Project 1: North America's Blue Carbon: Assessing the Role of Coastal Habitats in the Continent's Carbon Budget	Operating Year(s): 2013–2014
Planned Budget for two years: $450,000 **Year 1: $200,000** **Year 2: $250,000**	

Strategic Priority/Objective: Climate Change–Low-Carbon Economy / Healthy Communities and Ecosystems

Project Summary

Blue carbon is the carbon captured by living coastal and marine organisms and stored in marine and coastal ecosystems, including coastal habitats such as salt marshes, mangroves, and seagrass beds. This project only considers the component of blue carbon sequestered in these coastal habitats. Among the services provided by these habitats that occur in many places along North America's coastlines are: 1) carbon sequestration—the process of capturing carbon dioxide from the atmosphere and incorporating it into living biomass, measured as a rate of carbon uptake per year; and 2) carbon storage—the long-term confinement of carbon in plant materials or sediments, measured as total mass of carbon stored. Blue carbon storage habitats, when adequately protected, provide one of the few natural mechanisms for counteracting ocean acidification and other climate change impacts, and can result in other co-benefits such as food security and shoreline protection.

Current studies suggest that mangroves and coastal salt marshes annually sequester carbon at a rate two to four times greater than mature tropical forests and store three to five times more carbon per equivalent area compared with tropical forests. Most coastal blue carbon is stored in the soil, not in aboveground plant materials, as is the case with tropical forests. While coastal habitats provide a great service in capturing carbon, their destruction has several negative effects. When these habitats are damaged or destroyed, not only is their carbon sequestration capacity lost, but stored carbon is released and contributes to increasing levels of greenhouse gases in the atmosphere and increased acidification of coastal waters. As a result, damaged or destroyed coastal habitats change from being net carbon sinks to net carbon emitters. The role of coastal habitats in storing and sequestering carbon is also affected by up-river watershed processes, such as nutrient loading, sedimentation, and carbon fluxes.

This project is part of the Climate Change–Air Quality group of projects that supports work on measuring emissions and quantifying carbon sinks, mapping ecosystem carbon and developing approaches to mitigate black carbon. Parts of these cross-disciplinary projects integrate coastal/marine carbon and forest cycle research to obtain an improved understanding of the current and future role of these ecosystem-based systems in North America's carbon cycle.

Specifically, this project will advance the conservation and restoration of blue carbon habitats (i.e., salt marshes, mangroves and seagrass beds) by improving data, mapping, and approaches for developing and applying appropriate carbon budgets. The project will also identify and help fill research gaps concerning this critical and emerging component of ecosystem carbon, including social science gaps contributing to the economic valuation of blue carbon habitats. Because blue carbon habitats also have a wide range of other ecosystem benefits, including fish and wildlife habitat, flood protection and water quality improvement, the project will also contribute to and support the goals of the Healthy Communities and Ecosystems priority and, in particular, the Increased Resilience of Shared Ecosystems at Risk

strategic objective.

This project will:

1. Develop standardized methods and protocols to measure and map coastal blue carbon sequestration values and variability, through a workshop, in order to better estimate carbon sequestration, storage, and emissions from North America's blue carbon habitats.
2. Improve accuracy of geospatial data related to coastal blue carbon habitats (focusing primarily on salt marshes and mangroves) across the three countries and map them following consistent mapping standards.
3. Establish strategic on-the-ground partnerships to jointly conduct research addressing key gaps and through these partnerships collect, synthesize and analyze data at selected research sites around North America.

The project will develop a joint dataset on blue carbon habitats, including maps, carbon accounts and sequestration and emissions potential and will document the methods, data, and results. Information will be displayed through the North American Informational Online Platform on Climate Change and the *North American Environmental Atlas*.

Results from this project will improve our understanding of the current and future role of coastal systems in the North American carbon cycle. The results will inform improved management of these systems to foster carbon sinks and reduce carbon sources to achieve climate change mitigation objectives. In particular, the project will: a) help establish protocols and emissions factors for coastal blue carbon; b) improve the mapping, monitoring, carbon stock assessments, and modeling of the carbon dynamics of salt marshes, mangroves and seagrass beds (to a lesser extent, since it is least understood), including emissions from disturbed habitats; and c) foster enhanced management and protection of blue carbon habitats by identifying the best available approaches to reduce emissions and/or protect current carbon storage and sequestration in the three countries.

Short-term Outcomes (at halfway point)
- Findings and recommendations from one expert workshop on best practices for blue carbon measurements
- Inventory of coastal blue carbon geospatial data in the three countries
- Compilation of maps of coastal blue carbon habitats well advanced
- Network of experts involved in coastal blue carbon science, monitoring and management in the three countries
- Synthesis of blue carbon research projects in the three countries, including an analysis of gaps in research

Long-term Outcomes (by the end of the project)
- Standardized methods and protocols to measure and map coastal blue carbon sequestration, storage, and emissions
- Information on the impact of natural disturbances, land use, and land-use change on blue carbon
- Maps of blue carbon habitats completed
- Establishment of strategic partnerships to address key research questions through on-the-ground projects and information sharing
- Joint dataset of information, data and analysis from research sites around North America in conjunction with strategic partners to include in carbon budgets for blue carbon estimates.
- Expanded guidelines, including geographic scope and up-to-date science, for coastal managers about best practices to protect,

manage and restore blue carbon habitats.

Longer-term, environmental outcome (post project)
This project will improve management of coastal and marine systems to protect or restore natural carbon sinks and storage and reduce emissions from disturbed habitats. This will help Canada, Mexico, and the US achieve climate change mitigation objectives (e.g., incorporation of unprotected carbon sequestering habitats in marine protected area network planning). This project will also contribute important information for understanding and quantifying the carbon cycle and provide policy-relevant analyses about possible strategies for mitigating climate change through coastal ecosystem management, including the reduction of emissions from coastal land use change and habitat degradation. The project will enhance the collaboration among scientists involved in land cover mapping using remote sensing, modeling of coastal and marine systems in accordance with IPCC guidelines, and the distribution of relevant results through the existing CEC online platform on climate change. With the collaboration of scientists in three countries, the project will reduce duplication of efforts, harmonize approaches to improve consistency in analyses and reporting, and contribute to the development of analytical tools that can be applied to quantify coastal blue carbon stocks in all three countries.

Tasks necessary to reach the environmental outcome:

1. Develop standardized methods and protocols to measure and map coastal blue carbon values and variability, through a workshop with partners, in order to better estimate carbon sequestration, storage, and emissions from North America's blue carbon habitats.
2. Improve accuracy of geospatial data related to coastal blue carbon habitats (i.e., salt marshes, mangroves and seagrass beds) across the three countries and map them following consistent mapping standards.
3. Establish strategic on-the-ground partnerships to jointly conduct research addressing key gaps and through these partnerships, collect, synthesize and analyze data at selected research sites around North America.

Task 1) Develop standardized methods and protocols to measure coastal blue carbon values and variability, through a workshop with partners, in order to better estimate carbon sequestration, storage, and emissions from North America's blue carbon habitats and to identify the pressing threats to these habitats

Subtask	Project outputs	How does the subtask/output move the project towards the environmental outcome	Timing	Budget (activities)
1.1. Workshop with experts to develop standardized methods and protocols to measure coastal blue carbon sequestration, storage, and emissions values, including a	• Results from workshop with experts to establish methods and protocols to measure blue carbon, including the development and dissemination of a set of standardized mapping	Provides best practices for blue carbon measurements, including the most important factors affecting sequestration, storage, and emissions rates and significant threats to blue carbon habitats	**Year 1**: 1 workshop including development of mapping protocol	Year 1: $80,000 Year 2: $0

standardized mapping methodology to derive improved aerial coverage of blue carbon coastal habitats (salt marshes, seagrass beds and mangroves)	methods to map blue carbon habitats at the appropriate spatial scale • Development, dissemination and use of a set of standardized methods and protocols to measure blue carbon • Identification of existing and planned research projects (see Task 3)	Provides methods to identify priority blue carbon areas for protection, restoration and sound management in order to maximize carbon sequestration and storage.		
1.2. Workshop with the forest carbon, blue carbon and land cover mapping expert communities to identify models, tools and information to inform blue carbon science	• Results from a workshop with a wider group of experts on the potential for models and information already being used to model forest carbon and land cover change to inform the blue carbon science • Work plan for interactions and cooperation	Provides key information to the blue carbon community on: a) The effects of dissolved carbon that flows from the terrestrial ecosystem on blue carbon systems b) Data on mangroves, shorelines, estuaries, and near-shore systems that play important roles in the dynamics of blue carbon systems. These data support mapping and assessment of the areas, and system characteristics and changes. c) Information on natural disturbances, land use, and land-use change in watersheds that are feeding into aquatic systems to provide first order estimates of associated input of	**Year 2:** 1 workshop	Year 1: $0 Year 2: $30,000

		dissolved organic carbon and pollutants including nitrogen and phosphorus.		
Task 2) Improve accuracy of geospatial data related to coastal blue carbon habitats (i.e., salt marshes, mangroves and seagrass beds) across the three countries and map them following consistent mapping standards				
Subtask	**Project outputs**	**How does the subtask/output move the project towards the environmental outcome**	**Timing**	**Budget** (activities)
2.1 Compile existing maps, create new maps and identify data and methodological gaps in the location of blue carbon coastal habitats and associated ecological and environmental characteristics in conjunction with the North American Land Cover Monitoring System and the *North American Environmental Atlas* at the appropriate spatial scale and using agreed upon North American standards (Task 1.1)	• Maps and data on the location and characteristics of blue carbon habitats	Provides data and maps to identify blue carbon priority areas for protection, restoration and sound management in order to maximize carbon sequestration and storage and minimize risks	**Year 1:**Compilation and creation of maps **Year 2:** Creation of maps	Year 1: $35,000 Year 2: $20,000
2.2 Map a limited number of land use changes and other threats to blue carbon habitats in order to identify areas most at risk	• Maps and data on threats to blue carbon habitats	Provides data for the identification of priority conservation areas and risk assessments	**Year 2:** Map changes and threats to blue carbon	Year 1: $0 Year 2: $30,000

of further loss, which might warrant priority action for conservation efforts				
Task 3) Establish strategic on-the-ground partnerships to jointly conduct research addressing key gaps and through these partnerships, collect, synthesize and analyze data at selected research sites around North America				
Subtask	**Project outputs**	**How does the subtask/output move the project towards the environmental outcome**	**Timing**	**Budget** (activities)
3.1 Synthesize blue carbon research to foster scientific collaboration in this fast-evolving field and identify research gaps and priorities for future research, including social science	• Synthesis of blue carbon research by ecosystem type • Database of blue carbon projects and principal investigators • Recommendations for future blue carbon research, including needed social and natural science and impacts of climate change on these habitats	Provides a foundation for collaboration and targeting future research among diverse partners in this rapidly evolving field; will summarize the state of the current blue carbon science research efforts in North America	**Year 1**: Complete synthesis of existing and planned blue carbon research. **Year 2:** Complete recommendations for future research and implications for management of these systems	Year 1: $35,000 Year 2: $10,000
3.2 Establish strategic on-the-ground partnerships to jointly conduct research addressing key gaps and through these partnerships, collect, synthesize and analyze data at selected research sites around North America	• Data collected in research sites around North America • Joint dataset on blue carbon habitats, including maps, carbon accounts and sequestration and emissions potential	Answers key research questions identified by the North American blue carbon community to improve estimates of carbon storage, sequestration and flux/emissions, including impacts of natural and human-caused disturbances		Year 1: $50,000 Year 2: $140,000

3.3 Recommendations for policy and management opportunities related to blue carbon habitat protection and restoration	• Guidance document for policy and management opportunities related to high priority regions for blue carbon protection • Ensure consultation with key partners to ensure that the results from this project will have value and be applied to improve management of blue carbon habitats	Provides practical guidance to coastal policy-makers and managers about ways to protect or enhance carbon sequestration through management and restoration of blue carbon habitats Provides information for the online informational platform on climate change for analyses		Year 1: $0 Year 2: $20,000

Explain how this project meets the selection criteria adopted by Council in the Strategic Plan (See below)

The goal of all projects funded by the CEC will be to support the efforts of the Parties to conserve, protect and/or enhance the North American environment. The following criteria will guide the Secretariat, Working Groups, Committees, and other appropriate officials of the Parties in considering cooperative activities for Council approval under operational plans. These selection criteria do not apply for activities to be funded through the NAPECA grant program.

- **How does the project contribute to achieving Council's strategic objectives as described within the current Strategic Plan, or as related to other priorities subsequently confirmed by Council?**

This project is part of the Climate Change–Air Quality group of projects that supports work on measuring emissions and quantifying carbon sinks, mapping ecosystem carbon and developing approaches to mitigate black carbon. Parts of these cross-disciplinary projects integrate forest and coastal/marine carbon cycle research to obtain an improved understanding of the current and future role of these ecosystem-based systems in North America's carbon cycle. The results of the research will inform improved management of these systems to protect and manage sinks and reduce sources to achieve climate change mitigation objectives. As blue carbon habitats also have a wide range of other ecosystem benefits, including fish and wildlife habitat, protection from flood, storm-caused tidal surges and water quality improvement, the project also addresses the Healthy Communities and Ecosystems priority in particular, the Increased Resilience of Shared Ecosystems at Risk strategic objective.

Globally, terrestrial and marine ecosystems over the past two decades have annually removed from the atmosphere over 50% of the carbon emissions from human sources, such as those from the burning of fossil fuels and emissions from deforestation. Throughout North America, forests and coastal/marine ecosystems play an important role in national greenhouse gas budgets, with large regional differences in the distribution of sources and sinks. Understanding the current and projected future role of these systems in North America, including the impacts of management and climate change, is required to inform sustainable management of carbon sinks in forests and coastal/marine ecosystems.

- **Are the proposed objectives North American in scope? In other words, how are the proposed results relevant to protecting the environment in North America? (For example, what would Council members announce to the press at the successful completion of this project?)**

This project will provide important information at the North American scale to help understand and quantify the carbon cycle and provide policy-relevant analyses about possible strategies for mitigating climate change through coastal/marine ecosystem management, including the protection of coastal habitats as carbon sinks and the reduction of emissions from coastal degradation. The project will enhance the collaboration among North American scientists, coastal managers, and policy-makers involved in modeling terrestrial and aquatic systems in accordance with IPCC guidelines, coordinate land cover mapping using satellites, and distribute the relevant results through an online platform on climate change and other mechanisms.

- **What are the specific, clear and tangible results that will be achieved and how will progress toward each result be measured over time? Identify performance measures to be used to indicate success at reaching all outcomes and/or performance.**

The project will produce the following outputs: a set of standardized methods and protocols for blue carbon measurements and mapping; a set of standardized methods to map blue carbon habitats; maps and data on the location and characteristics of blue carbon habitats in North America; a synthesis of the state of current science research efforts associated with blue carbon in North America; a dataset describing carbon sequestration and storage in select study sites in North America; and recommendations for policy related to the management of high priority blue carbon regions. Progress will be measured through: 1) in the short term, the creation of a new experts group linking blue carbon, and land cover experts, the development of a cooperative work plan for this group, and a workshop being held with partners to develop the planned outputs; 2) in the medium term, the development of standardized methodologies and protocols, and original North American geo-referenced datasets; 3) in the long term, the dissemination of the standardized methodologies and original geo-referenced data to the blue carbon and related experts community. Ultimately, the project will demonstrate success through the uptake of the improved knowledge base and original tools by the blue carbon community and related experts to inform blue carbon science and blue carbon habitat management, in the context of climate change mitigation and adaptation.

- **Explain why the CEC is the most effective vehicle for the Parties to undertake the project, considering:**
  - **The value-added of doing it under the CEC cooperative program**
  - **Any other public, private or social organizations that work on such activities**
  - **Opportunities to cooperate and/or leverage resources with such organizations**
  - **Does the project propose a clear timeline for implementation of the activities, including a target end date for CEC's involvement? Where applicable, describe how the work will continue after CEC involvement ends.**
  - **Linkages with other relevant CEC projects, past or present, in order to create synergies, capitalize on experience, or avoid duplication**

This project builds on and complements previous and ongoing CEC work to address some of the key science needs for blue carbon, and applying this scientific understanding to improve management of these critical habitats for carbon sequestration. In addition, having a common online mapping platform to integrate terrestrial and coastal carbon information for North America will be an important tool for researchers.

Because research on blue carbon is a fairly new topic, relatively little is known about the sequestration, storage, and emissions potential in North American coastal ecosystems. Through the collaboration of scientists in three countries, the project will be the first effort to collaborate on this topic at the continental scale. A preliminary scoping study carried out under the CEC's 2011–2012 Ecosystem Carbon Sources and Storage: Information to Quantify and Manage for Greenhouse Gas Emissions Reductions project identified the need for harmonized data and maps, a community of continental experts and more research into how to quantify blue carbon. The project will reduce duplication of efforts, harmonize approaches to improve consistency in analyses and reporting, leverage previous work on forest carbon and land use change, and collaborate in the development and application of analytical tools and models that can be applied in all three countries. The CEC has been supporting several similar initiatives including the North American Carbon modeling group and the North American Land Cover Monitoring System. A workshop that brings together the mapping, forest modeling and blue carbon expert communities will help develop a work plan for interactions and cooperation and transfer of best practices. The 2011–2012 Engaging Communities to Conserve Marine Biodiversity through the North American Marine Protected Area Network project produced a *Guide for Planners and Managers to Design Resilient Marine Protected Area Networks in a Changing Climate* and *Scientific Guidelines for Designing Resilient Marine Protected Area Networks in a Changing Climate*. Both of these documents provide some guidance on blue carbon science and management within marine protected areas. The documents serve as a good foundation for expanding the scope to other geographical regions and the most cutting-edge science.

Work produced by this project will provide the North American blue carbon community enough information and data to identify research opportunities and partnerships to advance the estimations of blue carbon contributions in North America. It is hoped that the project will lay the foundation for further cooperative work outside the CEC.

- o **The target audience, as well as its receptivity and capacity to use the information that may be produced as a result of the project**
- o **The beneficiaries of capacity building activities that the project may include**
- o **The relevant stakeholders, with particular attention to communities, academia, NGOs and industry, and their involvement and contribution to a successful outcome**

Through this project, the CEC will build on previous work on forest carbon and land cover mapping to leverage these investments to benefit the nascent blue carbon science and management efforts in North America. In addition to this work, the CEC has identified blue carbon as a key element in designing climate-resilient marine protected area networks, and funded a Blue Carbon Scoping Study in 2012 to provide an overview of the status of blue carbon mapping in North America.

The project will also work closely with ongoing blue carbon work by North American and international organizations and NGOs to avoid duplication of effort and evaluate and adapt emerging research and tools for their applicability in the North American context. By working with these partners, this project will ensure that the results of this work will have value for policy-makers and managers of blue carbon habitats.

These initiatives and organizations include:

- The US Interagency Blue Carbon work group, made up of federal agencies interested in national and international blue carbon efforts. This group has been meeting for two years, primarily as a mechanism for information sharing as well as for developing collaborations between agencies. Agencies regularly attending these meetings include EPA, USGS, USFWS, State Department, USAID, and NOAA.

- Fisheries and Oceans Canada (DFO), which in 2011 created a competitive funding envelope to develop a more comprehensive science-based understanding of the impacts of climate change. This fund is intended to further develop the science and technology knowledge base in three designated priority areas: Canada's North, Marine and Freshwater Infrastructure, and Marine and Freshwater Ecosystem Impacts. Through the project proposal process, the CEC Marine Conservation Workgroup has reached out to blue carbon experts in the three countries and has received strong support for this proposal. The CEC intends to build this collaborative process with the federal agencies, NGOs, international organizations and others to implement the project.

- Parks Canada is working with Simon Fraser University to determine real fluxes in carbon and carbon storage in lakes in several western Canadian national parks.

- Mexico's National Commission for Protected Areas (Conanp), in coordination with the National Forest Commission (Conafor), the Mexican Fund for Nature Conservation (FMCN), the Investigation and Advanced Studies Center in Merida (Cinvestav-Mérida), the US Forest Service (USFS) and the US Agency for International Development (USAID), has undertaken a project that will allow the assessment of mangrove in relation to climate change mitigation. The project is intended to develop the methodology to determine the occurrence and density of carbon in mangrove of Mexican Protected Areas, to provide a baseline of the mangrove condition, to elaborate a set of recommendations for the conservation, restoration and assisted mitigation of local mangrove populations, and to have a validated protocol for sampling, classification and localization of mangrove populations and the estimation of carbon according to the mangrove type. This project was piloted in the Sian Ka'an Biosphere Reserve in 2011, was replicated in La Encrucijada Biosphere Reserve in 2012, and will be conducted in Marismas Nacionales Nayarit Biosphere Reserve in 2013. The results of Sian Ka'an show that the carbon stocks depend on the height of mangroves and that phosphorous levels in the soil limits carbon sequestration. The coastal wetlands of Sian Ka'an, covering around 172,176 ha, may store up to 58.0 million metric tons of carbon.

- The United States Forest Service (USFS) and Mexico (Conafor, Conabio and Conanp) efforts to map, monitor, and estimate carbon stocks and model carbon dynamics in mangrove forests. These institutions are considering establishing permanent carbon monitoring sites in Protected Areas in Mexico. The high resolution global mangrove forest spatial dataset developed by Chandra Giri from the United States Geological Survey (USGS) and others could be used as the model for future mapping efforts involving salt marshes and seagrasses.

- Restore America's Estuaries (RAE), a North American non-profit whose mission is to preserve the nation's network of estuaries by protecting and restoring the lands and waters essential to the richness and diversity of coastal life. They are focused on restoring coastal and estuarine habitats as a key strategy in adapting to climate change, as well as mitigating its impacts. RAE is leading an initiative to bring tidal wetlands restoration, protection, creation and avoided loss into the carbon markets. They have an ongoing study

in the Pacific Northwest investigating the potential of carbon markets to support watershed restoration and a proposal submitted for a project in the Gulf of Mexico.

- Conservation International (CI) is an international non-profit organization that works to ensure a healthy and productive planet, through science, policy and field work. CI has a number of ongoing blue carbon efforts, including the international Blue Carbon Science Work Group, which meets about twice a year and is in the process of developing a manual of blue carbon methodologies internationally and a data archive for global blue carbon data.