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Flood Resilience Education in the Hudson River Estuary: Needs Assessment and Program Evaluation

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Catskill Creek at Woodstock Dam during low flow (L) and flood conditions (R)
Photo Credit - Elizabeth LoGiudice

Abstract

In recent decades, very heavy rain events (the heaviest 1% of all rain events from 1958-2012) have increased in frequency by 71% in the Northeast U.S. As flooding increases, so does the need for flood control. Decisions related to flood control are the responsibility of many individuals and groups across the spectrum of a community, such as local planners, highway departments, and private landowners. Such decisions include strategies to minimize future

flooding impacts while also properly responding to storm impacts to streams and adjacent and associated infrastructure. This project had three main components: 1) a flood education needs assessment of local municipal officials (2013), 2) an evaluation of a flood education program for highway personnel (2013), and 3) a survey of riparian landowners (2014). The riparian landowner needs assessment determined that the majority of riparian landowners in the region have experienced flooding, yet few are actually engaging in stream management to mitigate flood issues on their land. Landowners are almost equally interested in in-person workshops, field training, and online learning. Therefore, it will be most effective to offer a mix of educational programs and communication options to riparian landowners in the Hudson River estuary.

Three Summary Points of Interest

- Research-based education is an important tool to increase the capacity of local government officials for community flood adaptation. To address flood adaptation and post-flood stream management in municipalities, Cornell Cooperative Extension and collaborators developed an educational program to increase municipal officials' knowledge about how to work effectively in streams after a flood. Overall, the program significantly increased knowledge of stream science, post-flood stream response, and structural techniques. To increase the effectiveness of the programs, future workshops should strive to increase participant knowledge retention over time and actively recruit participants with a low level of starting knowledge of streams and flooding.
- Seventy-two percent of riparian landowner survey respondents have experienced flooding and about 75% of them have had property damage from flooding. Over half of respondents considered how their management activities affect flooding on their own property, yet only 28% did activities on their land to decrease their risk for flooding. However, many of those actions may actually be detrimental to streams and contribute to flooding. Therefore, education on management activities should focus on understanding why certain stream management practices may be detrimental as well as why some are beneficial. Streamside landowners in the study area could benefit from an increase in or expanded riparian management programs, like Trees for Tribes, which offer both financial (e.g., trees are offered for free) and technical support to landowners.
- We are currently working to disseminate the findings of this project. To date, we have published one HDRU report, a Cornell University Community and Regional Development Institute (CaRDI) publication, and a peer reviewed publication. Two publications are currently in preparation for peer-reviewed journals.

Gary, G. and S. Allred. 2015. Needs Assessment of Hudson River Estuary Streamside Landowners: Flooding and Stream Management Behaviors, Motivations, and Education Preferences. HDRU Publ.15-1. Dept. of Nat. Resour., Coll. of Ag. and Life Sci., Cornell Univ., Ithaca, NY. 55 pp. <http://www2.dnr.cornell.edu/hdru/pubs/HDRUReport15-1.pdf>

Gary, G., Allred, S. and LoGiudice E. (2014). An Extension Education Program to Help Local Governments with Flood Adaptation. *Journal of Extension* [On-line], 52(4) Article 4IAw6. <http://www.joe.org/joe/2014august/iw6.php>

Gary, G., Allred, S. LoGiudice, E., Chatrchyan, A., Baglia, R., Mayhew, T., Olsen, D., and M. Wyman. 2013. Community adaptation to flooding in a changing climate: municipal officials' actions, decision-making and barriers. Cornell University, Community and Rural Development Institute (CaRDI), Research and Policy Brief. Issue 57, December 2013. <https://cardi.cals.cornell.edu/sites/cardi.cals.cornell.edu/files/shared/documents/ResearchPolicyBriefs/Policy-Brief-Dec13b.pdf>

Keywords: Community flood resilience, post-flood stream intervention training, stream management, flood adaptation, riparian landowners

Introduction

As the climate and local flood patterns change in the Hudson Valley, NY, municipal officials, highway personnel, and riparian landowners may need to make changes to behavior and policy to increase community and watershed resiliency. Such changes include strategies to minimize future flooding impacts while also properly responding to storm impacts to streams and adjacent and associated infrastructure. Cornell Cooperative Extension, in partnership with the New York State Department of Environmental Conservation's Hudson River Estuary Program and New York Water Resources Institute, is conducting an educational initiative with a focus on flood resiliency in the Hudson Estuary watershed. In an effort to tailor educational programs to specific audience needs, a needs assessment was completed for municipal officials and riparian landowners.

The NYS Water Resources Institute at Cornell funded an outreach and education project through the Hudson River Estuary Program (HREP) on climate change, flood resilience, stream management, and related topics. Shorna Allred and Gretchen Gary 1) conducted two needs assessments, one for municipal officials and one for riparian landowners, 2) supported the educational activity review and design, and 3) conducted a program evaluation of the municipal officials educational program and activities. The 2013 we focused primarily on the municipal officials needs assessment and educational program evaluation. In 2014, our primary focus was on the riparian landowner needs assessment.

An Extension Education Program to Help Local Governments with Flood Adaptation

From: Gary, G., Allred, S. and LoGiudice E. (2014). *An Extension Education Program to Help Local Governments with Flood Adaptation*. [On-line], 52(4) Article 4IAw6. <http://www.joe.org/joe/2014august/iw6.php>

To address flood adaptation and post-flood stream management in municipalities, we developed an educational program offering two Post Flood Stream Intervention training workshops in the Hudson Valley during 2013. Each training workshop included two parts: a 6-hour classroom session followed by a 5-hour field-based session 6 months later. The purpose of the Post Flood Stream Intervention workshops was to

increase participants' knowledge of stream and flood science and to improve decision-making ability when working in streams after a flood.

We used a pre-test/post-test design to gauge changes in knowledge as a result of participating in the educational program. Program participants were asked to complete a series of true/false and multiple-choice knowledge questions. The questions tested participant knowledge of flooding, stream function, and post-flood stream intervention prior to the beginning of the workshops and immediately following the workshops. To measure knowledge retention, participants were asked to answer the same set of knowledge questions immediately after the conclusion of the field session held 6 months after the initial workshop.

Participants experienced significant knowledge gains between the pre- and post-tests for the classroom sessions. The evaluation results indicate that the Post-Flood Stream Intervention program effectively increases knowledge of local government officials and other first responders about post-flood stream response techniques. Results demonstrate significant knowledge gains for both training locations, but also that the audiences came to the trainings with a fairly high level of understanding. Thus, it is necessary to make a concerted effort to reach audiences that may not have an understanding of flood issues, streams, or climate change and may be undertaking harmful post-flood stream intervention techniques.

Needs Assessment of Hudson River Estuary Streamside Landowners: Flooding and stream management behaviors, motivations, and education preferences

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Land-use decisions by private landowners can have social and environmental impacts that cross property lines, resulting in negative impacts often far from the source of the problem), such as flooding, erosion, and pollution. Eighty-five percent of the land in New York State is privately owned (NYSDEC 2012), which makes private landowners of riparian, or streamside, areas ("zones along water bodies that serve as interfaces between terrestrial and aquatic ecosystems" [Montgomery 1996]) an important audience for

This report was prepared for the New York State Water Resources Institute (WRI) and the Hudson River Estuary program of the New York State Department of Environmental Conservation, with support from the NYS Environmental Protection Fund.

education about floods and stream management. Some streamside landowners manage, or intend to manage, their land in ways that help buffer the impacts of flooding. Nevertheless, there are streamside landowners that manage their properties in ways that may contribute to flooding issues.

Flood Risk Perception

How people perceive risk has the ability to influence their decisions (Slovic and Weber 2002). Risk perception is a subjective concept that helps people to understand and cope with uncertainties (Weber 2001). People that are unaware of or are not concerned about flooding are less likely to take steps to mitigate the negative effects (Raaijmakers et al. 2008). Experience with flooding increases personal awareness of the risks associated with these events, especially when it occurs regularly (Kellens et al. 2011). Heightened risk perception with increased communication of risk occurs regardless of gender, education level, or type of communication (i.e., experiential workshops or focus groups) (Terpstra et al. 2009). However, recognition of flood risk does not necessarily lead to recognition that human actions (e.g., settling in a floodplain, development of impervious surfaces, agricultural activity) may exacerbate the risk (Figueriredo et al. 2009). Therefore, acknowledgement alone of flood risk may not be enough to change behaviors. Landowners must also be empowered to understand how they can make land-use decisions that can change their flood risk.

Personal Responsibility

Personal responsibility can be defined as being accountable to oneself and the needs and well being of others (Ruyter, 2002). Some landowners feel responsible to maintain the health of the watershed as a whole (Rosenberg and Margerum 2008, Donaldson and Lewis 2012). Furthermore, streamside landowners that do not feel a responsibility to manage their own property for the benefit of the watershed may be interested in stream management (e.g., stream bank restoration, tree planting, fencing, public access, and conservation easements) “in general” within the watershed, as long as it is not on their own land (Mojica-Howell et al. 2012). For example, people that feel personally responsible for watershed health are more likely to favor watershed and floodplain conservation initiatives (Mann et al. 2012, Story and

Forsyth 2008), when compared to those that do not. A strong sense of personal responsibility for flooding can motivate streamside management to undertake behaviors that reduce the negative impacts of flooding.

Stream Management Motivations and Barriers

A common concern among landowners is the cost of changing or implementing management practices (Broussard et al. 2011, Shandas 2007, Treiman and Dwyer 2002). Corbett (2002) found that financial motivations, past behaviors, exposure to information about the government, and self-efficacy were the most important indicators of future intent to participate in government-run streamside improvement programs. Streamside landowners are more likely to adopt a desired management practice on their land if they receive financial assistance (Skelton et al. 2005). Similarly, streamside landowners in the Chesapeake Bay watershed expressed more interest in stream bank restoration and conservation easement projects when a government cost-share benefit was available to them, although few were interested in the projects at their own expense (Mojica-Howell et al. 2012). These findings suggest that financial assistance would increase the success of stream management educational programs.

Many streamside landowners lack accurate, scientific information about what actions will reduce negative impacts of floods, or how to implement them on their property (Donaldson and Lewis 2012, Broussard et al. 2011, Shandas 2007, Dutcher et al. 2004, Doolittle 2003). An understanding of the importance of intact floodplain ecosystems can be an invaluable tool to motivate landowners to undertake stream management behaviors (Ambrose et al. 2006). Access to this type of ecosystem information often results in increased awareness for and consideration of ecological processes on one’s land. For example, landowners in Pennsylvania who had technical assistance with implementing streamside buffers became more knowledgeable about stream dynamics and environmental benefits of buffers than those that did not implement buffers (Armstrong and Stedman 2012-2).

When scientifically-based information regarding watershed stewardship is provided to landowners, they are more likely to consider changing their behavior (Broussard et al. 2011), especially if the program is subsidized (Armstrong and Stedman 2012, Corbett

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2002, Treiman and Dwyer 2002). For example, Broussard *et al.* (2011) reported that the majority of landowners they surveyed were willing to try maintaining streamside vegetation on their property, but faced barriers including a lack of understanding of how to do it or why it was important. Landowner enthusiasm for streamside management is reduced if they believe land-use on adjacent properties has negative impacts on streams (Armstrong and Stedman 2012-2). If landowners perceive an environmental or social benefit to streamside management actions (e.g., maintaining streamside vegetation), they are more likely to continue them, even if it is not easy or convenient to do so (Armstrong and Stedman 2012-2). Therefore, a community approach to education, rather than education on a case-by-case basis will be more effective in mitigating the negative effects of flooding across a watershed.

Decisions about flooding and stream management on private land are often made in a social context and follow normative influences. Landowners are often influenced by the actions of their neighbors; they may continue a land-use practice they view on their neighbors' property because they think it is proper behavior (Armstrong and Stedman 2012, Morris-Oswald and Sinclair 2005, Dutcher *et al.* 2004). Some streamside landowners like the view of the stream that they are used to, and may balk at management activities that change that view (Dutcher *et al.* 2004). The desire to follow the norm may be so strong that people will continue a practice even if it is not in the best interest of their land. For example, Dutcher *et al.* (2004) discovered that people mow their lawns to the water's edge because of the "norm of neatness," even when they did not necessarily want to. Similarly, some non-agricultural streamside landowners in the Chesapeake Bay watershed did not utilize streamside buffers, in part because it did not fit with the residential property setting and what the neighbors are doing (Armstrong and Stedman 2012).

Stream Management Education and Communication

Landowners in floodplains need access to information that will help them make responsible land management decisions. Understanding what causes flooding will help streamside landowners become aware of potential risks associated with flood events and help mitigate their

vulnerability to flooding (Botzen *et al.* 2009). An important preliminary step in any outreach program that intends to influence behavior is creating an awareness of watershed and flooding issues (Story and Forsyth 2008). Mann *et al.* (2012) demonstrated that people living in the Carson River, NV, watershed were almost two times more likely to vote in favor of floodplain conservation if they were given information regarding floodplains and watersheds.

Flood prevention is beneficial to landowners, local social and ecological communities, and watersheds. Facilitating landowner engagement in flood prevention measures requires educators to offer information regarding the social and environmental benefits associated with healthy streams and watersheds. To help motivate desired behavior, streamside landowners should have an understanding of tangible social and environmental benefits of a healthy watershed (Armstrong and Stedman 2012, Donaldson and Lewis 2012, Howgate and Kenyon 2009). Information should be presented in a positive way whenever possible. For example, a 500-year flood event could be presented as a "protection level of 99.8% per year" (Baan and Klijn 2004). Supplying information in a way that does not suggest catastrophic events are inevitable, but can be mitigated (although not altogether prevented) can help keep an audience engaged. Furthermore, landowners may benefit from technical advice on how to reduce their flood risk (Dutcher *et al.* 2004), and access to information about the legalities of working in stream systems in their municipality (Donaldson and Lewis 2012).

A community approach to education with frequent interactions among educators and the public can be effective for motivating desired landowner behavior that can benefit the landowner and watershed. For example, in a streamside education program evaluation by Ambrose *et al.* (2006), landowners that were members of a watershed or community group were more likely to have made a change in land management than those that were not. Furthermore, 100% of survey respondents that had frequent contact with streamside management educators indicated they learned something new, compared to 70% that had very little contact. Direct contact with educators is an extremely effective method for education.

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Communication of information to landowners is an important factor in facilitating informed decision-making. Generally, people want information presented in a way that is intelligible to them and that respects their feelings (Howgate and Kenyon 2009). Shandas (2007) asked landowners for the best way to communicate “regarding care for streamside property.” Newsletters (31%), word-of-mouth (19%), demonstrations (9%), and workshops (8%) were the most popular responses. People learn through diverse means, so a mix of in-person discussions, phone calls, printed materials, and hands-on demonstrations are likely to be needed to change behaviors in a community (Ambrose *et al.* 2006). There are geographic distinctions regarding preferences for information sources (Rosenberg and Margerum 2008), which reinforces the need to do landowner surveys in the Hudson River Estuary to tailor educational programs to the specific needs of landowners in the area.

The purpose of this research was to learn about riparian landowners’ risk perception, experiences, attitudes, and behavior with regard to flooding and stream management. The results will inform education and outreach to private landowners in the Hudson River Estuary. The specific objectives were to: 1) understand how and why streamside landowners in the study area manage their properties, especially in relation to flooding; 2) investigate flood risk perception and personal responsibility of streamside landowners; and 3) determine the flood and stream management education needs and communication preferences of streamside landowners in the study area.

Results & Discussion

Flood experience and personal responsibility

Seventy-two percent of respondents have experienced flooding. About 75% of respondents who have experienced flooding have property damage from flooding.

Over half (55%) of respondents consider how their management activities affect flooding on their own property. However, only 28% say they perform activities on their land that decrease their risk for flooding. Personal responsibility is positively correlated with flood risk perception and undertaking some stream management actions. However, many of those actions

may actually be detrimental to streams and contribute to flooding. Therefore, education on management activities should focus on understanding why certain stream management practices may be detrimental as well as why some are beneficial.

Streamside management behavior and motivations

Watershed organizations can facilitate stream management among landowners across property boundaries. Thirty-nine percent of respondents feel positive about participating in a watershed organization. However, only 4% have participated in a watershed organization in the past and 16% are likely to do it in the future. Respondents display similar discrepancies in attitude and behavior for collecting runoff (20% positive, 3% have done it in the past, and 4% likely to do it in the future) and planting or maintaining a buffer (65% positive, 20% have done it in the past, 30% likely to do it in the future) [see Table 1]. These discrepancies in attitude and behavior for management actions suggest that landowners’ may be willing to partake in these behaviors¹.

Almost 60% of respondents believe stream management is important to them or people in their household, yet few people are actually doing any stream management on their property.

More than half (61%) of respondents say that conducting flood management activities on their own land is their decision. However, only 40% are aware of the rules, laws, and regulations pertaining to stream management, 39% are able to get information regarding stream management, and 34% know where to get information on stream management. Respondents who are more aware of the rules, laws, and regulations are significantly more likely to have planted or maintained a buffer and participated in a watershed organization.

Table 1. Respondents’ mean attitude, past actions, and mean likelihood of future actions for stream management activities

¹ Not all properties in a floodplain are required to have insurance; some landowners may voluntarily obtain flood insurance even if it is not required for their property; and some properties in a floodplain may not require flood insurance if they are not mortgaged.

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Stream Management Action	Mean attitude*	Done in past % (n)	Likelihood in future**
Remove debris from stream	5.3	30% (161)	3.9
Plant/maintain streambank vegetation	5.2	20% (107)	3.0
Participate in a watershed organization	4.1	4% (21)	2.6
Remove sediment from stream	3.4	7% (36)	1.7
Remove vegetation from streambank	3.3	18% (96)	2.3
Straighten streambank	3.1	6% (34)	1.5
Mow to edge of stream	3.0	13% (67)	2.3
Collect runoff	3.0	3% (17)	1.4
Extract water from stream	2.9	7% (36)	1.8
Dam stream	1.9	3% (15)	1.2

*Attitude was measured on a 7-point Likert-type scale where 1 = negative and 7 = positive

**Likelihood was measured on a 7-point Likert-type scale where 1 = not at all likely and 7 = very likely

Barriers to management

Lack of money was identified as the most significant barrier to respondents performing stream management activities (55%), followed by lack of technical support (43%) and lack of time (34%). About a third of landowners feel that the government prevents them from performing stream management activities, and about a third do not know how to do stream management.

Education and communication needs

More than half (52%) of respondents do not know if their land is in a Federal Emergency Management Agency (FEMA) designated 100-year floodplain, and only 5% of respondents have flood insurance. Of the respondents who reported that their property is on a floodplain, only 16% have flood insurance.

Information in the mail is an effective way for educators to communicate with 68% of respondents, followed by

a website (57%), a site visit by an educator (55%), and an email newsletter (50%). Telephone communication is effective for only 27% of respondents.

Respondents are almost equally interested in: in-person workshops (29%), hands-on field training (29%), and online learning (32%), while 31% are not interested in educational events regarding stream management. Forty-seven percent of respondents are likely to participate in Trees for Tribes or a similar program. This could indicate a need for expanded advertising and recruitment for the Trees for Tribes program. Respondents' age has a significant effect on education preferences' over half of the respondents that are not interested educational events are over 65.

Policy Implications

- Local policy makers should focus on enhancing partnerships among agencies and regional and local conservation organizations to deliver streamside landowner educational programs in the Hudson River estuary watershed in NY. Landowner respondents of the survey who are members of conservation organizations expressed more interest in streamside management education and communication than those who are not members of conservation organizations.
- Policy makers should focus on distributing information about FEMA floodplain laws and regulations. Landowners in the study area are generally whether their land is in a Federal Emergency Management Agency (FEMA) floodplain, why this information is important to know, and why flood insurance may be important. More than half of respondents do not know if their land is in a FEMA designated floodplain.
- Riparian landowners in the study area could benefit from an increase in or expanded riparian management programs, like Trees for Tribes, which offer both financial (e.g., trees are offered for free) and technical support to landowners. Lack of money and lack of technical support are the largest barriers that respondents face for stream management.

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Methods

The Resiliency Project Team identified 18 watersheds in the Hudson River Estuary to be targeted for flood education programs:

Kinderhook Creek
Catskill Creek
Lower Non-Tidal Rondout Creek
Wallkill River
Claverack Creek
Lower Esopus Creek
Wappinger Creek
Fishkill Creek
Onesquetha-Coeymans Creek
Moodna Creek
Peekskill Hollow Creek
Annsville Creek
Foundry Brook-Hudson River
Quassaick Creek
Fall Kill Creek
Ramapo River
Casperkill Creek
Tidal Roundout Creek

Watersheds were targeted based on educational need, frequency of flooding, and staff and resource availability. We used quantitative research methods to gain an in-depth understanding regarding if, how, and why streamside landowners in the targeted watersheds manage their streamside property. The study population of streamside landowners was defined as: landowners with property in the target watersheds with a parcel of at least one acre and within 100 feet of a stream (identified using the National Hydrography Dataset).

The survey instrument asked about landowner 1) experiences with flooding on their property, 2) attitudes toward management activities, 3) interest in streamside management, past management activities, and likely future activities, and 4) preferences for streamside management education and communications options. Data were analyzed using the software program Statistical Package for the Social Sciences (SPSS).

Outreach Comments

RECOMMENDATIONS FOR FLOOD RESOURCE EDUCATORS

This report was prepared for the New York State Water Resources Institute (WRI) and the Hudson River Estuary program of the New York State Department of Environmental Conservation, with support from the NYS Environmental Protection Fund.

1. Educational programs for streamside landowners in the Hudson River estuary watershed in NY should include information on why stream management activities are important tools to reduce flood risk and what types of management can be done to reduce flood risk. Only 28% of respondents reported doing activities on their property that decrease their risk for flooding, and just over half of the respondents have not done any stream management activities listed on the survey.
2. Educational programs for streamside landowners in the Hudson River estuary watershed in NY should include information on why some stream management activities may be detrimental and should be avoided. Educational material highlighting beneficial activities could focus on collecting runoff and planting a buffer, since these are activities that some respondents feel positively about but few have done or plan to do (collecting runoff = 20% positive, 3% have done it in the past, and 4% likely to do it in the future; planting or maintaining a buffer = 65% positive, 20% have done it in the past, 30% likely to do it in the future).
3. Educational programs for streamside landowners in the Hudson River estuary watershed in NY should include information should appeal to the landowners' sense of personal responsibility for social and environmental effects of flooding. Fifty percent of respondents consider how their actions on their land impact their neighbors' land, which could indicate an awareness of social responsibility.
4. Educational programs for streamside landowners in the Hudson River estuary watershed in NY should include information on the rules, laws, and regulations pertaining to stream management (or clear instructions on how to obtain this information). The information should be pertinent to state, county, and local laws and regulations. Only 40% of respondents are aware of the rules, laws, and regulations pertaining to stream management, 39% are able to get information regarding stream management, and 34% know where to get information on stream management.
5. Information in the mail is an effective means of communication for nearly ¾ of respondents, and should be a method of communication to

streamside landowners Hudson River estuary watershed in NY whenever possible. A special effort should be made to communicate about stream management with Hudson River estuary watershed streamside landowners that are over the age of 65 by offering information through the mail – websites and emails are less effective for this age group than for younger streamside landowners. Those over 65 years of age are also the age group that is least interested in stream management educational events.

6. A mix of program types (i.e. in-person workshop, technical field training and online learning) should be offered as educational programs to streamside landowners Hudson River estuary watershed in NY. Respondents preferred each of these educational methods nearly equally.

Student Training

This project did not train any students.

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