Given the recent work of multiple teams around the United States in developing carbon methodologies and projects for coastal wetlands, this is indeed an exciting time for those interested in funding much-needed projects. Our experience has shown that careful planning of project size and project groupings, curtailing costly monitoring requirements and overly conservative assumptions within new methodologies, and collaborating with participating landowners early in the process are necessary to reach these goals. With appropriate planning, this sustainable revenue stream can become a reality.

Incorporating Ecosystem Carbon Into U.S. Federal Policies: A "Win-Win" for Climate and Coastal Habitat Conservation

By Dr. Ariana Sutton-Grier, Amber Moore, Peter Wiley, and Dr. Peter Edwards

There is recent increased federal interest in measuring, valuing, and ensuring the provision of ecosystem services to the American public. For example, in a recent report from the President's Council of Advisors on Science and Technology (PCAST), the council specifically called for the federal government to play an essential role in protecting the nation's environmental capital (defined as the nation's ecosystems and biodiversity) by better valuing ecosystem services and using that information to inform its planning and management decisions (PCAST 2011). Despite this growing interest, specific guidance on whether and how to incorporate ecosystem services into U.S. federal activities remains scarce, and agencies, including the National Oceanic and Atmospheric Administration (NOAA), are still working to determine how best to operationalize the concept of ecosystem services.

In this article, we discuss a different opportunity other than carbon markets that could also lead to additional habitat conservation. Here, we focus on a pilot effort underway at NOAA to incorporate carbon sequestration and storage (carbon services) of ecosystems (see Figure 1 for photos of these coastal "blue carbon" habitats) into the implementation of federal policies (see the full analysis in Sutton-Grier et al. 2013). We believe that, similar to the potential of carbon markets to lead to more habitat conservation, incorporating carbon services into federal activities and decisionmaking can also result in additional habitat conservation. Here, we summarize our findings examining three statutes that play an important role in NOAA's mission to protect coastal and marine habitats: the Clean Water Act (CWA); the Coastal Zone Management Act (CZMA); and the Oil Pollution Act's (OPA's) Natural Resource Damage Assessment (NRDA) process. The goal of this analysis was to determine the steps needed to incorporate carbon services into these federal policies, gaps in information for doing so, and a means for filling those gaps.

CWA

The Federal Water Pollution Control Act, otherwise known as the CWA, is the principal law governing pollution control and water quality of the nation's waterways. CWA §404(b) compensatory mitigation requirements apply when there are unavoidable adverse impacts from an authorized discharge to wetlands, streams, and other aquatic resources (Corps & EPA 2008), which must be mitigated to replace lost functions (EPA 2003; Corps & EPA 2008).

Although §404(b) of the CWA does not specifically reference coastal blue carbon, there are two potential opportunities for including it that will provide further incentives to conserve these important ecosystems. First, in the rare case where a permit is granted to fill or destroy a salt marsh, then in mitigating for the lost wetland functions, stored carbon in the wetland and the carbon sequestration potential of the wetland could be added as additional functions to be mitigated. This would require calculating the carbon services equivalency and determining the compensation requirements for each project. At this time, there is not an available method for calculating the carbon services equivalency. More data on how much carbon a restored salt marsh will take up and store each year are therefore needed.

A second method would be through development of a mitigation policy by a federal agency, which would guide the

Figure 1. Coastal habitats, especially (a) salt marsh, (b) mangroves, and (c) seagrasses (from the Channel Island Marine Sanctuary), are ecosystems that sequester and store large amounts of carbon, most of it buried belowground in soils. Photo credits: NOAA.

agency's recommendations made through its mandates. Having such a mitigation policy would be a method for socializing the concept of valuing carbon services in coastal habitats within federal agencies, stakeholder groups, and coastal communities. Although currently there are some gaps in our scientific information and understanding on the rates of carbon storage across different tidal wetland types and how restoration affects the recovery of carbon-regulating functions (Personal Communication, Stedman, 2013), studies are underway to attempt to answer these questions, which will allow for the development of a mitigation policy.

CZMA

Management of coastal resources requires a framework that manages competing ecological, social, and economic values. The CZMA establishes an overarching framework, recognizing a suite of societal values of coastal resources, and ultimately creates a process for making decisions to best balance competing uses of the coastal zone. The CZMA provides for management of U.S. coastal and Great Lakes resources through a balance of economic development and environmental conservation. It is administered by NOAA's Office of Ocean and Coastal Resource Management (OCRM) and implemented by the coastal state participants. The CZMA is a complex act that provides for management through the Coastal Zone Management Program and for research through the National Estuarine Research Reserve System (NERRS). Although no specific reference to coastal blue carbon exists in the CZMA, several areas have potential for inclusion in their execution, including funding priorities, research opportunities, and management elements.

NERRS contributes to carbon services through protection of coastal habitats. The research conducted within NERRS can provide the information needed to prioritize protection, restoration, and enhancement of coastal habitats and inform management decisions that take carbon services into account.

CZMA §309 provides for Coastal Zone Enhancement Grants. One of the goals of these grants is the protection, restoration, or enhancement of the existing coastal wetlands base. The creation of new coastal wetlands and carbon sequestration potential could represent one of the criteria used to prioritize wetland management or protection. Section 309 also provides for the development and adoption of procedures to consider and control cumulative and secondary impacts of coastal growth and development on coastal resources including wetlands. Carbon services could be considered one of the services impacted, both in terms of the release of carbon to the atmosphere as a result of habitat lost to development, and the diminished, future sequestration potential.

Finally, the Coastal and Estuarine Land Conservation Program (CELCP) was authorized for the purpose of protecting important coastal and estuarine areas that have

significant conservation, recreation, ecological, historical, or aesthetic values, or that are threatened by conversion from their natural or recreational state to other uses. CELCP decisions could incorporate carbon services in the criteria used for determining land acquisition decisions. However, because CELCP is currently unfunded, these criteria have not been revised recently.

Figure 2. Examples of habitat restoration projects NOAA has worked on in (a) salt marsh restoration in Bahia Grande in Texas, and (b) tidal flow restoration to support mangrove and submerged aquatic vegetation (SAV) restoration in Fort De Soto, Florida. Photo credit: NOAA Office of Habitat Conservation.

NRDA

OPA authorizes natural resource trustees to assess damages for injury to, destruction of, loss of, or use of natural resources. Injury assessments determine the nature of the damages in order to provide the technical basis for evaluating and scaling restoration efforts. According to OPA, an injury means "an observable or measurable adverse change in a natural resource or impairment of a natural resource service." Injury can include adverse changes in the chemical or physical quality or viability of a natural resource (i.e., nonliving resources can also be considered). This means carbon services could be a valid candidate for inclusion as "lost" natural resource functions (carbon storage) or as lost natural resource services (carbon sequestration).

Estimates of the ecological or ecosystem public losses are often evaluated using the best professional judgment of experts based on available data and relevant scientific literature. This means that for carbon services to be included in the NRDA process, the development of a best professional judgment assessment would need to include the impacts to carbon services as potential lines of evidence of injury to natural resources. If the NRDA process were to incorporate carbon services, this could result in more accurate assignment of losses. In some cases, this could result in increased estimates of injury, which, in turn, would lead to higher restoration requirements (i.e., more habitat restoration) to recover those services.

Conclusions

Our analysis reveals that it is possible to incorporate carbon services of ecosystems into existing processes used to implement the CWA, CZMA, and OPA's NRDA process. In the case of the CWA and the NRDA, incorporating carbon services would only mean including an additional attribute in the calculations of losses or injuries. Carbon services could also be written into funding priorities, research opportunities, and management elements of the CZMA. Thus, the overall processes remain the same; however, the inclusion of carbon services could result in changes in the outcomes, particularly in terms of assessing how much damage may have occurred or how much mitigation of lost natural resource services is necessary.

One significant conclusion from this analysis is that incorporating carbon services into federal policy implementation could provide increased protection or restoration of coastal habitats (Figure 2). Increased conservation outcomes could result from changing the way the federal government implements national policy and/or by stimulating increased investment in coastal habitat conservation through private carbon markets. Including carbon services in federal policy implementation may send an important policy signal to private-sector interests to consider the inclusion of carbon ecosystem services in their business planning. This could in turn result in higher levels of participation in private-sector-driven carbon markets. These outcomes would result in a "win-win" for both climate regulation and habitat conservation, preserving not only the carbon services, but also the many ecosystem services these habitats provide.

One of the main challenges to incorporating carbon services is a lack of understanding of the importance of these services in coastal habitats. Until relatively recently, it was not well-understood that these habitats were such significant carbon sinks (McLeod et al. 2011; Donato et al. 2011; Fourqurean et al. 2012), and the important carbon services of coastal habitats are still not broadly recognized by many natural resource managers and policymakers. Thus, there is still an important role for the *socialization* of the value of carbon services ("coastal blue carbon") among key stakeholders and the wider public. Another challenge is that there remain some important gaps in the scientific understanding of carbon services in these habitats, particularly regarding the recovery of carbon-regulating functions (both annual sequestration and long-term storage) when habitats are restored.

For carbon services to be routinely incorporated into federal policy implementation, we recommend that the next step be a pilot process. A single NRDA assessment or CWA mitigation consultation that incorporated carbon services would set a precedent for future consultations to follow. We hope this analysis can help encourage and facilitate this next step, using the CWA, CZMA, or the NRDA process as a test implementation.

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Blazing the Trail: Lessons Learned in Getting Scratched

By Dr. Sarah K. Mack

As trailblazers, we get scratched, stuck in the mud, and fight a potentially losing battle to save our wetlands. But for us at Tierra Resources, Louisiana is our home, and we believe in solving our own problems. At a rate of one football field an hour, Louisiana currently accounts for 90% of all coastal wetland loss in the United States. The Mississippi River Delta is one of the world's most unique and diverse ecosystems, and its wetlands and waterways contribute tens of billions of dollars to the national economy every year, supporting millions of jobs. Much of the United States depends on sustaining the navigation, flood control, energy production, and seafood production functions of the Mississippi River Delta and river system, yet each of those functions is currently at severe risk due to coastal wetland loss. One of the largest challenges is sufficient financing for coastal restoration on the scale all stakeholders agree is needed.

Carbon finance was first investigated as a mechanism to fund wetland restoration after Hurricane Katrina in 2005. A key obstacle was that there was no route to market for wetland carbon credits, since no methodologies had been approved on any carbon registry due to data gaps perceived to be too extensive. In 2007, Tierra Resources was founded with a mission to conserve, protect, and restore coastal wetland ecosystems by creating innovative solutions that support investment in blue carbon. We made many efforts to secure funding for a pilot project to address these data gaps, but no funders appeared willing to step forward. We had to try another approach.

A path forward became clear starting in 2009, with support from Entergy Corporation and Winrock's American Carbon Registry (ACR), the first and largest carbon offset program in the United States. Both organizations have long histories in the mid-south United States, and both shared Tierra Resources' concern that Louisiana's wetlands required immediate action. Working with its team of internationally recognized experts in land use and forest carbon science, the ACR supported a bottom-up approach to develop a quantification methodology for emissions reductions from wetlands restoration, using conservative approaches that would allow gaps in science to be addressed by monitoring actual offset projects. The carbon offset methodology would enable these efforts to earn carbon offset credits, thus serving as a route to market for wetland restoration projects to tap into the carbon market for much-needed funding. Entergy Corporation, the region's predominant provider of electric power,