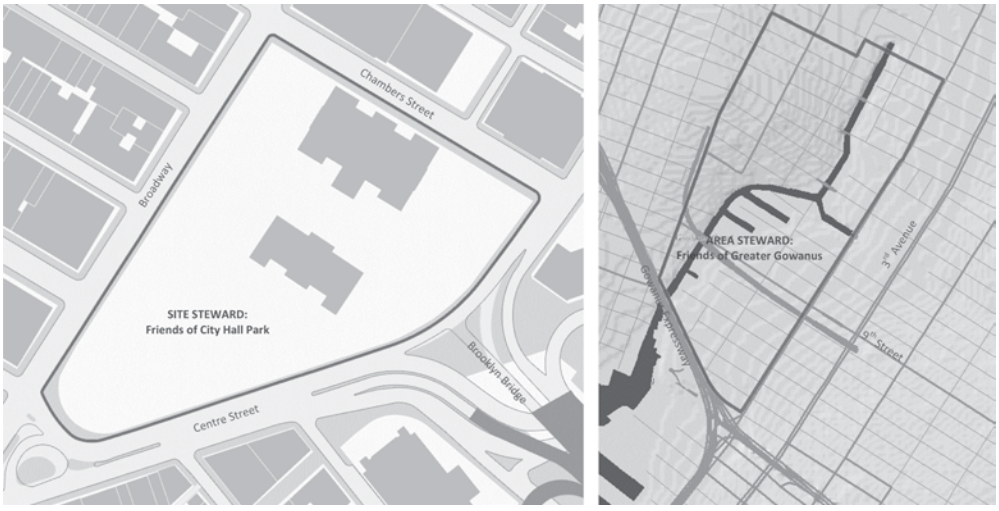

Figure 5.2 *The images above demonstrate two types of stewardship turf areas. The image on the left is the turf for a site-based group, the Friends of City Hall Park. The image on the right is the turf for an area-based group, Friends and Neighbors of Greater Gowanus (FROGG)*

A clear objective of this research was to understand how this civic landscape of stewardship relates to more easily identifiable forms of environmental management by public land managers and private property owners. In order to understand this relationship in a detailed fashion, each respondent was asked to provide multi-scale descriptions of where their group physically conducted its work in the designation area. This was accomplished through the use of a preselected, drop-down list of NYC neighborhoods in the online survey and an open-ended question designed to specify more precise locations of sites and areas where groups most often worked. From this data, we created polygons of service areas for input into spatial analytic software. Examples of a site-based stewardship polygon and an area-based polygon as shown in the online mapping tool known as STEW-MAP are shown in Figure 5.2. From this data, we were able to analyze the areas of active stewardship and further classify those areas according to the issues upon which organizations focused such as water access, park maintenance, or garden management.

Once the spatial extent of stewardship was clear, we analyzed the turf areas relative to additional environmental and demographic data. These data came from a number of sources readily available for cities throughout the United States and in many other countries. We analyzed stewardship relative to greenspace and changes in the extent of greenspace over several decades (measured per standardized area). The greenspace data were processed from raster grids of satellite imagery provided by the United States Geological Survey (Small and Lu 2006). We also examined stewardship relative to measurements of habitat connectivity within the city derived from satellite imagery and cadastral data showing detailed infrastructure in the city. Many cities including New York City have Light Detection and Ranging (LIDAR) remotely sensed measurements of infrastructure which provide highly detailed data. Also, we used social demographic

data available from the US Census and zoning, property value, and other policy-oriented data available from the City of New York.

The spatial relationships between these data have only begun to be explored. In bringing together stewardship and other socio-environmental data, forthcoming publications analyze whether changes in greening, levels of greenspace, degree of habitat connectivity, and rapid socio-demographic changes correlate with various levels of stewardship. This research design demonstrates the potential for using spatial analysis as an integrating platform across increasingly available high-resolution climate change data and spatially explicit stewardship data. This is one avenue for future research.

In all, the spatial data and spatial analytic component of the research examines how environmental management capacity is distributed across space. Emerging analysis of this data points toward locally specific unevenness in the relationship between environmental conditions, ecosystem services, and stewardship. This highlights the need to understand sustainability and resilience as a neighborhood-level management dilemma.

5.5.3 Social Network Analysis

Understanding the social networks of groups in relation to geophysical space is fundamental to learning how resources, materials, information and knowledge flow through New York City's stewardship system. Social network analysis (SNA) is commonly deployed as a quantitative method rooted in graph theory that provides a way to visualize and analyze complex networks (Wasserman and Faust 1994). Much SNA research is based on highly structured analysis of 'complete networks', wherein all participants in a network are enumerated and surveyed, such that every tie between every actor is documented, until a complete network matrix is collected. Other recent research examines 'ego networks' – the sets of ties closely linked to a set of egos (respondents) – and uses SNA more qualitatively, as a way to begin to visualize a component of the network that one is studying. The limitation of the latter is that researchers cannot use many of the most powerful quantitative tools to understand the structure and characteristics of the total network, because they do not know the nature of ties from un-surveyed members of the network (Hanneman and Riddle 2005). Ego networks do, however, elucidate the relations and ties of the egos in one's study, demonstrate the relative positioning of egos, and show an impressionistic sense of the local networks surrounding these egos (Wellman 1979; Marsden 1990; Scott 2000; Burt 2007).

Scholars have used network analysis to examine a broad set of social and natural science questions. As Rocheleau and Roth (2007) argue, networks have served as metaphors, models, and theoretical tools within this research that has examined topics including: the social networks of environmental stakeholders (Prell et al. 2009), communication patterns and resource exchange (Crona and Bodin 2006), links between social networks and resilience to climate change (Newman and Dale 2004), and organizational networks of urban civic environmental organizations (Ernstson et al. 2008). This line of inquiry is well established for studies that examine inter-organizational dynamics. Literature in sociology and political science, for example, has looked at organizational alliances (Ansell 2003), ties among organizations that share members (Carroll and Ratner 1996; Cornwell and Harrison 2004), and the presence, structure, and effects of 'civic networks' – which are defined as 'the web of collaborative ties and overlapping memberships between

participatory organizations, formally independent of the state, acting on behalf of collective and public interests' (Baldassari and Diani 2007, p. 736).

Our research builds upon the recent tradition that applies social network analysis to the understanding of environmental actors and networked governance. As this research demonstrates, network issues are implicit to the study of urban environmental stewardship. From the research questions posed about networked governance, to the methodologies employed, to the network diagrams we created, we were concerned with qualitative and quantitative aspects of the stewardship networks throughout. Specifically, we built upon the method developed by Baldassari and Diani (2007) that asked civic organizations to identify their top three partners. The New York City stewardship survey also asked each respondent to identify their top three partners (or 'alters' in social network lexicon) in each of the following sectors: government, civil society, the private sector, and schools. When the survey was replicated in other cities, though, additional network questions were added. For example, in Seattle, researchers explored the content of these network ties, asking whether groups received information, provided information, received funding, provided funding, or worked in coalitions (Romolini et al. 2013). These network questions provide operational data about how stewardship groups learn, adapt and grow across spatial territory.

Our survey gathered data on the most important ego-networks from each of the respondents described above. While this approach limits the scope of understanding that can be gained about the overall network, it does offer a 'representative sample of the social environment around respondents' (Marsden 1990, p. 438; see also Scott 2000; Wellman 1979). Also, prior research has found that certain network dynamics can be analyzed in a robust fashion with data on close ties. For example, Burt (2007, p. 119) finds, 'Brokerage benefits are dramatically concentrated in the immediate network . . . [and, as a result] brokerage can be measured with designs in which data are limited to an immediate network'. Therefore while this data cannot describe all aspects of the stewardship system, it is well suited to identify overall dynamics and discover specialized roles which groups may be playing.

Responses to the New York City survey underwent substantial quality assurance/quality control (QA/QC) from their raw state in order to prepare the data for analysis:

1. *Standardization*. (a) Names of organizations were standardized with a common spelling. (b) Any additional alters identified beyond the top three in each sector were excluded.
2. *Error checking*. (a) Any answers that were mischaracterized (for example, calling 'the Parks Department' a civic group) were recoded to the appropriate sector. (b) Any responses that could not be identified to a specific organization (for example, 'churches' and 'community boards') were recoded as 'GENERAL' and were excluded.
3. *Formatting*. Data were entered into an Excel database that was then imported into the software UCINET (Borgatti et al 2002).

Using social network analysis software UCINET and NetDraw we performed a wide range of analyses about the characteristics of networks and made graphic visualizations of the networks. Networks were portrayed as a series of nodes (dots) connected by ties (lines) and visualizations were customized using different orientations/layouts, sizes, and

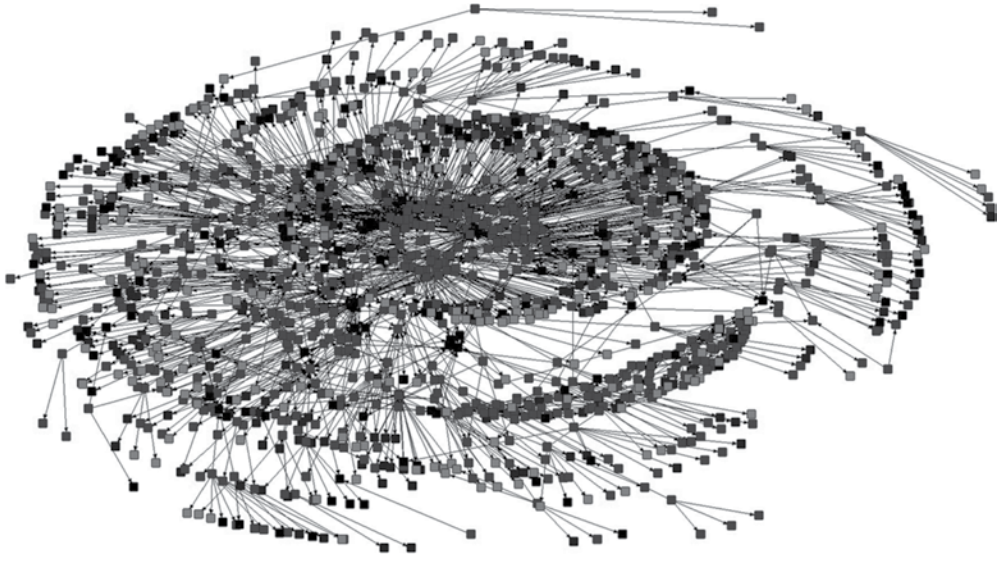

Figure 5.3 *This figure identifies the full stewardship network in New York City across civic, private, and public groups. Examination of this diagram reveals a strong coordinating role for public sector agencies which have numerous connections and lie at the center of the diagram*

colors. For example, we created a color-coded diagram of the overall stewardship network, including all respondents and their partners across public, private, civic, and educational spheres. This image, shown in black and white for exemplary purposes in Figure 5.3, demonstrated the full complexity and density of the New York City stewardship network and served as a useful illustration of the abstract concept of networked governance. Diagrams such as this pair well with qualitative accounts of case studies and statistical representations of survey findings to create a more robust and multi-dimensional understanding of urban stewardship. We also created more detailed views of the civic-to-government and civic-to-civic portions of the network, and calculated the overall network centralization of each. Comparison of these two networks revealed the civic-to-civic network to be more diffuse and polycentric than the civic-to-government network, which was more centralized and hierarchical. The civic-to-civic network continued to be an area of further research through our mixed-method approach (see interviews section).

Examination of the civic-to-civic network embedded within the diagram in Figure 5.3 shows that groups are clustered according to the types of sites that they steward in the urban environment. The functional communities within the network include land stewardship groups and groups focused on water-related issues. The civic stewardship network also includes clusters of groups with broad civic missions that extend beyond environmental stewardship. For example, there is a cluster of connected groups concerned with historic preservation, architecture, urban planning, and the built environment. To a lesser extent there are also some geographic clusters of connected groups working at the neighborhood scale, which include block associations, 'friends of' parks groups, and

community gardens. Our data show that the social and spatial structure of these networks matter for urban environmental stewardship outcomes.

Finally, we sought to understand the specialized roles that different actors played within the network. Because the study focuses on an ego-network rather than a complete network, the most important use of social network analysis software was to examine the positioning of actors relative to others within the known network. First, to get a ranking of the size of the nodes, we calculated the number of in-degree ties (the number of respondents that identified a group as a partner) and out-degree ties (the number of civic partners identified by the group, to a maximum of three) of each partner. We also calculated the betweenness of each respondent, which is a measure of the degree to which a point lies between other points in a graph (Scott 2000). We wanted to understand the way in which certain prominent, central actors with a high number of ties that also occupy important structural positions within the network were functioning as 'brokers' or 'bridge organizations' (Bodin et al. 2006; Burt 2007). Thus, we selected all organizations that were more than two standard deviations away from the mean in terms of both in-degree ties and betweenness (Connolly et al. 2013). This set of umbrella groups or 'bridge organizations' served as the sample used for our in-depth organizational interviews, described below. As network theory predicts, we found that these organizations are playing a crucial role in sharing information and resources in order to coordinate action across the network. These groups help bridge across sectors (public/private) and scales (citywide/neighborhood) in the complex management of urban environments. Our interview data, described below, allowed us to understand how and why these roles identified in the network analysis were performed.

5.5.4 Interview Analysis

There are a number of ways to do interview research that range from more to less structured. In some cases, interviews are completely scripted, with researchers reading the text of a survey verbatim to the subject. Responses to this type of interview are usually classified into categories and they tend to take the form of survey responses with limited options (like yes/no, or male/female). In other cases, interviews are much less structured and do not require a formal script. During such interviews, researchers ask a series of questions that are adjusted based on the subject and his or her responses to the questions (for more detail on this methodology, see Weiss 1994; Lofland et al. 2006; see also Khan and Fisher 2013, ch. 5). With this type of interviews, responses tend to be open-ended and analysis can take on a variety of forms that looks at similarities and differences in the responses across subjects. It is this less structured method that we utilize in our research on urban environmental stewardship.

Open-ended semi-structured interviews are frequently conducted at a field site with research subjects. In our case, most of our interviews take place in the offices of stewardship groups. Although this method is called 'semi-structured', researchers must determine the overall structure of the interviews. This step involves both deciding on the general questions to ask, as well as specific probes that may be utilized to direct the respondent as necessary. The questions are typically written up in an interview protocol, which is approved by a university's institutional review board prior to data collection.

Since the interviews are semi-structured, however, the researcher is able to follow any

theme that emerges in an interview that may be relevant to the research project. A keen focus on the structure of the interview ensures that the data collected will be analyzable to answer specific research questions. In most cases, interviews are recorded so that they can be transcribed – the content of the interview is typed for further analysis. Having all subjects' verbatim responses provides a dataset that can be analyzed and coded to answer the research questions. Because the researcher asked the same core questions of everyone in the dataset, analysis involves comparing and contrasting responses across the subjects. Each interview was conducted with two researchers present in order to provide cross-validation that the protocol was followed and that follow-up issues were explored.

To ensure that the findings from open-ended semi-structured interviews are generalizable, interview research must also develop a sample that is representative of the population to which the researcher wants to generalize. The strongest interview research is that which employs a sampling frame that either aims to include everyone in the population or that randomly selects respondents from the population. In the case of our research on urban environmental stewardship, we selected stewardship organizations that were most commonly named by their peers as collaborators and that occupied key bridging roles in the overall organizational network as measured by their betweenness scores (see network section). By selecting groups that were the most 'central' to the stewardship network in this manner, our interview data provides details about the network in general, and the leaders of the network specifically. The interview data collected with organizations selected because of their specialized roles within the stewardship networks of New York City provided in-depth understanding of how the selected organizations function to integrate social and environmental demands. The interviews also provided data about why these highly central roles form.

5.6 DIFFUSION OF THE METHOD TO AFFECT PRACTICE

The cross-disciplinary knowledge gained by the study described above has been integrated into management strategies for city parks and federal forestry plans. One example is the development of a public online tool known as STEW-MAP. Stewardship maps tell us about the presence, capacity, geographic turf, and social networks of environmental stewardship groups in a given city or region. The interactive STEW-MAP for New York City currently displays data for 405 stewardship groups citywide and shows the groups' turf areas alongside other open space data layers.

For the first time, these social infrastructure data are treated by policymakers and other interested parties as part of green infrastructure asset mapping. For example, managers in New York City's Department of Parks and Recreation have queried the data to find stewardship groups working near specific forest restoration projects. Funders or community organizers can also identify areas with the greatest or least presence of stewardship groups, taking into account organization size and focus area. Those seeking to disseminate policy information can target the most connected groups to quickly and effectively reach an entire network or a subset of groups. Finally, members of the public who want to know who is working in a particular neighborhood or who can provide technical resources for a project can search the database, which displays results as a list or on a map.

Practically speaking, this online map highlights existing stewardship gaps and overlaps in order to strengthen organizational capacities, enhance citizen monitoring, promote broader civic engagement with on-the-ground environmental projects, and build effective partnerships among stakeholders involved in urban sustainability. Thus, information generated by this method can help connect potentially fragmented stewardship groups with the ultimate goal of measuring, monitoring, and optimizing the contribution of our civic resources. In short, stewardship mapping is a tool with growing application for natural resource managers, funders, policymakers, educators, stewardship groups, and the public.

5.7 CONCLUSION

The strategy for analyzing urban environmental stewardship described above begins from the recognition that social-ecological issues are generally more complex than any one method can handle. Rather, triangulation across quantitative and qualitative data is required in order to integrate the epistemological directives of the relevant disciplines. We suggest that quantitative survey data is the most useful as a means for establishing a typology of stewardship. As well, spatial data on the extent of stewardship turfs, environmental conditions, demographics, and the built environment all serve as a basis for integrating social and ecological dynamics. Spatial analytic and social network methods serve as cross-platform techniques for combining the data, and interview methods allow for greater understanding of how and why certain stewards play keys roles in carrying information and resources across scales and sectors.

Urban environmental stewardship offers a lens through which the social structure of environmental management becomes visible. In further developing the methods described here to include emerging datasets around issues such as local climate change dynamics and international examples of stewardship, the neighborhood-scale challenges of environmental management can be better understood. Further, the unevenness that characterizes social capacity for managing environmental processes can be compared across cities.

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