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## Environmental Education Response to Hurricane Sandy in the New York Metropolitan Region

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Volunteers restoring dunes in Rockaway. Photo: B DuBois

### INTRODUCTION

In devastating forests, farmlands, coastlines, and even small city gardens and parks, disasters create openings in the landscape for new seedlings to take root. Fires, droughts, hurricanes, and war also change social systems – similarly creating space for new processes to emerge. For example, in New Orleans following the BP Oil Spill, over 100,000 local and non-local volunteers were involved in beach clean-ups,<sup>(11, 24)</sup> and in the aftermath of Hurricane Katrina, volunteers planted and cared for damaged trees as an expression of their rootedness and resilience.<sup>(22)</sup> Similarly, following the 9/11 terrorist attacks, hundreds of individuals and groups spontaneously planted flowers and trees to create living memorials in directly impacted communities of New York, Washington DC, Shanksville PA, as well as elsewhere across the US.<sup>(20)</sup> Interestingly, individuals who engage in pro-environmental behaviors often indicate having experienced an environmental disaster was important in motivating such behaviors.<sup>(3)</sup>

Drawing from the literature on disturbance and social-ecological systems resilience, McPhearson and Tidball<sup>(9)</sup> propose that disasters provide a niche for new environmental education (EE) programs to emerge, and that environmental educators should take advantage of such opportunities. In fact, the history of EE is in part a history of transformations following major disasters as well as in response to less drastic changes in social-ecological systems. The early EE nature study tradition in the US emerged following a period of widespread farm to city migration, causing concerns that young people would lose opportunities to learn from spending time in nature.<sup>(2)</sup> EE as nature study was radically transformed 30 years later, when devastating droughts and the associated Dust Bowl catalyzed a new conservation education movement focusing on wise use of natural resources and more sustainable agricultural practices. During the 1960s, EE once again underwent major changes, this time adapting a problem-solving approach in response to increasing awareness of environmental pollution.<sup>(14, 17, 18)</sup> More recently, societal recognition of how social and environmental concerns are inextricably linked has spurred new approaches to EE including place-based education,<sup>(16)</sup> Education for Sustainable Development,<sup>(10)</sup> and community EE.<sup>(12)</sup>

Climate change is increasingly permeating the media, politics, and our collective awareness, particularly when it manifests itself in major flooding and damage such as brought about by Hurricane Sandy. In response, EE has incorporated climate change into various curricula, with a focus largely on individual actions people can take to mitigate energy consumption and greenhouse gasses (Chaopricha, unpublished data). However, given the seriousness of the threats posed by climate change, simply amplifying existing messages and approaches focusing on individual behaviors raises questions about EE's effectiveness in addressing large-scale changes associated with climate change. On top of considering issues of scale mismatch, the reality of climate change suggests a need to step back and question some of the grounding assumptions of EE. For example, should EE play a role in climate change adaptation, or would that suggest an abandonment of EE's foundations of changing environmental attitudes and behaviors to improve environmental quality? Are there creative ways in which EE could integrate mitigation and adaptation? Should EE seek to focus on factors that lead to collective action in addition to individual behaviors?

Even if one believes that EE should transform its practices in light of climate change, the approaches for so doing are not evident. For this reason, we have embarked on two related projects. First we are conducting a literature and web search of climate change EE materials to determine if and how adaptation is being incorporated (Chaopricha and Krasny, in progress). Second we conducted a study of how EE providers in New York City were changing their practices following Hurricane Sandy. Because immediately after the devastating Hurricane in October 2012, media reports suggested a threshold change in the intensity of the public discourse about climate change, we hypothesized that EE programs might similarly be instituting major changes in their programming. In short, this paper addresses the following question: How did EE and related environmental learning and stewardship programs in and around New York City change in response to Hurricane Sandy?

In addressing this question, we used a learning arenas framework<sup>(6)</sup> that includes a broad range of EE and environmental learning opportunities. More specifically, we considered both structured

EE programs taking place in settings such as public gardens, parks, nature centers, schools, and summer youth programs, as well as learning that takes place through less formal activities such as hands-on restoration and stewardship (e.g., community gardening), recreational activities and demonstrations (e.g., bike rides with an educational theme), and community engagement in disaster planning and response.

## **METHODS**

### *Setting and participants*

This study took place 12-16 months following Hurricane Sandy in metropolitan New York City. Programs were initially identified through a selective sampling of 796 stewardship organizations listed on the US Forest Service STEW-MAP database.<sup>(4, 21)</sup> In particular, we chose stewardship organizations which, based on their location, were likely to have seen physical damage from Sandy or whose participants would have been impacted by the storm (e.g., groups in lower Manhattan were more impacted than groups in the Bronx). We also attempted to sample the large iconic green infrastructure and practice based institutions in metropolitan New York (e.g., The Nature Conservancy), along with the most networked organizations that were identified through the STEW-MAP analysis (e.g., Green Thumb).<sup>(1, 23)</sup> We pursued additional informants through snowball sampling where initial informants were asked to identify organizations that they thought may have adapted their work post-Sandy. Finally, we made contact with the Environmental Education Advisory Council of NYC, and reached out to member organizations on their list. Our final sample of 45 organizations was purposefully skewed to capture the organizations most likely to have made changes in their programs post-Sandy, but is not a representative or random sample of all organizations that conduct EE in NYC. Organizational missions varied (Table 1). For each organization we interviewed one educator or program leader, with the exception of organizations X and Y, where interviews were conducted with three staff members in different programs or at different levels of the same program; results from these interviews were combined in reporting the findings.

### *Data collection*

The first author conducted semi-structured interviews of key informants at each organization to determine changes in the organizations' EE and related programs post-Sandy. The questions focused on the organizations' typical work and on changes in the type of work, sites where programs are conducted, and messages conveyed through their programs, as well as any other changes in their work as a result of Hurricane Sandy. The phone and in-person interviews ranged from 30 to 60 minutes and were recorded and transcribed verbatim when possible; where interviews were not recorded detailed notes were taken during the interview. In five cases where an interview was not possible, informants responded via email. Themes emerging during the interviews were read back to the interviewees and refined using their feedback to improve reliability. The first author also conducted site visits to programs at eight organizations (Rockaway Waterfront Alliance, Breezy Point Green Committee, Lower East Side Ecology Center, The River Project, Rockaway Conservancy, Rocking the Boat, Smallwater, and The Urban Assembly New York Harbor School); and participant observation of community meetings, civic ecology practices (e.g., dune restoration), and other events at four organizations (New York Restoration Project, Gowanus Canal Conservancy, Breezy Point Green Committee, and American Littoral Society, Northeast Chapter). We also reviewed the mission statements and

online descriptions of the organizations, which was used to gain a fuller understanding of their typical work.

### *Data analysis*

The first author generated themes from the transcribed interviews using a grounded theory approach, where data collection, data analysis and theory development were pursued concurrently.<sup>(19)</sup> He then created a summary highlighting the general themes from the interviews. The summaries of emergent themes from the interviews were used to develop a coding strategy for changes in the work or meaning of the work described by the educators, which was used to code all transcripts. The second author then read all transcripts and suggested revisions of the coding scheme. Initial codes were defined and refined through constant comparison by both authors who agreed on the final coding scheme. A similar process was used for analyzing the mission statements.

### *Validity*

We ensured construct validity through discussions and review of our interview instrument by experts in EE. Additionally, field site visits and participant observation helped in interpreting and ground-truthing our findings. Finally, we asked participants to review the initial draft of our findings for their particular organizations, and received responses from all 39 out of 45 organizations. In all cases where study participants made changes in the categories we had assigned to their work based on interviews, they added rather than subtracted categories. At least three explanations are possible for the study participants' additions: (1) we missed important activities in the interviews; (2) seeing the categories we had assigned through coding the open-ended interviews, the study participants were reminded of additional activities they had forgotten to tell us earlier; and (3) study participants wanted to demonstrate the capacity of their organizations by showing they were doing more activities. Because we cannot distinguish which data set -- our original interpretations or the categories added by participants who reviewed results for their organizations -- is most accurate, we include both data sets in the findings.

## **FINDINGS**

### *Organizational profiles*

The majority of organizations (28) have an explicit environmental education focus, while nearly half (21) include community engagement based around the environment in their work (Table 1). Just less than half (19) incorporate civic ecology stewardship, while 18 engage in environmental advocacy, and 16 in conservation efforts. A smaller portion of organizations incorporate community planning or design (11), science and research (9), recreation (6), waste or energy (5), youth development (5), and/or disaster relief (2). While no organization incorporated all 11 categories, they ranged from 1-9, with an average of just over 3 categories per organization.

### *Response to Hurricane Sandy*

All but one organization implemented changes in their EE and related stewardship programs and/or implemented organizational changes in response to Hurricane Sandy (Tables 2-4). The most common program or practice change was using Sandy as a tangible example to reinforce climate change, energy, wastewater management, and other lessons that had been taught previously. For example, prior to the storm Queens Botanical Garden taught third graders about energy, and after the storm educators adapted their lessons to incorporate the children's personal

experience of losing power and awareness of how their power was produced and transported. Similarly, this organization had been teaching about wetlands prior to the storm and used Sandy as an example of the importance of planning for wetlands and water and sewer management. Organizations also commonly used Superstorm Sandy to reinforce or advocate for existing organizational missions and messages. For example, the Trust for Public Land NYC Playgrounds Project used Sandy as an example during community design sessions to drive home the message of needing green infrastructure in NYC neighborhoods; and The River Project used Sandy to emphasize the role of shallows and reefs in the health and resilience of the New York harbor and its estuary.

Another common change was adding new stewardship activities specifically focused on adapting to climate change and mitigating future storm impacts. For example, Breezy Point Green Committee conducted volunteer dune restoration projects along the heavily-impacted Rockaway beaches and Lower East Side Ecology Center's tree planting activities were informed by damage from the storm surge.

The dune restoration projects also can be considered as evidence of a new focus on resilience, which was a common finding among multiple organizations. GrowNYC supported community gardens that had lost trees and suffered flooding in the storm, and wrote a manual outlining how community gardens can prepare for and respond to storm damage,<sup>(5)</sup> thus connecting stewardship with resilience. A total of 20 organizations claimed they added a focus on resilience post-Sandy, sometimes as a new concept or informing new programs. These included Rockaway Waterfront Alliance, which added an environmental resilience curriculum to their EE school workshops, and developed and is seeking funding to incorporate a new Resilience Institute, through which young people will research their local area and consider soft and hard structures in coastline protection. Previously, Rockaway Waterfront Alliance had engaged in climate change education, and supported a shore corps program, but had not had an EE program focused on planning for coastal protection. In general, organizations seemed to define resilience as creating green and gray infrastructure. Examples included building berms at the inland edge of marshes to protect houses (Northeast Chapter, American Littoral Society) and placing artificial oyster reefs to reduce wave action and installing floodwalls (Hudson River Park Trust), as well as a greater focus on ongoing activities such as installing solar charging stations (Breezy Point Green Committee) and assisting municipalities and highway departments working on stream and ditch management and stormwater runoff (Hudson River Estuary Program). Two programs incorporated notions of social resilience into their programs: the Harbor School talked about resiliency as replacing sustainability in their curriculum and The Nature Conservancy reported that coastal resiliency became central to their programs after Sandy. The Nature Conservancy also incorporated a new focus on empowering urban historically neglected communities to become active agents of change, which they related to fostering local resilience.

Organizations also conducted new educational activities such as a public bike tour of the high water mark in lower Manhattan conducted by Green Map, which included a discussion of hurricanes and resiliency. In another example, Solar One supported the development of cooperatives that leverage community buying power to purchase solar panels.

A common organizational response to Sandy was expanding audiences or volunteers. Most notable was Hudson River Park Trust, which experienced an overwhelming influx of volunteers

from within and outside the city for the first several months after the storm. Other organizations that engaged volunteers in stewardship included Rockaway Waterfront Alliance, Breezy Point Green Committee, and the Northeast Chapter of the American Littoral Society. Another response was networking with other organizations to try to obtain funding (Hudson River Park Trust) or to better develop responses to climate change (Green Map). Note that Hudson River Park Trust was one of the most heavily impacted among the organizations we interviewed in terms of storm damage, experiencing tens of millions of dollars in damage to park infrastructure (e.g., utilities), whereas Green Map creates maps of green infrastructure throughout the city and thus would have been intimately familiar with Sandy's impacts.

In only two organizations did Sandy seem to “change the conversation” or influence thinking more deeply. These included The Nature Conservancy, which added a focus on empowering urban communities to foster local social-ecological systems resilience and Green Map's efforts to expand its networks locally and globally so as to engage in conversation about the role of maps in addressing climate change. Further, only two organizations used phrases such as “tipping point” or “game changer” to describe the effects Sandy might have on their work and the City (NYS Department of Environmental Conservation and The Nature Conservancy).

#### *Factors external to EE and stewardship organizations post-Sandy*

Overall, informants described more coverage of environmental issues and green infrastructure in the press, and more acceptance of their work by politicians and city residents. For example, a staff member at the NY Restoration Project described a shifted landscape post-Sandy, where “funders, students, teachers, private partners, and municipal partners are expressing a totally vertical understanding of a need for our work...there are now less [*sic*] questions about the relevance of our work.” This funding universe included large federal as well as smaller grants. Organization W adapted their own small-grants program and reached out to their funders to provide grassroots neighborhood rebuilding initiatives immediately after the hurricane hit in November/December 2012, and again in a subsequent grant cycle in May 2013. In addition, interviewees from the NY Restoration Project, Northeast Chapter of the American Littoral Society, and other organizations mentioned that resilience, climate change, and other storm and recovery-related terms had become buzzwords, which resulted in increased acceptance of and funding for particular types of EE and civic ecology stewardship efforts.

## **DISCUSSION**

In finding that the overwhelming majority of New York City EE and stewardship organizations changed their programs in response to Hurricane Sandy, the results of this study support McPhearson and Tidball's<sup>(9)</sup> notion that disasters provide a “niche” for new EE approaches to emerge. Further, similar to the situation after the BP oil spill,<sup>(24)</sup> a number of organizations experienced a large influx of volunteers and conducted new volunteer stewardship activities such as dune restoration.

Changes in educational programs, related stewardship activities, and organizations were primarily incremental rather than transformational in nature, the most common being using Sandy as an example of climate change and related content to enhance learning of topics that had previously been taught. In short, it appears that Sandy was not a threshold moment for EE in New York City; the response of organizations might be termed adaptive in terms of capitalizing

on new information, but not transformational in the sense of deeply questioning the contributions of their organizations to the threats posed by climate change.<sup>(16)</sup>

The incorporation of notions of resilience into educational programming was notable, albeit definitions of resilience varied, which may reflect the term's multiple meanings and levels of analysis.<sup>(8)</sup> One organization, The Nature Conservancy, articulated work consistent with social-ecological systems resilience; it is possible that The Nature Conservancy education program director we interviewed was familiar with the larger resilience literature specifically linking EE to social-ecological systems resilience.<sup>(4)</sup> Related, former New York Mayor Bloomberg convened a Special Initiative for Rebuilding and Resiliency in December 2012, which incorporates infrastructure and the built environment as well as community rebuilding and resiliency; and the Jamaica Bay Science and Resilience Center launched by Mayor Bloomberg and Department of Interior Secretary Sally Jewell after Hurricane Sandy integrates social as well as ecological and engineering science. Thus a discourse around linked social-ecological systems resilience exists in New York in larger organizations and in government. Concern among New Yorkers that Mayor Bloomberg's initiatives did not do enough to address community resilience and social and environmental justice issues<sup>(1)</sup> suggests a role for smaller-scale EE and stewardship programs in climate change resilience and resilience education and planning, should they adopt a broader perspective on resilience that incorporates social processes in addition to physical infrastructure.

Several explanations might explain the relative lack of transformational changes in EE programs post-Sandy, including funding and organizational size, mission, and location. Emergency grants that became available post-Sandy focused largely on planning and rebuilding rather than EE per se. The New York City Department of Education funding for a green school program at Organization Y stipulates adherence to the common-core standards, thus limiting the program's leeway in making changes following disaster. In addition, most of organizations were small non-profits whose limited resources constrained their ability to make large changes and organizational missions that focused on youth/community development interest (e.g., Rocking the Boat) or curriculum-based education proved incompatible with making changes focused on climate change. Finally, location relative to storm damage may have played a role in post-Sandy changes; Rocking the Boat, which made only small changes, is located in the Bronx and experienced minimal damage during the storm.

Another possible explanation for the incremental rather than transformational changes is the nature of the climate change problem. Climate change is a prime example of a "wicked" problem; such problems are characterized as complex, intractable, and severe.<sup>(7)</sup> Unlike "tame" problems such as determining the chemical composition of a substance, wicked problems do not lend themselves to solutions using recognized scientific methods<sup>(13)</sup> or traditional governance<sup>(15)</sup> approaches. Further, environmental problems cannot be separated from complex issues of justice and equity, whose resolutions require multiple players, perspectives and approaches. Thus, it may have been difficult for organizations acting on their own to envision how EE might radically change its approaches in the light of such difficult problems.

## **CONCLUSION**

Hurricane Sandy struck the east coast in October 2012, and significantly impacted neighborhoods and residents in much of New York City. Recognizing that the needs to rebuild some areas, to relocate people living in the most vulnerable sites, and to support people in Sandy's aftermath persists, we also contend that EE and stewardship may play a role in adaptation and mitigation to better prepare for and perhaps reduce future sea level rise and storm intensities. Though work related to climate change was ongoing pre-Sandy, the relevance of this work both internally to groups and externally in the larger metropolitan New York context became more widely accepted post-Sandy. Whereas Sandy has not created threshold changes in EE practices in NYC, the increased awareness and interest may lay the groundwork for future changes. The challenge will be to bring groups together to collaboratively define what those changes should be.

**TABLE 1. Activities engaged in by organizations included in this study. (Based on organizational mission and responses to interview questions: “Can you briefly describe your typical work?” Organizations that requested their names not be used are listed as organization W-Z.)**

| <b>PROGRAM</b>                                  | <i>EE</i> | <i>Science/Research</i> | <i>Civic Ecology</i> | <i>Advocacy</i> | <i>Planning/Design</i> | <i>Conser-<br/>vation</i> | <i>Community<br/>/Engage-<br/>ment</i> | <i>Waste/<br/>Energy</i> | <i>Disaster<br/>Relief</i> | <i>Recre<br/>ation</i> | <i>Youth<br/>Develop<br/>ment</i> |
|---|-----------|-------------------------|----------------------|-----------------|------------------------|---------------------------|--|--------------------------|----------------------------|------------------------|-----------------------------------|
| 596 Acres                                       |           |                         |                      | x               |                        |                           |  |                          |                            |                        |                                   |
| Alley Pond Environmental Center                 | x         |                         |                      | x               |                        | x                         |  |                          |                            |                        |                                   |
| American Littoral Society,<br>Northeast Chapter | x         |                         | x                    | x               |                        |                           | x                                      |                          |                            |                        |                                   |
| Battery Urban Farm                              | x         |                         | x                    |                 |                        |                           |  | x                        |                            |                        |                                   |
| Breezy Point Land Management<br>Committee       |           |                         | x                    |                 | x                      | x                         | x                                      |                          |                            |                        |                                   |
| Brooklyn Botanic Garden                         | x         |                         | x                    |                 |                        | x                         | x                                      |                          |                            | x                      |                                   |
| Brooklyn Bridge Park<br>Conservancy             | x         | x                       |                      |                 | x                      | x                         | x                                      |                          |                            | x                      |                                   |
| Build it Green! NYC                             |           |                         |                      | x               |                        |                           |  | x                        |                            |                        |                                   |
| Central Park Conservancy                        |           |                         |                      |                 | x                      |                           |  |                          |                            |                        |                                   |
| Clean Ocean Action                              | x         |                         | x                    | x               |                        |                           |  |                          |                            |                        |                                   |
| Gowanus Canal Conservancy                       | x         |                         | x                    | x               | x                      |                           | x                                      | x                        |                            |                        |                                   |
| GrowNYC   | x         |                         | x                    |                 |                        |                           |  |                          |                            |                        |                                   |
| Green Map                                       |           |                         | x                    | x               | x                      | x                         | x                                      |                          |                            |                        | x                                 |
| GreenThumb                                      |           |                         | x                    |                 |                        |                           | x                                      |                          |                            |                        |                                   |
| Horticultural Society of New<br>York            | x         |                         |                      | x               | x                      | x                         | x                                      |                          |                            |                        | x                                 |

| <b>PROGRAM</b>   | <i>EE</i> | <i>Science/<br/>Research</i> | <i>Civic<br/>Ecology</i> | <i>Advocacy</i> | <i>Planning/<br/>Design</i> | <i>Conser-<br/>vation</i> | <i>Community<br/>/Engage-<br/>ment</i> | <i>Waste/<br/>Energy</i> | <i>Disaster<br/>Relief</i> | <i>Recre<br/>ation</i> | <i>Youth<br/>Develop<br/>ment</i> |
|--|-----------|------------------------------|--------------------------|-----------------|-----------------------------|---------------------------|--|--------------------------|----------------------------|------------------------|-----------------------------------|
| Hudson River Estuary Program   | x         | x                            |                          |                 |                             | x                         |  |                          |                            | x                      |                                   |
| The Human Impacts Institute  | x         |                              |                          |                 |                             |                           | x                                      |                          |                            |                        |                                   |
| Hudson River Park Trust  | x         |                              | x                        |                 | x                           | x                         |  |                          |                            | x                      |                                   |
| Jamaica Bay Wildlife Refuge  | x         |                              | x                        |                 |                             | x                         |  |                          |                            |                        |                                   |
| Just Food  | x         |                              |                          | x               |                             |                           | x                                      |                          |                            |                        |                                   |
| Lamont-Doherty Earth<br>Observatory, The Earth Institute,<br>Columbia University |           | x                            |                          | x               |                             |                           |  |                          |                            |                        |                                   |
| Liberty Science Center   | x         | x                            |                          |                 |                             |                           | x                                      |                          |                            |                        |                                   |
| Lower East Side Ecology Center   | x         |                              | x                        | x               | x                           |                           | x                                      | x                        |                            |                        | x                                 |
| The Nature Conservancy, LEAF<br>Program  | x         |                              | x                        |                 |                             | x                         |  |                          |                            |                        |                                   |
| New York Cares, Disaster<br>Recovery   |           |                              |                          |                 |                             |                           |  |                          | x                          |                        |                                   |
| New York Hall of Science   | x         |                              |                          |                 |                             |                           |  |                          |                            |                        |                                   |
| New York Horticultural Society   | x         |                              |                          | x               | x                           | x                         | x                                      |                          |                            |                        |                                   |
| New York Restoration Project   | x         |                              | x                        |                 |                             |                           | x                                      |                          | x                          |                        | x                                 |
| Organization W   |           |                              |                          |                 |                             |                           | x                                      |                          |                            |                        |                                   |
| Organization X   | x         | x                            |                          | x               |                             | x                         |  |                          |                            |                        | x                                 |
| Organization Y   | x         |                              | x                        |                 |                             | x                         | x                                      |                          |                            |                        | x                                 |

| <b>PROGRAM</b>                                     | <i>EE</i> | <i>Science/<br/>Research</i> | <i>Civic<br/>Ecology</i> | <i>Advocacy</i> | <i>Planning/<br/>Design</i> | <i>Conser-<br/>vation</i> | <i>Community<br/>/Engage-<br/>ment</i> | <i>Waste/<br/>Energy</i> | <i>Disaster<br/>Relief</i> | <i>Recre<br/>ation</i> | <i>Youth<br/>Develop<br/>ment</i> |
|--|-----------|------------------------------|--------------------------|-----------------|-----------------------------|---------------------------|--|--------------------------|----------------------------|------------------------|-----------------------------------|
| Organization Z                                     | x         | x                            | x                        | x               |                             | x                         | x                                      |                          |                            |                        |                                   |
| Queens Botanical Garden                            | x         |                              | x                        |                 |                             | x                         | x                                      | x                        |                            | x                      | x                                 |
| NYSDEC Region 2, ReLeaf                            | x         |                              |                          |                 | x                           | x                         |  |                          |                            |                        |                                   |
| The River Project                                  | x         | x                            | x                        |                 | x                           | x                         | x                                      |                          |                            |                        |                                   |
| Rockaway Conservancy                               |           |                              |                          |                 |                             | x                         | x                                      |                          |                            |                        |                                   |
| Rockaway Waterfront Alliance                       | x         | x                            | x                        | x               | x                           |                           | x                                      |                          |                            | x                      | x                                 |
| Rocking the Boat                                   | x         |                              | x                        |                 |                             | x                         | x                                      |                          |                            | x                      | x                                 |
| Row New York                                       |           |                              |                          |                 |                             |                           |  |                          |                            | x                      | x                                 |
| Smallwater   |           |                              | x                        |                 |                             |                           | x                                      | x                        | x                          | x                      |                                   |
| Solar One, K-12 Education Program                  | x         |                              |                          |                 |                             |                           |  | x                        |                            |                        |                                   |
| Trees New York                                     | x         |                              | x                        | x               |                             |                           | x                                      |                          |                            |                        |                                   |
| The Trust for Public Land, NYC Playgrounds Program |           |                              |                          |                 | x                           | x                         | x                                      |                          |                            |                        |                                   |
| Two Bridges Neighborhood Council, STEM Education   | x         | x                            |                          | x               |                             |                           | x                                      |                          |                            | x                      |                                   |
| Uprose   |           | x                            |                          | x               | x                           |                           | x                                      |                          |                            |                        | x                                 |
| The Urban Assembly New York Harbor School          | x         | x                            | x                        | x               |                             |                           | x                                      |                          |                            |                        | x                                 |

**TABLE 2. Program and organizational responses to Hurricane Sandy. (x=data from interviews; x<sub>1</sub>= additions from member checks. Organizations that requested their names not be used are listed as organization W-Z. Superscripts: <sup>1</sup>Site damaged by Hurricane Sandy, <sup>2</sup>New program, center, or organization.)**

| Program   | Program content/practice          |  |                   |                                      | Organizational                     |                             |                                   |                              |                       | No change | Total |
|---|-----------------------------------|--|-------------------|--------------------------------------|------------------------------------|-----------------------------|-----------------------------------|------------------------------|-----------------------|-----------|-------|
|   | <i>Reinforce existing content</i> | <i>Stewardship/ Restoration activities</i> | <i>Resilience</i> | <i>Other new content/ activities</i> | <i>Reinforce message/ Advocacy</i> | <i>Engage new audiences</i> | <i>Partner with organizations</i> | <i>Engage new volunteers</i> | <i>Obtain funding</i> |           |       |
| 596 acres   |                                   |  |                   |                                      | x <sub>1</sub>                     |                             |                                   |                              |                       |           | 1     |
| Alley Pond Environmental Center                           | x                                 |  |                   |                                      |                                    |                             |                                   |                              |                       |           | 1     |
| American Littoral Society, Northeast Chapter <sup>1</sup> |                                   | x  | x                 |                                      |                                    |                             | x                                 |                              |                       |           | 3     |
| Battery Urban Farm <sup>1</sup>                           |                                   |  | x                 |                                      |                                    |                             |                                   | x                            | x                     |           | 3     |
| Breezy Point Land Management Committee <sup>1,2</sup>     |                                   | x  | x <sub>1</sub>    | x <sub>1</sub>                       |                                    | x <sub>1</sub>              | x <sub>1</sub>                    | x <sub>1</sub>               | x <sub>1</sub>        |           | 1     |
| Brooklyn Botanic Garden                                   | x                                 | x  |                   | x                                    |                                    |                             |                                   | x                            |                       |           | 4     |
| Brooklyn Bridge Park Conservancy <sup>1</sup>             | x                                 | x <sub>1</sub>                             | x <sub>1</sub>    | x <sub>1</sub>                       | x                                  | x <sub>1</sub>              | x <sub>1</sub>                    | x <sub>1</sub>               | x <sub>1</sub>        |           | 9     |
| Build it Green! NYC <sup>1</sup>                          |                                   | x <sub>1</sub>                             |                   |                                      | x                                  |                             | x                                 | x                            |                       |           | 4     |
| Clean Ocean Action  |                                   | x  |                   | x <sub>1</sub>                       | x                                  |                             | x <sub>1</sub>                    | x                            |                       |           | 5     |
| Gowanus Canal Conservancy <sup>1</sup>                    | x                                 |  |                   |                                      |                                    |                             |                                   |                              |                       |           | 1     |
| GrowNYC   | x                                 | x <sub>1</sub>                             |                   | x                                    | x                                  |                             |                                   |                              |                       |           | 4     |
| Green Map   | x <sub>1</sub>                    |  | x <sub>1</sub>    | x                                    | x                                  | x                           | x                                 |                              | x <sub>1</sub>        |           | 7     |
| GreenThumb  | x <sub>1</sub>                    | x <sub>1</sub>                             | x <sub>1</sub>    | x                                    |                                    | x <sub>1</sub>              | x <sub>1</sub>                    | x <sub>1</sub>               | x                     |           | 8     |

| Program   | Program content/practice   |                                     |                |                               | Organizational              |                      |                            |                       |                | No change      | Total |
|---|----------------------------|-------------------------------------|----------------|-------------------------------|-----------------------------|----------------------|----------------------------|-----------------------|----------------|----------------|-------|
|   | Reinforce existing content | Stewardship/ Restoration activities | Resilience     | Other new content/ activities | Reinforce message/ Advocacy | Engage new audiences | Partner with organizations | Engage new volunteers | Obtain funding |                |       |
| The Horticultural Society of New York                 |                            |                                     |                |                               |                             |                      |                            |                       |                | x <sub>1</sub> | 1     |
| Hudson River Estuary Program <sup>1</sup>             | x                          |                                     |                |                               |                             |                      |                            |                       |                |                | 1     |
| Hudson River Park Trust <sup>1</sup>                  | x                          | x                                   | x              | x                             |                             |                      | x                          | x                     | x              |                | 7     |
| The Human Impacts Institute                           |                            |                                     |                | x                             |                             | x                    |                            |                       |                |                | 2     |
| Jamaica Bay Wildlife Refuge <sup>1</sup>              |                            |                                     |                | x                             | x                           |                      |                            | x                     |                |                | 3     |
| Just Food   | x                          |                                     |                |                               |                             |                      |                            |                       |                |                | 1     |
| Lamont-Doherty Earth Observatory, Columbia University | x                          |                                     |                |                               |                             | x <sub>1</sub>       | x <sub>1</sub>             |                       | x <sub>1</sub> |                | 4     |
| Liberty Science Center                                | x                          |                                     |                |                               |                             | x                    | x                          |                       |                |                | 3     |
| Lower East Side Ecology Center <sup>1</sup>           | x                          | x                                   | x <sub>1</sub> |                               |                             |                      |                            |                       |                |                | 3     |
| The Nature Conservancy, LEAF Program                  |                            | x                                   | x              | x                             |                             | x                    |                            |                       |                |                | 4     |
| New York Cares, Disaster Recovery                     |                            | x                                   |                |                               |                             | x <sub>1</sub>       | x <sub>1</sub>             | x                     |                |                | 4     |
| New York Hall of Science                              | x                          |                                     |                |                               |                             |                      |                            |                       |                |                | 1     |
| New York Restoration                                  | x <sub>1</sub>             | x <sub>1</sub>                      | x <sub>1</sub> | x <sub>1</sub>                | x <sub>1</sub>              |                      |                            |                       | x              | x              | 6     |

| Program  | Program content/practice   |                                    |                |                              | Organizational             |                      |                            |                       |                | No change | Total |
|--|----------------------------|------------------------------------|----------------|------------------------------|----------------------------|----------------------|----------------------------|-----------------------|----------------|-----------|-------|
|  | Reinforce existing content | Stewardship/Restoration activities | Resilience     | Other new content/activities | Reinforce message/Advocacy | Engage new audiences | Partner with organizations | Engage new volunteers | Obtain funding |           |       |
| Project  |                            |                                    |                |                              |                            |                      |                            |                       |                |           |       |
| NYSDEC Region 2, ReLeaf                          |                            |                                    |                |                              | x                          |                      |                            |                       |                |           | 1     |
| Queens Botanical Garden                          | x                          |                                    |                |                              |                            | x                    |                            |                       | x              |           | 2     |
| Organization W                                   |                            |                                    |                |                              |                            |                      |                            |                       | x              |           | 1     |
| Organization X <sup>1</sup>                      |                            | x <sub>1</sub>                     | x <sub>1</sub> |                              | x <sub>1</sub>             | x <sub>1</sub>       | x <sub>1</sub>             |                       |                |           | 5     |
| Organization Y                                   |                            | x                                  |                |                              |                            |                      |                            | x                     |                |           | 2     |
| Organization Z                                   |                            |                                    |                |                              | x                          | x                    | x                          | x                     |                |           | 4     |
| The River Project <sup>1</sup>                   | x                          | x <sub>1</sub>                     | x              |                              | x                          |                      |                            |                       |                |           | 4     |
| Rockaway Conservancy <sup>1,2</sup>              |                            | x                                  | x              |                              | x                          |                      |                            |                       |                |           | 3     |
| Rockaway Waterfront Alliance <sup>1</sup>        | x                          | x                                  | x              | x                            | x <sub>1</sub>             |                      | x <sub>1</sub>             | x                     | x              |           | 8     |
| Rocking the Boat                                 | x                          | x <sub>1</sub>                     |                |                              |                            |                      |                            |                       |                |           | 1     |
| Row New York                                     | x                          |                                    |                |                              | x <sub>1</sub>             | x                    |                            |                       |                |           | 3     |
| Smallwater <sup>1,2</sup>                        |                            | x                                  | x              |                              |                            | x                    | x                          | x                     | x              |           | 6     |
| Solar One, K-12 Education Program <sup>1,2</sup> | x                          |                                    |                | x                            | x                          |                      |                            |                       | x              |           | 4     |
| Trees New York                                   | x <sub>1</sub>             |                                    |                | x <sub>1</sub>               | x                          | x <sub>1</sub>       |                            |                       |                |           | 4     |
| The Trust for Public Land,                       | x                          |                                    |                |                              | x                          |                      |                            |                       |                |           | 2     |

| Program   | Program content/practice          |  |                   |                                      | Organizational                     |                             |                                   |                              |                       | No change | Total |
|---|-----------------------------------|--|-------------------|--------------------------------------|------------------------------------|-----------------------------|-----------------------------------|------------------------------|-----------------------|-----------|-------|
|   | <i>Reinforce existing content</i> | <i>Stewardship/ Restoration activities</i> | <i>Resilience</i> | <i>Other new content/ activities</i> | <i>Reinforce message/ Advocacy</i> | <i>Engage new audiences</i> | <i>Partner with organizations</i> | <i>Engage new volunteers</i> | <i>Obtain funding</i> |           |       |
| NYC Playgrounds Program                                       |                                   |  |                   |                                      |                                    |                             |                                   |                              |                       |           |       |
| Two Bridges Neighborhood Council, STEM Education <sup>1</sup> | x                                 | x <sub>1</sub>                             | x <sub>1</sub>    | x <sub>1</sub>                       | x <sub>1</sub>                     | x <sub>1</sub>              | x <sub>1</sub>                    |                              | x <sub>1</sub>        |           | 8     |
| Uprose <sup>2</sup>   |                                   |  | x                 | x                                    |                                    |                             |                                   |                              |                       |           | 2     |
| The Urban Assembly New York Harbor School <sup>1</sup>        | x                                 | x <sub>1</sub>                             | x                 |                                      | x                                  | x <sub>1</sub>              | x                                 |                              |                       |           | 6     |

**TABLE 3. Frequencies of program and organizational changes post-Sandy.**

|                             | Program content/practice          |  |                   |                                      | Organizational                     |                             |                                   |                              |                       |                  |
|-----------------------------|-----------------------------------|--|-------------------|--------------------------------------|------------------------------------|-----------------------------|-----------------------------------|------------------------------|-----------------------|------------------|
|                             | <i>Reinforce existing content</i> | <i>Stewardship/ Restoration activities</i> | <i>Resilience</i> | <i>Other new content/ activities</i> | <i>Reinforce message/ Advocacy</i> | <i>Engage new audiences</i> | <i>Partner with organizations</i> | <i>Engage new volunteers</i> | <i>Obtain funding</i> | <i>No change</i> |
| Interview                   | 21                                | 12   | 10                | 11                                   | 14                                 | 8                           | 8                                 | 11                           | 9                     | 1                |
| Additions from member check | 4                                 | 10   | 8                 | 6                                    | 6                                  | 9                           | 9                                 | 3                            | 5                     | 1                |
| Total                       | 25                                | 22   | 18                | 17                                   | 20                                 | 17                          | 17                                | 14                           | 14                    | 2                |

**TABLE 4. Representative examples of environmental education program content/practice changes and organizational changes in response to Hurricane Sandy.**

| Organization  | Example  |
|---|--|
| <b>PROGRAM CONTENT/PRACTICE CHANGES</b>                           |  |
| <i>Reinforce existing content using Sandy impacts as examples</i> |  |
| Alley Pond Environmental Center                                   | Incorporated climate change lesson plan using Sandy impacts as clearer examples, but recognized that this may be relevant only as long as Sandy is in the memory of the youth they work with.  |
| Hudson River Estuary Program                                      | Supported multiple EE programs to incorporate Sandy as example of climate change impacts using data on Hudson River changes during Hurricanes Sandy and Irene gathered by their Hudson River Environmental Conditions Observing System.  |
| Lower East Side Ecology Center                                    | Used the high water line during Sandy and GIS maps to show residents how the flooded areas during Sandy match up with former salt marsh areas as educational tools, to push for increased community involvement in waterfront planning, and to inform policy.  |
| New York Hall of Science  | Used Sandy as an example and incorporated data from Sandy to update their Climate and Urban Systems Partnership map that aims to visualize how climate change is projected to impact New York City.  |
| Queens Botanical Garden   | Incorporated youth's awareness of their relationship to energy and wetlands as a result of Sandy into ongoing educational programs.  |
| Rocking the Boat  | Used Sandy as a 'tangible example' to say that climate change is real.   |
| The Urban Assembly New York Harbor School                         | Used Sandy as an example of climate change during classroom lessons and as data for nutrients and oysters research partnership, and continued work with the Billion Oyster Project as a green infrastructure response to Sandy.  |
| <i>New environmental stewardship/restoration opportunities</i>    |  |
| Breezy Point Green Committee                                      | Constructed and planted a dune with volunteers and are developing a dune restoration plan as part of larger assessment of green infrastructure and coastal protection plan for Breezy Point. (Green Committee was formed after Hurricane Irene but found new interest and urgency in their work post-Sandy.) |
| GrowNYC   | More active participants in street tree, school gardens, and other stewardship, and expanded stormwater management in parks in coastal areas.  |
| New York Cares, Disaster Recovery                                 | Expanded existing volunteer shoreline cleanups to include water and wetlands cleanups and plantings.   |

| Organization                                     | Example   |
|--|---|
| <b><i>Incorporating resilience into work</i></b> |   |
| American Littoral Society, Northeast Chapter     | Added consideration of resilience of nearby neighborhoods in their dune/marsh restoration work by building up dunes in Broad Channel.   |
| Rockaway Waterfront Alliance                     | Added an environmental resiliency curriculum to their environmental education school workshops.   |
| The Nature Conservancy, LEAF Program             | Added focus on historically neglected communities and those hardest hit by the storm, through community based restoration projects that address coastal resiliency.             |
| Uprose   | Established Sunset Park Climate Justice and Community Resiliency Center, first grassroots-led, climate adaptation and community resiliency planning project in the city         |
| <b><i>Other new content/activities</i></b>       |   |
| Brooklyn Botanic Garden                          | Reinterpreted Tree House exhibit as way to recycle woody debris left by storm, used in Tree Explorations program.   |
| Green Map  | Developed a map and conducted bike tour of Lower East Side, to bring attention to climate change using Sandy impacts.   |
| Greenthumb & GrowNYC                             | Assisted 10 community gardens affected by Sandy and wrote resilience manual for community gardeners.  |
| Hudson River Park Trust                          | Developing interpretive signage along the Hudson River to increase public awareness of river tides.   |
| Human Impacts Institute                          | Worked with artists to create installations relating to Sandy.  |
| Jamaica Bay Wildlife Refuge                      | Growing and planting native plants in the refuge and communities impacted by Sandy with the help of local schools; funded by post-Sandy grant monies                            |
| Organization X                                   | Established forest ecosystem resilience study of canopy gaps created by Sandy and gap impacts on surrounding forest, results of which will inform management practice.          |
| Rockaway Waterfront Alliance                     | Partnered with local artist and schools to develop the driftwood Sea-Song Memorial sculpture, which serves as “metaphor for the strength of community and cooperation.”         |
| Solar One, K-12 Education Program                | Started a community solar project after Sandy, supporting coops and private building owners to purchase and share the cost of installing solar in their neighborhood/community. |
| The Nature Conservancy, LEAF Program             | Focusing much more on restoration and working to empower residents, particularly in historically neglected communities, to be active agents of change.                          |
| Uprose   | Created the Climate Justice and Community Resiliency Center at the request of their community.  |

| Organization  | Example   |
|---|---|
| <b>ORGANIZATIONAL CHANGES</b>                             |   |
| <i>New programs, centers, or organizations</i>            |   |
| Organization Y  | Established recovery conservation efforts at national parks.  |
| Rockaway Conservancy                                      | Hosted workshop on gardening post-Sandy, hosted a soil and plant sale for the community; and helped with restoration of community gardens.  |
| Smallwater  | Worked with volunteers to conduct beach cleanups, create a community garden, and develop a community center focused on environmental education outreach.                                      |
| Uprose  | Established Sunset Park Climate Justice and Community Resiliency Center, first grassroots-led, climate adaptation and community resiliency planning project in the city.                      |
| <i>Sandy used an example to reinforce mission/message</i> |   |
| GreenThumb  | Leveraged Sandy as example of broken food system to focus public attention on developing a local food system through community gardening and urban forestry.                                  |
| Lamont-Doherty Earth Observatory                          | Used Sandy as opportunity for staff scientists to explain concepts including climate change, extreme events, and storm surge to public through media and seminars.                            |
| The River Project   | Greater emphasis in ongoing education on protective role of shallows and reefs on health and resilience of NY harbor and estuary.   |
| Solar One   | Added adaptation message by incorporating focus on educating about and supporting use of solar as locally harvested energy option.  |
| Trees New York  | Ramped up their use of structural pruning and used their network of citizen pruners to gather information about tree health to support the City's efforts to restore urban forest post-Sandy. |
| The Trust for Public Land, NYC Playgrounds Program        | Used Sandy as an example during community design sessions to drive home the message of needing green infrastructure in NYC neighborhoods.   |
| <i>Engaging new audience since Sandy</i>                  |   |
| Liberty Science Center                                    | Used their Global Microscope to transmit an electronic field trip about Sandy to Chinese students using NOAA and NASA data to create a 3D mapping visualization of the storm surge.           |
| Green Map   | Lower East Ride and other efforts engaged new audience, bolstered by translating maps into Spanish and Chinese.   |

| <b>Organization</b>  | <b>Example</b>  |
|--|---|
| <b><i>Engaging new volunteers/participants since Sandy</i></b> |   |
| Build it Green! NYC  | Worked with new volunteers and supported Sandy-impacted community groups through material donations and information, resulting in expanded partnerships.  |
| Clean Ocean Action   | Organized Waves of Action For the Shore to help clean up marine and storm debris; dedicated one day per month to Waves of Action, resulting in 14,000 volunteers participating in 280 projects in over 100 communities. |
| Hudson River Park Trust  | Embraced new volunteers and community involvement in park recovery and other activities.  |
| New York Cares, Disaster Recovery                              | Expanded existing volunteer activities to new communities and developed long-term volunteer base through community garden restoration, landscaping on school grounds and parks, and environmental cleanups after Sandy. |
| Organization X   | Engaged new volunteers in cleaning up after trees uprooted or destroyed.  |
| Rockaway Waterfront Alliance                                   | Added a dune restoration campaign with volunteer support.   |
| <b><i>Obtain new funding</i></b>                               |   |
| Battery Urban Farm   | Funding for Rebuild by Design, based in a resiliency framework, will pay for the reconstruction of the Battery and the Farm.  |
| Rockaway Waterfront Alliance                                   | Received multiple grants to develop emergency preparedness campaign (First Wave) and conduct dune restoration (Shore Corps).  |
| <b><i>New organizational partnerships</i></b>                  |   |
| American Littoral Society, Northeast Chapter                   | Developed partnerships with Parks and Recreation and other NYC departments focusing on Jamaica Bay  |
| Hudson River Park Trust  | Networked with other organizations to try to obtain funding for Sandy-related projects.   |
| Riverkeeper  | Hosted Greening Post-Sandy New York, an “eco-salon” to discuss and establish new partnerships to support work being done after the hurricane.   |
| <b><i>No change</i></b>  |   |
| New York Horticultural Society                                 | Had little damage to their physical location and their educational practices were affected very little by the impact of the storm.  |

## Appendix I. Interview Questionnaire

### Nature/Focus of Work

Briefly describe the nature/focus of your organization (e.g. environmental education, environmental justice, environmental or community advocacy/activism)

### Sandy Impacts

In the following topics, briefly describe how your work has changed, or why it hasn't, as a result of Sandy. (If you are a new group or organization that has responded to Sandy, please describe your work in the following topics.)

- A. Type of work** (for example: advocacy, community governance/engagement, environmental education, environmental justice, public health)
- B. Type of site** (for example: classroom, energy/solar, museum, park, sewershed/watershed, urban forest)
- C. Location of work.** If possible include neighborhood (for example, Far Rockaway, Belle Harbor, Coney Island, Canarsie, Sheepshead Bay, New Dorp) or cross streets (for example, "Lower Manhattan south of Canal St."; "The NW corner of 6th and 25th St.")
- D. Message.** Has there been a change in the message that your group/organization tries to communicate to your participants/audience as a result of Sandy? If so, please describe.
- E. Other.** Is there anything we have not asked about that is a change in the way that your organization works as a result of Hurricane Sandy?

### University Partnerships<sup>1</sup>

Would you like to further incorporate university partnerships related to climate change/flooding/disasters/stress in your work going forward? If so, please describe.

### Snowballing

What groups/organizations do you suggest we speak with that you know have adapted their work (for example: advocacy, environmental stewardship/educational practice, community engagement) as a result of Hurricane Sandy? Please provide a contact name and email if possible.

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<sup>1</sup> The question about university partnerships was asked because the research is part of a larger research/ outreach effort that provides professional development for environmental educators and related professionals.

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