Green Infrastructure for Coastal Resilience

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ORIGINAL BIG IDEA
16: Hub research topic - Green infrastructure & preparing our coasts for the 21st century. How can we move beyond reactive to proactive planning for the future? What information is needed? Where are the bright spots/best examples and how can we apply these. Critical to have national and local/state gov't at the table, as well as business, homeowners, & researchers. A series of webinars, workshops, and site visits to gather best practices, and then obtain large scale commitments (ex, such as LA master plan) and investments to make really big changes.

Preface to Revised BIG IDEA:
Green Infrastructure (by this we mean both the constructed infrastructure like storm drainage systems, detention ponds, rain gardens, etc. as well as natural infrastructure like wetlands, estuaries, mangroves, shorelines, etc.) are collectively our defense against extreme weather events and water pollution. In addition to contributing to sustainable stormwater management, Green infrastructure has been shown to improve health and well-being, reduce the urban heat island effect, and increase land values. Coastal communities, given their unique stresses from sea level rise and climate change, offer a unique testbed for advancing holistic green infrastructure design that engages scientists, engineers, citizens, and decision makers at a community scale. In the built environment, the fundamental underpinnings of green stormwater infrastructure call for their near ubiquitous presence in watersheds to effect change and bring about a more natural hydrologic cycle, this is inherently a community dependent strategy for coastal resilience.

What is your specific* recommendation?

- That a hub focus specifically on one or more urban communities across sizes and socioeconomic scales as testbeds for exploring the impact of green infrastructure on specific outcomes for these (e.g., reducing flooding, improved well-being, improved livability, etc.).

- Coastal systems and their associated extremes have the potential to stretch green infrastructure to its limits, what is the ability of these systems to bring resilience to the system, and are they able to bounce back / recuperate with minimal effort post-event.

- That research be focused on how green infrastructure for stormwater management be applied to the unique hydrologic conditions present within coastal environments.

- Unique characteristics of coastal urban environments: high groundwater table (no room for infiltration). Rising sea levels causing stormwater infrastructure to “back up” at high tide.

- Minimal study of green infrastructure has taken place at the watershed scale, leaving doubts as to how a large distribution of controls will act in concert.

- Identify engineering-based performance standards and design guidance for green infrastructure along the coast (living shorelines, mangroves, seagrasses, coral reefs) similar to that for breakwaters, revetments, etc.

- Green infrastructure presents a way to unique way to engage communities. It can be a living laboratory for teaching about hazards and natural processes. It can be a way for constituents to contribute to system maintenance and community building. It can also be a way to aid in localized data collection.

Why is it valuable?

Large storms are expected to increase in frequency, intensity, and duration. The 100 year storm won't be the 100 year storm in the future. Sea level rise further increases the risk of flooding due to high annual exceedance probability events and the severity of flooding during hurricanes or strong storms. We need new ways to manage stormwater in coastal communities to reduce flooding risks caused by these changing environmental conditions. If successful, coastal communities will suffer less from flooding impacts. Green infrastructure offers cost effective design alternatives compared to traditional engineering strategies, and in contrast with traditional engineered coastal structures, can naturally recover following damage due to extreme storms.

Stakeholders include residents of coastal and inland communities vulnerable to extreme rainfall, riverine, or coastal flooding. We can partner with community planners, city managers, and local NGOs to improve community buy-in for installing natural features and to identify best practices for design. Another benefit of Green infrastructure is that these features provide ecosystem services by acting as habitats and natural water filtration systems.

An important note is that hazards differentially affect communities, with poorer and more marginalized members of societies living in riskier areas. Further, implementation of green infrastructure, historically, has concentrated in more affluent areas. By exploring benefits and cost-effective, we can generate scalable solutions that are more inclusive and offer broader hazard reduction.

What's the reasoning or supporting evidence behind it?

Success in this context can be measured by a reduction in flooding impacts to coastal communities (i.e., loss avoidance). By measuring flooding impacts (e.g., flooded roads, flooded homes, flooding buildings, etc.) over time with innovative sensor technology, along with the introduction of novel, coastal-relevant green infrastructure, it will be possible to measure the benefit of these interventions on flood impacts. By creating novel, community-scale hydrologic and hydraulic drainage models, it will be possible to test the impact of new proposed infrastructure designs before constructing them, and to validate these models using on-the-ground observational data.

Critical to these efforts is the issue of scale. A substantial body of literature has documented the benefits of large (km scale) mangrove forests in mitigating damage due to tsunamis and hurricanes. However, mangroves and other natural coastal features have been shown to provide protection at the parcel scale. Conversely, constructed green infrastructure has focused on small (parcel-scale) implementations and less work has focused on watershed or community-scale impacts of these systems. Additional research is needed to quantify these benefits and identify the limits at which natural features either fail or do not provide protection. To identify these benefits and limitations, field and laboratory studies are required to measure the effects of vegetation on mitigating flood hazards on multiple scales.