Response, Recovery, and Resilience to Oil Spills and Environmental Disasters: Exploration and Use of Novel Approaches to Enhance Community Resilience

Margaret A. Reams, PhD
Department of Environmental Sciences
Louisiana State University

Anna K. Harding, PhD
College of Public Health
and Human Sciences
Oregon State University

Wilma Subra, MS
Subra Company, Inc.

Nina S. N. Lam, PhD
Department of Environmental Sciences
Louisiana State University

Steven G. O'Connell, PhD
Lane Tidwell, PhD
Kim A. Anderson, PhD
Department of Environmental
and Molecular Toxicology
Oregon State University

Abstract **Researchers from Oregon State and Louisiana State Universities convened a diverse gathering of leaders of Gulf Coast regional nongovernmental organizations, regulatory agencies, residents, and researchers to examine events following environmental disasters. The overall goals of the workshop were to develop unique findings from participant experiences that could be beneficial and to offer specific recommendations for the improvement of response, recovery, and resilience in future disasters. We examined three topics related to enhancing resilience to environmental disasters: rapid response for characterizing exposure; recovery and the role of the citizen scientist; and increased resilience with community participation. The participants shared their experiences and recommended solutions including increased training for citizen scientists, expanded use of innovative sampling technologies, and greater sharing of environmental conditions and information among stakeholders and agencies postevent. The recommendations will improve future response and recovery efforts, and should strengthen communities by supporting key theoretical attributes of resilience.**

Introduction

Environmental disasters like the Gulf Coast hurricanes of 2005 and the BP oil spill of 2010 provide opportunities to examine response and recovery efforts and to derive useful lessons. Following these events, researchers, policy makers, and public interest organizations have weighed in with insights and recommendations designed to improve future planning and responses to large-scale environmental disturbances. For example, the Federal Emergency Management Agency has called for a more comprehensive "whole community" approach with greater interaction among stakeholders, public agencies, nongovernmental organizations (NGOs), and researchers to support improved pre-event planning, emergency response, and a range of recovery activities (Federal Emergency Management Agency, 2011).

Some observers point to the need for a new "community of practice" among researchers, service providers, planners, and residents to coordinate their efforts for better anticipation and response to future environmental disasters (Amaratunga, 2014; Cundill, Roux, & Parker, 2015; McNutt, 2015). Others encourage more participatory decision making and citizen input into pre-emergency planning and policy development to support recovery (Nelson, Adger, & Brown, 2007). Each of these involves some type of expanded and improved communication and information-sharing functions among the various entities with responsibilities for planning, emergency response, and recovery assistance following environmental disasters.

An examination of the response and recovery activities conducted by public agencies, NGOs, academic researchers, and community stakeholders following recent events along the Gulf Coast provides insights into how these efforts can be improved in the future. Researchers funded by the National Institute of Environmental Health Sciences (NIEHS) Superfund Research Programs at Oregon State University (OSU) and Louisiana State University (LSU) convened a diverse gathering of leaders of Louisiana and Gulf Coast regional NGOs, state regulatory agencies, community residents, and academic researchers to examine events following Hurricanes Katrina and Rita of 2005, the BP gulf oil spill of 2010, the Mississippi River floods of 2011, and Hurricane Isaac of 2012.

The workshop, Response, Recovery, and Resilience to Oil Spills and Environmental Disasters, was held on January 29, 2013, in Baton Rouge, Louisiana. Highlights and web-based information was disseminated (http://superfund.oregonstate.edu/LSUSymposium). This event was held in a workshop format and provided a venue for a large cross section of individuals to share their experiences. Specifically, participants explored how improvements in pre-emergency planning, postevent monitoring of environmental conditions, and better communication of exposure risks might contribute to stronger recovery and enhance community resilience. The workshop topics encompassed a range of activities conducted in the Gulf Coast region by workshop participants in the aftermath of the recent disasters. For example, the Gulf Restoration Network encouraged residents to systematically document and share observations concerning the location and effects of the BP oil spill.

The objective of this article is to present the recommendations of the workshop participants to improve planning and response in three areas: 1) response and exposure risk characterization, 2) recovery and the role of the citizen science in monitoring postdisaster conditions, and 3) resilience and encouragement of community participation in predisaster planning. The findings and recommendations present new knowledge for building communities of practice for disaster planning, supporting citizen science activities, and enhancing the overall resilience of vulnerable communities to large-scale environmental disturbances.

Study Design

We organized the workshop to examine response and recovery-related activities conducted after the Gulf Coast environmental disasters, and to develop specific recommendations to improve efforts in the future. Response and recovery planning as well as the subsequent implementation—due to different protective goals of various players in environmental disaster—often progress in parallel or have insufficient interactions. Therefore, the workshop was aimed at developing mutual understanding among workshop participants, generating awareness of monitoring technologies for characterizing exposure, exploring agile community resources, and identifying methods for better data and information sharing. Recommendations from workshop participants who have firsthand experiences are particularly useful because they identify points of linkage between response efforts and recovery, illuminating the process or critical path through which community resilience can be strengthened following environmental disasters.

We invited participants from organizations and public agencies with responsibilities and involvement in recent environmental disasters along the Gulf Coast to attend a one-day symposium and workshop held on the campus of LSU in Baton Rouge. The meeting was held on January 29, 2013, and was cohosted by researchers of the Superfund Research Programs at OSU and LSU. The attendees represented a diverse group of stakeholders and a broad range of expertise, including 15 individuals representing seven NGOs who work directly with residents of south Louisiana communities. These included the Louisiana Bucket Brigade, a citizen science and air monitoring group; the Louisiana Environmental Action Network, an association of activist citizens from around the state whose communities face environmental disturbances and pollution issues; and the Mary Queen of Vietnam Community Development Corporation in New Orleans, a group representing the environmental concerns of the Vietnamese residents of New Orleans East. Also, representatives of the Gulf Restoration Network, the Lake Pontchartrain Basin Foundation, the Baton Rouge Citizens to Save Our Drinking Water, and the Louisiana Wildlife Federation participated. These NGOs have years of experience working with residents and several were active in recovery assistance following the storms of 2005 and the 2010 oil spill. As a result, they were able to bring to the discussions real-world experience and insights into the needs of their constituents.

Other participants included 18 representatives of Louisiana state regulatory agencies, including the Department of Health and Hospitals, the Department of Environmental Quality, the Louisiana Department of Wildlife and Fisheries, the Louisiana Department of Natural Resources, and the Louisiana Oil Spill Coordinator's Office. Five participants represented the oil and gas industry, including the Shell Pipeline division and oil field service companies. Three participants from the federal government represented the U.S. Coast Guard and the U.S. Environmental Protection Agency (U.S. EPA) Dallas Region 6. In addition, 25 academic researchers and 15 graduate students from various academic disciplines including environmental and health sciences, chemistry, oceanography and coastal sciences, geography, economics, political science, and communication participated in the symposium. They represented OSU, LSU, University of New Orleans, and McNeese State University. Several experts from the groups listed above were included to provide information on newer monitoring technologies that could be deployed in environmental disasters. The morning portion of the symposium consisted of speakers and the afternoon session included three focus-group discussions. In all, 41 individuals participated in the focus groups.

We followed established methodology for focus-group discussions of specific questions and topics (Kitzinger, 2007). We selected several professionals in environmental fields to lead the focus groups. The leaders explained the objectives of each focus-group session and the guidelines for interaction, introduced the specific questions, moderated and guided the discussion, and encouraged all members of the group to speak freely, so as to increase interaction among participants. The key points of the discussions were recorded by at least one notetaker assigned to each group.

Focus groups worked in parallel on three topics: 1) response and exposure risk characterization, 2) recovery and the role of the citizen scientist, and 3) resilience and community participation. Citizen science refers to collaboration between scientists and volunteers to systematically observe and gather information about selected real-world issues. The interaction is increasingly recognized as a useful approach to raise the science literacy of nonexperts, to gather data to advance understanding of a range of environmental issues, and to identify research topics of concern to community residents (Bonney et al., 2009). The focus groups also examined the advantages and challenges to developing a new framework for response and recovery. Each group included representatives of regulatory agencies and NGOs who work closely with residents and academic researchers. At the end of the workshop, the participants reconvened and presented summaries of their discussions, points of consensus, and recommendations for improved disaster response and recovery planning.

Results

The workshop was convened in Baton Rouge in late January 2013, with 81 in attendance for the symposium and 41 participating in the workshop, including participants from regulatory

TABLE **1**

Focus-Group Discussion Findings for Improving Response to Environmental Disasters to Facilitate Resilience

Focus Group 1: Response and Exposure Risk Characterization

1. **During emergency events, which contaminants should be assessed and where?**
   - Citizens were concerned with lack of transparency and uncertainty about regulated chemical locations before and after a disaster.
   - There was no consensus on what chemicals should be monitored.
   - Predisaster planning and sampling strategies should be shared with local communities.
2. **How to determine and employ monitoring approaches?**
   - It is critical to have the community engaged for site selection for chemical sampling to characterize postdisaster contamination.
   - Use techniques that do not require a priori knowledge about potential contaminants prior to sampling.
   - Employ passive sampling devices so that samples can be collected and archived in laboratory freezers for later use if needed.
   - It is unlikely that all chemicals that should be monitored will be known in order to fully characterize risk; therefore, it is important to maximize chemicals screened.
3. **What quality assessment/quality control standards are needed to ensure citizen scientist-collected data are useful?**
   - More people often are needed during and after environmental disasters to perform environmental monitoring.
   - Part of quality assurance would include standard operating procedures (SOPs) and applicable training processes for citizens and nongovernmental organizations (NGOs).
   - Employ newer technologies, such as photographs with GPS, as part of training and documentation.

Focus Group 2: Recovery and the Role of the Citizen Scientist

1. **What are the best practices for training citizen scientists?**
   - Citizen scientist training must be transparent while ensuring safety of participants.
   - Clear SOPs need to be developed specifically for citizen scientists.
2. **How can citizen scientists integrate effectively with exposure assessments?**
   - Citizen scientists must be actively engaged in predisaster planning.
   - Citizen science programs should include multiple partners, such as technology or engineering groups, advisors, community groups, government agencies, universities, and NGOs.
   - Use communication expertise that is community specific and valuable for information sharing amongst the interested parties.
   - Citizen scientists should engage in identification of sampling sites.
   - Data are easily accessible by all interested parties.

Focus Group 3: Resilience and Community Participation

1. **What are the best approaches for community participation in assessing local environmental conditions?**
   - Understanding the individual community is essential, and that there is no “one-size-fits-all” model.
   - Learn from history and tradition, and seek local ecological knowledge of the community.
2. **How can information be shared among groups?**
   - Identify community-specific concerns following environmental disasters.
   - Proactively work with communities to develop response and recovery plans.
   - Use social media tools to share results of environmental monitoring with interested individuals and groups within the communities.
   - Share accurate and timely information with applicable risk communicated.
3. **How can communities build resilience to environmental disasters?**
   - Communicate accurate risk reduction strategies.
   - Support redundancy of services so that key functions can be carried out in the aftermath of disasters.
   - Encourage NGOs, agencies, and academics to reach across cultural boundaries to better serve communities that have been hit by disaster.

agencies, NGOs, universities, and oil and gas companies. Presentations are available (http://superfund.oregonstate.edu/LSUSymposium).

The participants selected one of three focus-group discussions to join. Most of the participants did not know each other personally, and the focus groups created the opportunity for members of the various organizations to establish connections. Each group focused on one topic and included members of each organization represented. We were particularly interested in areas of consensus and nonconsensus, given the diversity of roles played by the participants. The participants shared and examined historical successes and failures and identified ways to improve response and recovery, leading to specific recommendations. The main points from each of the three focus group discussions are summarized in the following section and in Table 1.

Theme 1: Response and Exposure Risk Characterization

A consensus could not be achieved to define a template for identifying chemicals that should be monitored. Certainly, the Emergency Planning and Community Right-to-Know Act of 1986 makes emergency planning easier by requiring regulated industries to report to state and federal authorities annually the amounts of listed chemicals that are used, treated, stored, transported, and/or disposed of by the firms, and this information is available to residents (U.S. EPA, 2017). So, while it is recognized that agencies have records of hazardous chemicals used and stored in commercial settings within a community, these records alone were considered insufficient as the sole basis for monitoring. It was acknowledged that some hazardous chemicals might not be disclosed in a timely or thorough fashion, especially if they change hands. In addition, during some environmental disasters, contaminants, and hazardous chemicals might be moved some distance from their original storage location.

For example, participants from the Louisiana Bucket Brigade reported that during the 2011 Mississippi River flooding, multiple chemical waste pits were affected, and some did not have responsible parties identified. Given that state agencies lack the resources and staff to assess all sites after a disaster and tend to respond to the worst ones, many sites were not evaluated. These concerns about the oversight of hazardous materials were coupled with the acknowledgement that many chemicals are not regulated. Also, the possible lack of transparency of chemical storage and use before, during, and after an environmental disaster was a reoccurring theme.

The concerns expressed reflect a sense of “undone science” wherein there might be knowledge gaps concerning exposure risks, due in part to when and where monitoring is conducted within communities (Hess, 2007). Such knowledge gaps have been characterized as “outcomes of undone science” (Frickel & Vincent, 2011). While there was general agreement that there should be transparent processes for both monitoring and for deciding which chemicals should be tracked after environmental disasters, no consensus could be achieved about the processes. Discussions faltered when the groups attempted to develop a protocol for monitoring specific chemicals.

Monitoring Approaches

It is highly unlikely that all chemicals that can pose a risk will be known after an environmental disaster. Even prior to an environmental disaster, it is often not possible to know which chemicals should be monitored to fully characterize risk. One approach to address these concerns is to utilize techniques that do not require an a priori knowledge about potential contaminants prior to sampling. Field sampling approaches that use technologies that can be subsequently analyzed back at the laboratory for many contaminants may be especially valuable. One example is passive sampling techniques. Various passive sampling devices (PSDs) are applicable to a broad range of chemicals. Several different types of PSDs could be used to further expand the range of chemicals that could be monitored.

Another important feature of employing passive samplers is that samples from the field could be collected and archived in laboratory freezers for later use if needed. Should contaminants of concern be discovered later, these archived samples could be analyzed and provide important feedback to the communities concerning the spatial and temporal extent of the contamination. The cost of this more robust approach to characterizing risk could be kept low, as not all archived passive samplers would be analyzed necessarily, which is typically the most expensive part of monitoring. The archived environmental disaster samples could become a valuable curated collection.

Monitoring Quality Assurance

Consensus was achieved that more person power often is needed during and after environmental disasters for environmental monitoring. Also, the participants agreed that citizen scientists could be useful in these types of circumstances when state agency personnel might have difficulty getting into affected communities to conduct assessments. Consensus was not achieved, however, that citizen scientists or NGOs could be useful and potentially trusted to collect samples that might hold up under legal scrutiny. While there was great enthusiasm by communities and NGOs to cooperate with agencies, there was reluctance to change the status quo, and concern that citizen scientists would need to have documented training and other safeguards—as yet undefined—to ensure sample integrity. There was significant interest in receiving training from existing agency-sponsored courses addressing proper methods of field sampling. Also, this training would have to be conducted prior to emergency events so that volunteers could be mobilized quickly. The participants also expressed interest in co-developing training materials (including training videos), courses, and other focused outreach resources that could be used specifically in preparation of environmental disasters. It was agreed that training materials should include a quality assurance plan for citizens and NGOs to promote sampling results that are trusted and useful.

Theme 2: Recovery and the Role of the Citizen Scientist

Training Citizen Scientists

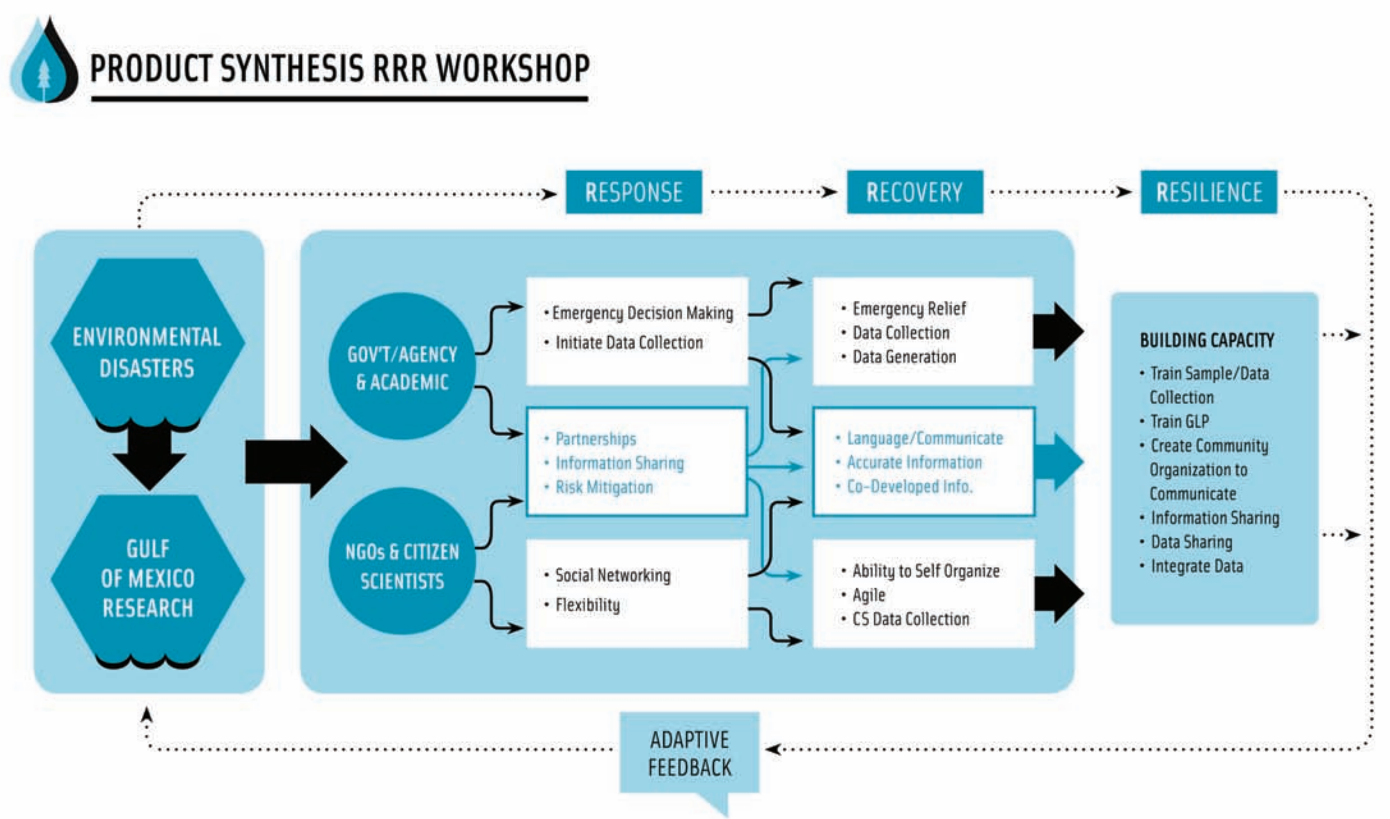
It was recognized that training of citizen scientists should occur prior to environmental disasters. While some focus-group participants still expressed a desire to protect the goals of their agencies and stressed the need to maintain the status quo of roles and responsibilities for environmental monitoring, training citizen scientists was considered an important use of an “agile” community resource. In addition to quality training discussed above, the development and use of standardized procedures was considered essential.

Citizen Scientist Integration

There was a consensus that the goals and objectives of citizen science programs should include multiple partners, such as technology or engi-

FIGURE 1

Synthesis of Workshop Results



RRR = Response, recovery, and resilience; NGOs = nongovernmental organizations; CS = collaborative stage; GLP = good laboratory practice.

neering groups or advisors, community groups, government agencies, universities, and NGOs. Citizen scientist groups have the ability to self-organize and develop important community partnerships. Many have developed excellent lines of communication within the community. With the incorporation of citizen groups with agencies, universities, and NGOs, the nexus of integration could be powerful. Citizen scientist groups also often possess language and communication expertise that is community-specific and valuable for information sharing amongst interested parties.

Theme 3: Resilience and Community Participation

Community Participation in Assessing Local Environmental Conditions

This group of discussants agreed on a fundamental need to understand the communities themselves and to take into account the socioeconomic and geographic diversity of communities, as there is no "one-size-fits-all" model for assessing local environmental conditions and exposure risks in the aftermath of environmental emergencies. The group stressed the need for broad-based, collaborative efforts that build trust among community members so that information can be provided that is relevant to the specific community.

The group agreed on the need for further investment in proactive response and recovery planning, requiring a plan that addresses community-specific needs and risks. Receiving timely and updated information about specific actions residents can take to reduce their exposure risks was determined to be critical to communities. Bidirectional lines of communication between regulatory agencies and communities were identified as being important to build trust and to identify community-specific concerns following environmental disasters. The group agreed it was important to learn from history and tradition, and to seek out those who could provide traditional ecological and historical knowledge of the community. One suggestion was to incorporate into school curricula or on websites information about the local environment, natural hazards, and strategies for risk mitigation that would make the knowledge more broadly known.

Finally, the discussants agreed that communities can be made more resilient through diversification of skill sets within communities. They stressed the importance of supporting redundancy of services so that key functions can be carried in the aftermath of disasters. For example, information sharing could be achieved through greater use of social media tools, to share results of environmental monitoring with interested individuals and groups within the communities. The group also suggested greater utilization of cloud-based, open-sourced technology both to communicate information about environmental conditions and to gather feedback from the public.

Discussion

The workshop was created to gather information that could be used to improve planning and response to future environmental disasters. Figure 1 summarizes points of consensus and also depicts two important dimensions of the challenge.

The first dimension is the current set of functions and roles played by regulators, researchers, NGOs, and community residents as exhibited during the response and recovery phases of recent Gulf Coast disasters. The second dimension depicts key conceptual linkages between response and recovery efforts and longer-term resilience within a community. In the center section of the diagram, boxes outlined in blue summarize the prescriptive recommendations for new partnerships and shared functions to be carried out by the various groups during the response and recovery phases.

During the response phase, the functions provided by government agencies and academic researchers during recent disasters and those performed by nonexperts (e.g., citizens and NGOs) have tended to be distinct, with no overlapping duties or shared functions. For example, agency officials were responsible for emergency decision making, including assessing exposure risks, issuing warnings concerning air and water quality, and even ordering public evacuations of highly affected areas. By contrast, the functions performed by residents and NGOs involved passing on information through established social groups and communication networks.

The recommendations were clear from the workshop participants: the two types of entities should work together to form ongoing partnerships to support accurate information gathering and sharing, and to develop and disseminate risk mitigation strategies. This approach provides a clear mechanism or process for community members to self-organize to carry out necessary functions after disasters, one of the key theoretical attributes of more resilient communities (Adger, 2000; Holling, 1973, 1996; Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008). Also, increased opportunities for residents to participate in environmental monitoring addresses one of the significant issues raised by the focus groups, a concern that agency representatives might not conduct environmental monitoring in specific areas most relevant to the environmental exposure risks of the residents. "Functional redundancy" is an attribute of more resilient communities both in the immediate aftermath and recovery periods, and could be increased by more individuals and groups recording their observations of environmental conditions following large-scale disturbances (Holling, 1973, 1996). Also, because residents conducting monitoring are probably highly motivated to share the results of their efforts, the monitoring should encourage more communication among residents and support the creation and maintenance of networks of interested individuals and groups.

During the recovery phase, functions performed by the experts and nonexperts also have tended to be distinct, with government agencies concerned with emergency relief and data collection to assess changes in environmental threat levels. Groups of residents and various NGOs, however, also performed important functions related to disaster relief and assistance. At this stage, the participants called for increased interaction to perform shared functions including co-developing of information about environmental conditions and residents' needs in the aftermath of the disaster. They stressed the need to work together to gather the most accurate data possible to assess the exposure conditions within the local community.

Through increased coordination of efforts and improved, ongoing, bidirectional communication between government agencies and communities, the participants envisioned community stakeholders being able to conduct more accurate assessments of exposure risks—furthering another key theoretical element of resilience, a holistic and scientific understanding of risk (Adger, 2006; Gunderson, 2000). Expanded citizen monitoring efforts and use of innovative technologies, such as passive sampling devices, should contribute to more accurate assessments of local conditions, especially because residents can place the information they compile in the context of the concerns and behavior patterns of their neighbors.

Lastly, the increased interaction should support the formulation and implementation of adaptive strategies, including postdisaster response plans that reflect more closely the concerns of residents regarding potential environmental exposure risks. Further, increased monitoring and communication among community stakeholders, researchers, and agency officials should lead, in time, to more thorough evaluations of response actions, thereby informing the adjustments and modifications necessary to improve postdisaster response and recovery efforts. This evaluation and improvement process is shown as a feedback mechanism in the diagram and enhances the third element of more resilient communities: the capacity to adapt to changing levels of risk (Adger, 2006; Lam, Arenas, Pace, LeSage, & Campanella, 2012; Lam, Reams, Li, Li, & Mata, 2016; LeSage, Pace, Campanella, Lam, & Liu, 2011; Nelson et al., 2007; Reams, Lam, & Baker, 2012; Reams, Lam, Cale, & Hinton, 2013).

Recommendations and Conclusions

The results of the focused discussions of the three topics of interest indicate clearly that the topics are interrelated. The workshop participants recommended that improvements in the first topic—response and exposure risk characterization—could be achieved through better pre-event planning so that the likely contaminants that might be released into local environments can be identified. Also, participants emphasized the importance of environmental monitoring to be conducted in the specific places where residents have acute concerns. The participants were in agreement that because of the importance of this issue, residents and citizen scientists should be trained prior to emergencies and used to help address this gap in information about environmental conditions following environmental disasters. This type of pre-event planning could support new communities of practice among community stakeholders, including residents, NGOs, and public decision makers.

The second discussion topic—recovery and the role of the citizen scientist—led to a similar call for more information about local environmental conditions following disasters. The focus-group participants stated that residents often have questions about exposure risks in their own neighborhoods from floodwaters and sediments, for example, and that these questions were not addressed by agency employees. As a result, residents worried about the safety of moving around their neighborhoods; their concerns were not allayed by either the environmental assessment activities or the postdisaster communication efforts of the state regulatory agencies.

To address this need for more information, the focus groups expressed enthusiasm for the wider use of new PSDs, which can be used by groups of residents to gather information from their own neighborhoods, thereby creating a new source of data that can be shared with environmental agencies. To realize these benefits, residents will need training and the participants recommended the development of new web-based training courses to promote best practices for those who would conduct the monitoring. Increased opportunities for environmental monitoring by nonexperts have the potential to raise residents' scientific understanding of local hazards, and to enhance their capacity to participate more substantively in environmental policy development and emergency planning.

The potential for citizen scientist-driven environmental projects are quickly developing. One such opportunity is where citizen scientists can receive training, develop their own projects, or join an existing network (http://citizen.science.oregonstate.edu). Certainly, the greater use of PSDs by citizen scientists could generate more information to be shared with agency officials, academic researchers, and others. The site enables citizen scientists to develop a profile, perform online training, request sampling sites, or join local events. The website also manages sample submissions and allows users to view their data, key features identified in the focus groups. Additional resources to support a greater role for nonexperts in disaster recovery can be found on the Citizen Science Association website (http://citizenscienceassociation.org).

The third discussion theme concerned how to encourage more public participation in decisions to support more resilient communities in the longer term. The group stressed a fundamental need for improved communication and trust among community residents, especially those identified as community leaders, NGOs, researchers, and public agencies. The foundation of social capital that is needed to support longer-term resilience needs to be established before the next disturbance (Gunderson, 2000).

The central communication challenge is how to get information about environmental conditions following disasters into the hands of community residents and other stakeholders. One lesson repeatedly noted by NGO and community presentations was that information concerning data and risk is more effectively received by communities through known community leaders rather than agency or academic researchers. The participants recommended the use of network-type organizations like the Louisiana Environmental Action Network, the Gulf Restoration Network, and the Louisiana Bucket Brigade, whose members monitor and observe local environmental conditions and share that information with the public through interactive websites. The participants also suggested public agencies, residents, and NGOs make wider use of social media strategies, including tweets and Facebook postings to share monitoring results, and create interactive online maps showing locations and information gathered from monitoring sites.

Finally, the participants agreed that the level of trust needs to be improved among residents, public agencies, and other groups following disasters. They recommended increased opportunities for public and NGO participation in emergency planning and response activities within the local community. The groups agreed that recovery of communities would be quicker if bidirectional communication is enhanced between residents and regulatory agencies. Also, the participants recommended the wider use of formal data-sharing agreements between researchers and community groups to build trust and enhance the capacity for collaboration among residents, NGOs, and academic researchers. Increased trust, more systematic interaction, and information gathering and sharing among these key groups should help enhance the long-term resilience of coastal and industrialized communities facing exposure risks from significant natural and technological hazards.

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Corresponding Author: Kim A. Anderson, Department of Environmental and Molecular Toxicology, Oregon State University, Agricultural Life Sciences Building, Room 1007, Corvallis, OR 97331.
E-mail: kim.anderson@oregonstate.edu.

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Did You Know?

More than 900 environmental health professionals enjoyed over 200 educational sessions at NEHA's 2017 AEC in Grand Rapids, Michigan, this July. The conference received a variety of media attention—watch and listen to the interviews at www.neha.org/news-events/latest-news/neha-aec-2017-makes-history.