Ecosystem Conservation – Flash Presentations

Apartadó's River Master Plan: Mitigating risk of flooding in the face of managed retreat and climate change in a biodiversity hotspot

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The submission aims to present the Master Plan for the Apartadó river in Colombia; a territory marked by the presence of indigenous and Afro-Colombian communities and deemed a biodiversity hot-spot. Apartadó is highly vulnerable to the effects of climate variability and change, with climate projections indicating an increase in precipitation and temperature in an already humid area. The formulation of the Master Plan addresses climate adaptation in tropical settings, environmental and climate justice and managed retreat in marginalized communities.

How, What, and When? - Defining Substantial Damage for Transfer of Development Rights.

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Coastal communities are faced with difficult decisions as they weigh strategy options to plan against increasing flood impacts due to sea level rise. Preserving the tax base can weigh heavily in this process; however, the realities of the high cost of structural solutions may ultimately constrain options towards retreat for many localities. Retreat may be reactive to increasingly repetitive loss, or pro-active. Pro-active options range from proven voluntary acquisition programs to new concepts such as "rolling easements". As such new concepts are considered, the legal and procedural mechanics of the programs must be explored and refine to facilitate implementation. Wetlands Watch is leading a multi-year pilot project that utilizes land conservation to facilitate the abandonment of flooded properties in coastal Virginia through transfer of development rights in a rolling easement approach. One aspect of the approach that must be addressed is defining the "trigger" mechanism to invoke the transfer of property rights. A specific consideration for the trigger mechanism in the pilot project is the likelihood of the property becoming substantially damaged (when a structure damaged more than 50% by an event). Substantial damage is dependent on many factors, such as flood frequency, changes for the flood frequency due to the rate of sea level rise, as well as individual building characteristics that define exposure to damage. Flood risk professionals at Dewberry were engaged to help resolve these aspects of Wetland's Watch pilot project. Our presentation will provide an overview of the strategy approach of the 50% damage trigger mechanism. We will provide background on how the flood hazards change with sea level rise, and processes and considerations in quantifying the changing probability of substantial damage. Case examples include looking at trigger mechanisms through different approaches, such as the consideration of changing flood probability or the use of annualized loss to define the substantial damage trigger point. The presentation is expected to provide effective practices to participants who are considering similar strategies for implementation.

Managing Retreat Through Natural Barriers Which Provide Carbon and Heavy Metal Stocks

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Challenges posed by managed retreat are marked by past injustices over decades, centuries, and millennia. The legacy of forced location haunts the indigenous communities, people of color, and under-privileged. To understand what is at stake when land is lost it is advantageous to retrieve histories, both oral and written, as well as legacies derived from the archives sequestered in the sediments. Urban tidal marshes such as Jamaica Bay today provide habitat for fisheries, water filtration, extensive biodiversity, carbon sequestration, and coastal protection. These remnant wetlands are a renowned haven for 325 species of migratory and resident birds today and are increasingly valued for the horseshoe crabs, diamondback terrapins, and over 90 fish species. What is not generally appreciated is the extent to which these marshes unfortunately sequester heavy metals that are in danger of polluting estuarine waters as sea level rises. Our research shows the extent to which these marshes contain lead, copper, and zinc which reflect the industrialization since the 1800's. As accelerating sea level rises, marsh erosion at the edges has been well documented in recent decades, and restoration efforts in some marshes have been successful. Future efforts require consideration of the negative consequences of the loss of these important stores of both carbon and heavy metals to the estuary, and the solutions needed to keep them in place. We focus on expanding efforts for marsh preservation in the context of strategic retreat and adaptation.

Retreat of Salt Marshes: Natural, Managed, or Blocked?

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Coastal marshes are found in intertidal zones around estuaries. These tidal wetlands provide habitat for numerous aquatic and terrestrial organisms such as invertebrates, fish, and birds. They also provide numerous ecosystem services to humans, including storm and flood protection and sequestration of pollutants including metals, nitrogen, and carbon dioxide. The metals they sequester will not be toxic to resident animals. The nitrogen they sequester will not cause eutrophication with hypoxia and harmful algal blooms. The carbon dioxide they sequester will not contribute to climate change. When faced with sea level rise (SLR) marshes must either increase their elevation to keep up with SLR, or move inland, or else be "drowned". Many marshes in the CT/NY/NJ area, where SLR is higher than average, are not getting adequate sediments to elevate fast enough, and inland migration is difficult in developed areas. Such marshes are subject to a phenomenon termed "coastal squeeze." In a study of NJ marshes for NJDEP, (https://www.nj.gov/dep/sab/sab-salt-marsh.pdf) we found very few marshes were elevating fast enough, and only those in undeveloped Delaware Bay were migrating inland successfully, into coastal forests. Some property just inland of marshes is in private hands, and owners may be inclined to build bulkheads to protect their yards. This will destroy the marsh totally. However, it is possible for local municipalities to encourage "migration pathways" for marshes. Migration pathways are areas that could convert to wetlands. Areas that are both undeveloped and contiguous to existing wetlands are more likely to become pathways than developed areas or areas not adjacent to existing marsh. Pathways can be facilitated by preserving migration spaces, removing berms, resizing bridges and culverts, and adjusting the slope of the land. Creating pathways generally involves local governments working with landowners, using instruments such as conservation easements. Problems that can arise are unfamiliarity with potential pathways, connecting scientific findings to policy and practice, insufficient budget, lack of coordination on land acquisition, lack of guidance on managing lands for coastal habitat advancement, and uncertainty about when and how marshes can move upslope. Education is critical for

local communities and politicians. Prioritization will depend on ecological and geophysical issues, but also on political and social factors. In identifying which communities are appropriate for pilot projects, there are arguments for whether planners should focus on communities with more resources or those with fewer, raising issues of environmental justice. Towns in Eastern Suffolk County have developed a Community Preservation Fund, through which the properly owner sells the house and land to the town and the house is removed, leaving open space for marsh migration. The future of tidal salt marshes will be influenced by adjacent landowners whose decisions could promote or block marsh migration. It has been found that conservation easements are unlikely to be sufficient to mitigate losses from sea level rise, but some other strategies like restrictive covenants and future interest agreements appear more likely to be adopted by landowners. However, these are unproven in practice and are likely to be more expensive. Failure to factor human behavior into conservation planning can lead to an overly optimistic view of success in marsh migration. Beyond marsh migration, other possible strategies to preserve coastal marshes include modifying current practices of removing invasive Phragmites (which allows marshes to elevate more rapidly), adding additional sediments to the marsh surface ("thin layer deposition") and creating a "living shoreline" by adding hard materials such as oyster reefs in front of eroding marsh edges.

Salt marsh migration as a critical conservation strategy in NYC

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New York City (NYC) has 520 miles of coastline, about one third of which is parkland. Sea level rise (SLR) associated with climate change increases risks not just for NYC Parks system's built infrastructure, but also for salt marshes that once dominated the coast and still provide valuable ecosystem and social benefits to the City. NYC salt marshes are at risk due to the local high rate of SLR exacerbated by geologic subsidence, erosion, water quality impacts, and sediment supply disruptions that limit build up of mineral soil. These stresses lead to acres of vegetated marshland being converted to mudflat around NYC each year, and result in loss of important ecosystem services, such as fish nursery habitat, bird nesting and rearing grounds, carbon sequestration, and wave energy dissipation. Although existing salt marsh is vulnerable to SLR, one potential mitigating factor is the development of new marsh through marsh migration. Marshes can migrate horizontally and establish where higher land, usually next to wetlands, becomes regularly flooded. This process is limited in NYC largely by physical barriers, including steep slopes, roads and buildings. For example, almost 80% of NYC Parks largest salt marsh complexes will be prevented from migrating landward due to development, debris or other obstructions. Despite these constraints, the greatest potential for conserving tidal marsh area in NYC, and possibly the most cost effective, may lie in marsh migration occurring across existing open space, according to modelling of wetland vegetation change under future inundation scenarios. To help us understand this potential, we recently initiated a research project, funded by the U.S. EPA, to assess physical and vegetation characteristics where dry land will be flooded daily by 2085. Our goals are, one, to identify needed management actions, such as removing anthropogenic debris and remnant fill, to facilitate marsh migration, and, two, to prioritize conservation and transfer and acquisition of properties with high likelihood of becoming functional salt marsh in the next half century. By evaluating baseline conditions at select long term study sites, we will aim to understand and facilitate the process of wetland migration in NYC over time. Some low-lying developed land that will be inundated regularly in the future may also contribute to marsh migration areas, and therefore marsh conservation. Ramblersville, a neighborhood in Queens along Jamaica Bay, provides one potential example. Following heavy damage to homes in

Ramblersville from Hurricane Sandy, the City developed a buy-out program resulting in the demolition of houses and return of lots to vegetated open space across several acres. NYC Parks will accept ownership of these parcels and manage their restoration to coastal wetland and preservation for future marsh migration. We aim to assess how marsh structure develops over time in these former lots and what interventions are needed to establish functional wetland habitats within and adjacent to communities that will continue to adapt to and change with SLR. Studying these processes in existing open space as well as in much more complex developed landscapes will help us better understand how and where marsh migration can preserve wetland resources and functions across the City.

The case for a paradigm shift in flood adaptation: introducing a new Flood Adaptation Hierarchy

Co-Authors: Alison Branco, Andrew Peck, Marci Bortman, Michelle Brown, Stevie Adams, Mike McCann, Elizabeth Smith, Anna Bartlett, Mali'o Kodis (All: The Nature Conservancy in New York)

Past land use patterns and modern development pressures have led to the risky situation on our shorelines today: communities are in danger from flooding. And these flood risks are ever-increasing in our changing climate. Too often, management of this risk leads to short-term “solutions” that harm nature and do not make people safer in the long-term. In fact, many shoreline management activities meant to protect development lead to a false sense of security, thereby increasing future flood risk to people and property. Coastal managers want to, and must, balance the needs of people and nature, but struggle to do so in the current decision-making structure where goals are too often narrowly defined based on the protection of property. Here, we present a hierarchical decision-making framework that will assist local/state officials and project planners alike to select flood risk reduction options that best balance the needs of people and nature for the long-term. This framework prioritizes the preservation of natural processes, the needs of nature to naturally adapt to climate change, and the need for communities to truly reduce risk, rather than defer it. It is also a flexible framework, recognizing there is no optimal solution that can be applied everywhere. Rather, it allows the particular constraints of every situation to be evaluated and incorporated into stepwise decision-making. The Flood Adaptation Hierarchy is equally applicable to coastal areas battling storm surge and sea level rise as it is to inland riverine, lake, or stormwater flooding. This framework could be implemented in many contexts, including public and private grant programs, state and/or municipal regulations and permitting, comprehensive planning, funding allocations, and even decisions by individual property owners.

The Inundation of Contaminated Sites under an Environment of Managed Coastal Retreat: Technical Mitigation and Risk Considerations under Encroaching Seas

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The environmental and economic health of many global communities is strongly tied to their seamless connection to coastal access. Not only for purposes of housing, transportation, food supply and recreation, but also because coastal land has provided some of the most available opportunities for industrial development and waste management, including both managed and unregulated disposal of hazardous materials and chemicals. By some estimates tens of thousands of landfills and other legacy contaminated sites are located within coastal zones subject to sea level and groundwater rise, inundation from high and King tides, excessive erosion and flooding during extreme events and

concomitant land subsidence in some areas with the San Francisco Bay area of northern California being a prime example. This condition also is true for other continental coastal areas in North America (e.g. Miami and south Florida), Europe (e.g., much of the coastline of England), and Australia. But perhaps this condition is most acute for Pacific island nations including Kiribati, the Cook Islands, Fiji, the Solomon Islands and others where given their size and low-lying elevation for developable areas there is little to no land available for migration of landfills, critical infrastructure or people. Scientists, government officials and academicians have already noted that many of the coastal hazardous waste sites and legacy landfills predate modern technical design intended to protect areas from the interned waste and we know from experience and practice that thousands of contaminated land sites ring shorelines or are in potential areas of inundation in major urban and rural areas around the globe. Recent reports by government agencies, including the Government Accounting Office and media reports on the impact of extreme precipitation events on hazardous waste sites give credence to this concern – but none are focused on the potentially greater risk under a potential managed retreat scenario.

A question worth addressing with regard to the continued ingress of sea water and concomitant groundwater rise (depending on subsurface conditions along the terra-ocean nexus) is how to address those legacy waste management and contaminated land sites under a program of managed retreat. From a practice level perspective regarding contaminated land management, clean-up remedies have been implemented to varying degrees of success, but the practice by and large has not considered climate induced acute or chronic changes to the hydrologic character of sites for which clean-up remedies are designed. With the continued progress of climatic shifts, the stress on existing groundwater and surface water protection measures for these coastal sites, and the ability to design new protection and clean up approaches will continue to increase dramatically. Not only will the hydrologic regime continue to adjust to the rising seas, but geochemical and biological conditions will also be influenced by the incursion of saline water and rise of fresh and brackish water from beneath. Chemical migration from the partially or potentially completely inundated sites will be of concern, and for those sites that have undergone some level of technical remediation using biological or geochemical remedies to reduce the mobility or toxicity of the contaminants in a groundwater system, the ability of the remedy to perform as intended may be compromised. This research is a continuing effort to assess the application of conventional and innovative remedial measures with respect to their likely performance in a climate-new coastal environment. The consideration of technology “coping” and adaptation is part of developing a clean-up and protection framework for groundwater remediation that will effectively meet current and anticipated future conditions with a level of acceptable performance. Key items include the timing of any managed retreat and what that implies for coastal contaminated land management. For example, with chronic changes, time may still remain to adjust remedy performance to account for great loading of dissolved salts, saline impacts to phytoremediation schemes, changes in water quality parameters (e.g., pH, dissolved oxygen, reduction-oxidation conditions) that affect contaminant mobility and toxicity) and hydraulic gradient shifts. Under acute changes, however, the remedial choices are likely more limited and estimates of impact from inundated contaminated land sites to the coastal ecosystem would be a priority to determine if physical protections are needed as retreat continues.

As a practice, we still are early in assessing contaminated land management along coastal areas in the face of continued climatic stress. This is a rather unfortunate recognition considering that scientific analysis identified and affirmed the continued track of sea level rise decades ago and further pointed to low-lying populated areas, such as the Pacific Island nations discussed earlier, as directly threatened from this pervasive condition. However, it is apparent that considerations to date have not consistently nor comprehensively considered climatic shifts in environmental protection and remediation design. As the concept of managed retreat continues to gain ground, our study and research must also consider the limitations of the approach for some areas, and how we will manage and reduce or remove the risk of

legacy contamination in these future inundated lands. Going forward, a reasonable approach for sites affected by contaminant impact, where the results of a risk analysis indicates an increasing threat from the changed conditions, is to assess the potential for climate induced chronic (and acute) stress to affect contaminant occurrence and movement, and to evaluate which remedies would be most resilient to climatic shock. The work described herein is one aspect of new thinking that is intended to be useful for responsible parties, regulators, and designers so that appropriate risk management methods as well as expectations can be properly vetted to avoid the potentially negative influence of climatic change to contaminated land and remedial system performance.

The Roles for Conservation Organizations in Strategic Retreat as a Climate Adaptation Strategy

Co-Authors: Malio Kodis, Sarah Newkirk, Marci Bortman (All: The Nature Conservancy)

As climate change accelerates the frequency and intensity of natural disasters, damage to public and private property is also increasing, putting exorbitant strain on governments and communities. Societies across the world are working to adapt to climate change, but climate adaptation is currently inadequate to meet the needs of the people left increasingly vulnerable and the places that risk being irreversibly changed or destroyed. One tactic of climate adaptation is strategic retreat, sometimes referred to as managed retreat. Strategic retreat is the process by which the government or another entity purchases (buys out) developed properties that are at risk of destruction or have been destroyed by natural disasters. The structure is most often demolished and the land is placed under a permanent easement to prevent future development. What happens next is dependent on the entities involved in the buyouts, and can range from derelict, vacant lots to full restoration of ecosystems and their abilities to mitigate flood damage. Sometimes recreational amenities, such as trails or park infrastructure, are prioritized and funded as well. Conservation organizations can leverage their expertise in conservation planning, land acquisition and restoration, policy advocacy and partnership development to improve the implementation of strategic retreat so that nature and people can thrive in the long-term. In this work, we review ways that conservation organizations have and can continue to engage in buyout processes to ensure positive outcomes for communities and nature. Conservation organizations must also evolve their approaches to climate adaptation to integrate equity and redress historical injustices in land use, and contribute towards improving strategic retreat for a more just and resilient future across disaster-prone communities. This work focuses on the context of disasters and climate adaptation in the United States, though many of the principles presented are applicable around the world.