



Coastal Habitat Conservation in a Changing Climate: Information Resources for the Mid-Atlantic Region June 2010

The purpose of this document is to provide an overview of and links to some key informational resources to assist governmental, tribal, and non-governmental organizations and individuals involved in planning and implementation of coastal habitat conservation activities in the U.S. Mid-Atlantic (NY, NJ, DE, VA, MD, DC) region in developing strategies to meet their conservation objectives in an era of climate change. It was developed as supplemental information for a stakeholder workshop sponsored by the NOAA Climate Program Office and the Office of Habitat Conservation held June 21st – 23rd, 2010, in Wilmington, Delaware.

The information presented here is not intended to be a comprehensive, exhaustive list of all available resources. Rather, it highlights some of the relevant and timely information available as decision makers in the region begin to grapple with the challenges and opportunities to incorporate and address the current and projected impacts of climate change in coastal habitat conservation efforts within the region. Many of the resources highlighted here provide information and links to additional relevant tools and data sources.

These and many other resources are available at the NOAA Coastal Services Center's *Coastal Climate Adaptation* website <http://collaborate.csc.noaa.gov/climateadaptation/>, which provides an ongoing forum and resource for key tools and information to assist in coastal climate change adaptation efforts across the country.

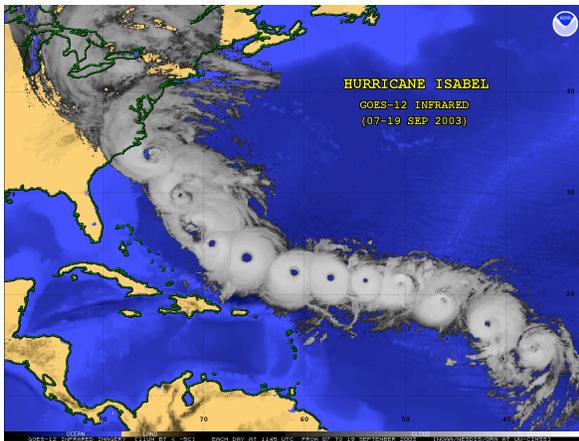
Climate Change in the Mid-Atlantic: What Do We Know and What Does it Mean for Coastal Habitats?

Physical Climate Change, General Regional Impacts

- **U.S. Climate Change Science Program (CCSP) and U.S. Global Change Research Program (USGCRP). 2009. *Global Climate Change Impacts in the United States*. <http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>. This is one of the most recent comprehensive summaries of climate change impacts for the U.S., based largely on a review of the scientific literature (including that detailed in the Scientific Assessment listed below). Information is organized by sector (e.g., ecosystems, water resources, human health) as well as by region (e.g., Northeast, Southeast).**
- **CCSP. 2008. *Scientific Assessment of the Effects of Global Change on the United States*. <http://www.climate-science.gov/Library/scientific-assessment/Scientific->**

[AssessmentFINAL.pdf](#). This report, developed for CCSP by the Committee on Environment and Natural Resources of the National Science and Technology Council, largely draws from and synthesizes previous assessments of global change, particularly focusing on climate change (but also including such challenges as changing ozone concentrations, ecosystem shifts, land and water use, and ocean chemistry). The climate change data is largely national in scale, with minimal regional downscaling. Information on impacts is organized around different sectors (e.g., the natural environment, human health) and is not separated out by region.

- **Mid-Atlantic Regional Assessment (MARA) Team, Penn State. 2000. *Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change. Mid-Atlantic Overview and Foundations.* <http://www.cara.psu.edu/mara/results/index.html>.** Although this publication was published ten years ago, it still provides a useful and comprehensive assessment of climate change impacts for the region, consisting of DE, MD, PA, VA, WV, and parts of NY, NJ,



and NC. The study included some downscaled analysis of global climate model outputs for the region as well as identified projections based on a review of existing literature. Chapter 7 provides an overview of impacts to coastal zones in the region, including sea-level rise, changes in temperature and precipitation patterns, and altered streamflows.

- **Najjar, R.G., et al. 2000. The potential impacts of climate change on the Mid-Atlantic region. *Climate Research* 14: 219-233. <http://www.int-res.com/articles/cr/14/c014p219.pdf>.** This article provides a nice summary of much of the same information included in the MARA assessment.

Coastal Impacts

- **U.S. EPA. 2009. *U.S. Climate Change Science Program Synthesis and Assessment Product [SAP] 4.1: Coastal Sensitivity to Sea Level Rise: A Focus on the Mid-Atlantic Region.* <http://www.climate-science.gov/Library/sap/sap4-1/default.php>.** Part I (Chapters 1- 5), along with the appendices, provide an overview and detailed description of the known and potential impacts of sea-level rise on coastal wetlands, beaches, and other habitats and associated species in the Mid-Atlantic region (from New York to North Carolina). The information provided in the report is based on evaluation of existing studies as well as assessments based on expert opinion. Information is both descriptive and visual (i.e., map-based, at a relatively low-resolution and broad landscape scale). It is also important to note that much of the report (Chapters 6-14) provides considerable information on societal implications and potential

management/adaptation options, including a very useful discussion of barriers to action. Another key element of this study is research led by Jim Titus that overlays projected sea-level rise with projected coastal development. While much of this work was not included in the final SAP 4.1 product, it is available at: <http://papers.risingsea.net/> (along with a plethora of other resources).

- **Glick, P., Clough, J., and Nunley, B. 2008. *Sea-Level Rise and Coastal Habitats in the Chesapeake Bay Region. Technical Report. National Wildlife Federation (NWF).*** http://www.nwf.org/Global-Warming/Effects-on-Wildlife-and-Habitat/Estuaries-and-Coastal-Wetlands/~media/PDFs/Global%20Warming/Reports/FullSeaLevelRiseandCoastalHabitats_ChesapeakeRegion.ashx. This study used the Sea Level Affecting Marshes Model (SLAMM) to assess potential impacts of sea-level rise specifically on coastal wetland habitats in the Chesapeake Bay region, including Delaware Bay and coastal beaches from southern NJ to the VA/NC border. This model is one of a number of sea-level rise impact models available. It is neither the most simplistic nor the most complex, but does provide a useful landscape-level picture of how coastal habitats might change under multiple scenarios of sea-level rise.
- **U.S. Geological Survey (USGS). 2007. *Potential for Shoreline Changes Due to Sea-level Rise along the Mid-Atlantic Region.*** <http://pubs.usgs.gov/of/2007/1278>. This study was referenced in the SAP 4.1 assessment, but is worth looking at on its own in that it provides a useful description of some of the coastal processes associated with sea-level rise impacts, and highlights important caveats.
- **Boesch, D.F., et al. 2007. *Coastal Dead Zones & Global Climate Change: Ramifications of Climate Change for Chesapeake Bay Hypoxia.*** Pew Center on Global Climate Change. <http://www.pewclimate.org/docUploads/Regional-Impacts-Chesapeake.pdf>. This report does an excellent job of addressing climate change impacts on a key coastal system in the context of “existing stressors,” in this case the issues associated with eutrophication in the Chesapeake Bay. The report provides an overview/summary of the scientific literature on the subject as well as identifies potential management options.

Assessing the Impacts and Vulnerability of Coastal Habitats in the Mid-Atlantic

Vulnerability Assessment Concepts and Tools

- **The Nature Conservancy (TNC) Coastal Resilience project,** <http://www.coastalresilience.org>. The Nature Conservancy has developed a “Coastal Resilience” project in partnership with NOAA, the Association of State Flood Plain Managers, NASA Goddard Institute for Space Studies, Pace Law School, the University of Southern Mississippi, and the UCSB Marine Science Institute to provide coastal communities with easy access to information to assist in coastal planning and management decisions regarding resources at risk from sea-level rise and coastal hazards. The

initial project has focused on the Long Island, NY region, but the intent is to broaden it for application to other regions in the coming months. A key feature of the project is a Future Scenarios Mapper, which provides an interactive tool for visualizing sea-level rise and storm surge, and for identifying ecological and socioeconomic resources at risk.



- **NatureServe *Climate Change Vulnerability Index*.**

<http://www.natureserve.org/prodServices/climatechange/ClimateChange.jsp#v1point2>.

NatureServe and its network of member programs have developed a downloadable tool to provide a relatively rapid and cost-effective means of assessing the vulnerability of plant and animal species to the impacts of climate change. The Index allows users to apply readily available information about a species' natural history, distribution, and landscape circumstances to predict whether it will likely suffer range contractions, population reductions, or both in the coming years based on regionally "downscaled" climate change projections.

- **Glick, P. and Stein, B. (editors). 2010 (Draft). *Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment*. National Wildlife Federation.**
http://www.nwf.org/Global-Warming/Climate-Smart-Conservation/Safeguarding-Wildlife/~media/PDFs/Global%20Warming/NWF_Scanning_the_Conservation_Horizon.ashx.

This report, which currently is undergoing formal peer review, was developed by an expert-working group on vulnerability assessment convened by NWF in collaboration with the U.S. Fish & Wildlife Service (USFWS). It is designed to help fish and wildlife professionals and other conservation practitioners understand how vulnerability assessments can help them in responding to the challenges of managing natural resources in an era of climate change. This guide is designed to support future training sessions to be held on vulnerability assessment and adaptation planning.

Taking Action: Development and planning of actions and strategies for adaptation

General Climate Change Adaptation

- **Groves, C., et al. 2010. *Climate Change and Conservation: A Primer for Assessing Impacts and Advancing Ecosystem-based Adaptation in The Nature Conservancy*.**
<http://conserveonline.org/workspaces/climateadaptation/documents/a-primer-for-assessing-impacts/documents/a-primer-for-assessing-impacts-and-advancing-eba/@@view.html>. This report was originally developed as an "internal" guide for TNC staff, but has gained popularity outside of the Conservancy. It is a comprehensive, easy-to-understand

guide that addresses some of the key issues that are likely to be most relevant to conservation on-the-ground.

- **Association of Fish and Wildlife Agencies (AFWA). 2009. *Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans & Other Management Plans*. http://www.fws.gov/southwest/Climatechange/docs/afwaClimatechangeGuidanceDocumentUpdatedSept3_FINAL.pdf.** This guide is the product of a Climate Change Wildlife Action Plan Work Group created by AFWA and Teaming with Wildlife in September 2008. The guide provides context and information for state fish and wildlife agencies as well as other relevant conservation practitioners about general principles of climate change vulnerability assessment and adaptation planning for natural resources, and includes a number of useful case studies for both. As with other resources identified here, the AFWA report lists a number of useful reports, articles, and websites for additional information.
- **Glick, P., Staudt, A., and Stein, B. 2009. *A New Era for Conservation: Review of Climate Change Adaptation Literature*. National Wildlife Federation. <http://ncseonline.org/WHPRP/NWF/Adaptation2009/Documents/FinalNWFClimateChangeAdaptationLiteratureReview.pdf>.** NWF developed this review paper as a background contribution to the *Adaptation 2009* conference, held in February 2009 in Washington, D.C. It provides an overview of climate change adaptation, including overarching principles and barriers, as well as examples of adaptation strategies for four broad habitat types: forests, grasslands/shrublands, freshwater systems, and coasts and estuaries.
- **CCSP. 2008. *Synthesis and Assessment Product 4.4 Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*. <http://downloads.climate-science.gov/sap/sap4-4-final-report-all.pdf>.** This report provides quite a bit of detail about the state of climate change adaptation in the U.S., with a focus on natural systems. It is broken out into a number of sector-specific chapters, including chapters for National Estuaries, National Wildlife Refuges (including coastal refuges), and Marine Protected Areas.

Coastal Adaptation

- **National Research Council of the National Academy of Sciences (NAS). 2010. *Ocean Acidification: A National Strategy to Meet the Challenges of a Changing Ocean*. <http://www.nap.edu/catalog/12904.html>.** While the majority of coastal/marine adaptation strategies have focused on sea-level rise, storms, and other “direct” impacts, ocean acidification increasingly is emerging as a major concern. This report is one of the first attempts at a comprehensive strategy to begin addressing the issue from an adaptation, rather than mitigation, perspective. Research is a primary focus of this report, but NRC offers some recommendations on how to prioritize that work moving forward.



- **Malik, M.M. September 2009. *Survey of State Initiatives for Conservation of Coastal Habitats from Sea-Level Rise*. Rhode Island Coastal Resources Management Council. http://seagrant.gso.uri.edu/ccd/SLR_Survey.pdf.** This is one of the most detailed surveys to date on what coastal states across the country are doing to address sea-level rise. It highlights research activities, policies, and on-

the-ground actions.

- **Kling, D. and Sanchirico, J.N. 2009. *An Adaptation Portfolio for the United States Coastal and Marine Environment*. Resources for the Future. <http://www.rff.org/rff/documents/RFF-Rpt-Adaptation-KlingSanchirico.pdf>.** This report provides more of an overview/summary of the impacts of climate change on the nation's coastal and marine systems; its discussion of adaptation options is relatively brief. However, it does provide an interesting discussion of policies that address a range of climate change impacts (not just sea-level rise).
- **U.S. EPA Climate Ready Estuaries. 2009. *Synthesis of Adaptation Options for Coastal Areas*. Washington, D.C. U.S. Environmental Protection Agency, Climate Ready Estuaries Program. EPA 430-F-08-024. http://www.epa.gov/climatereadyestuaries/downloads/CRE_Synthesis_1.09.pdf.** EPA's Climate Ready Estuaries (CRE) is a partnership established in 2008 between EPA and the National Estuary Program (NEP) to "build capacity among coastal managers to improve the resilience of coastal areas to the impacts of climate change." This document provides an easily-digested summary of adaptation options for coastal areas to address a range of climate change impacts on estuarine shores and open water, coastal wetlands, and associated species, including: sea-level rise; increases in water temperatures; altered timing of seasonal changes; increases in air temperatures; changes in precipitation; elevated atmospheric CO₂; and changes in storm intensity. The document also identifies areas where measures are being implemented.

Case Studies: Snapshots of Strategies and Actions Accounting for Climate Change

- **NOAA Coastal Services Center. 2009. *Local Strategies for Addressing Climate Change*. (<http://www.csc.noaa.gov/magazine/climatechangestrategies.pdf>).** This is one example of a growing number of Coastal Services Center tools, training, technical assistance, publications, and geospatial datasets available that were developed for or can be applied to climate change adaptation (<http://csc.noaa.gov/climate/>). This particular report generally focuses on human communities, but with an important emphasis on the protection of natural systems and the ecosystem services they provide. It is also a useful reference from a communications perspective.

- Delaware Coastal Programs Office. 2010. *Preparing for Sea Level Rise: Development of a Sea Level Rise Initiative. Sea Level Rise Initiative Project Compendium.*
http://www.swc.dnrec.delaware.gov/coastal/Documents/SeaLevelRise/SLRCompendium10_1_10.pdf. This compendium provides an excellent view of the “process” of developing a sea-level rise adaptation strategy, including detailed descriptions of multiple vulnerability assessments that have either been completed or are underway and the status of policy development and project implementation. An interesting “companion” document is a report produced by **Responsive Management (2010): Delaware Resident’s Opinions on Climate Change and Sea Level Rise**
<http://www.swc.dnrec.delaware.gov/coastal/Documents/SeaLevelRise/SLRSurveyReport.pdf>, that should be particularly helpful in communications and outreach around proposed response measures.
- Maryland Commission on Climate Change Adaptation and Response Working Group. 2008. *Comprehensive Strategy for Reducing Maryland’s Vulnerability to Climate Change. Phase 1: Sea Level Rise and Coastal Storms.*
<http://www.mde.state.md.us/assets/document/Air/ClimateChange/Chapter5.pdf>. This strategy covers adaptation recommendations to address impacts of sea-level rise and coastal storms to infrastructure, economic resources, human health and safety, and natural resources. Interestingly, the **State of Maryland also developed a Sea Level Rise Response Strategy in 2000**
<http://www.ecy.wa.gov/climatechange/PAWGdocs/ci/071007CIsealevelstrategy.pdf>, which offers an opportunity to compare the two strategies to see where progress has (or has not yet) been made on the sea-level rise front.
- Maryland Department of Comprehensive Planning, Worcester County. 2008. *Planning for Sea Level Rise and Storm Surge in Worcester County, Maryland.*
<http://www.dnr.state.md.us/dnrnews/pdfs/Worcester.pdf>. This is a highly detailed assessment and sea level rise adaptation plan that builds on the county’s Comprehensive Development Plan. One of the important elements of this plan is the follow-up process it lays out for prioritization of recommended actions.

Moving Forward – Collaboration and Coordination Opportunities

- U.S. Department of the Interior (DOI). **Strategic Response to Climate Change.**
<http://www.doi.gov/whatwedo/climate/strategy/index.cfm#>. In response to Interior Secretary Ken Salazar’s Secretarial Order No. 3289, DOI has launched a strategic climate change response strategy to help guide its respective agencies in developing strong, collaborative, science-based climate change mitigation and adaptation measures to achieve its mission to protect the nation’s land, water, and wildlife resources. Two important initiatives under this

plan include: (1) the development of regional Landscape Conservation Cooperatives (LCC), which are intended to enhance coordination and leverage resources among diverse stakeholders to support climate change adaptation efforts across the country (much of the coastal Mid-Atlantic region is served by the North Atlantic LCC, <http://www.fws.gov/northeast/climatechange/pdf/NorthAtlanticLCCfinal.pdf>); and (2) the establishment of regional Climate Science Centers (CSC) , which expand the scope and reach of the National Climate Change and Wildlife Science Center (<http://nccw.usgs.gov/>) to provide scientific information, tools, and techniques to anticipate, monitor, and adapt to climate change.

- **NOAA. 2010. *Programmatic Framework for Considering Climate Change Impacts in Coastal Habitat Restoration, Land Acquisition, and Facility Development Investments*.** Information Contact: Roger Griffis (Roger.Griffis@noaa.gov). This report is an important follow-on to NOAA's 2008 report *Incorporating Climate Change into NOAA's Stewardship Responsibilities for Living Marine Resources and Coastal Ecosystems: A Strategy for Progress* (<http://spo.nmfs.noaa.gov/tm/spo95.pdf>) as well as the 2007 GAO report *Climate Change: Agencies Should Develop Guidance for Addressing the Effects on Federal Land and Water Resources* (<http://www.gao.gov/products/GAO-07-863>). It provides recommendations for *specific actions* among relevant NOAA programs, with very useful guidelines and criteria for integrating climate change into project monitoring, restoration planning, land acquisition, and facilities development.
- **Interagency Climate Change Adaptation Task Force. 2010. *Progress Report of the Interagency Climate Change Adaptation Task Force*.** <http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100315-interagency-adaptation-progress-report.pdf>. This is a brief update on the progress of the Interagency Climate Change Adaptation Task Force, which is being spearheaded by the Council on Environmental Quality (CEQ). At the federal agency level, much of the coordination activities in the coming months will likely fall under this umbrella.
- **NOAA Chesapeake Bay Office and USGS Chesapeake Bay Program Office. 2009. *Responding to Climate Change in the Chesapeake Bay Watershed*.** <http://executiveorder.chesapeakebay.net/file.axd?file=2009%2F11%2F202d+Climate+Change+Report.pdf>. This is a "draft" document from the Department of Commerce and Department of the Interior to fulfill Section 202d of Executive Order 13508, which charges Federal agencies to make recommendations to "...assess the impacts of a changing climate on the Chesapeake Bay and develop a strategy for adapting natural resource programs and public infrastructure to the impacts of a changing climate on water quality and living resources in the Chesapeake Bay watershed." What is notable about this report is its multi-agency focus, including recommended actions for greater coordination and collaboration among NOAA, USGS, EPA, USFWS, USDA, and FEMA. This type of coordination will be critical to successful adaptation.

- **The Mid-Atlantic Regional Council on the Ocean (MARCO).**
<http://www.midatlanticocean.org/climate-change.pdf>. In June 2009, the Governors of NY, NJ, DE, MD, and VA committed to a new, comprehensive regional approach to protecting the region’s ocean and coastal resources, including efforts to prepare the region for sea-level rise and other climate change impacts. This effort is another step to bolster much-needed interstate cooperation and collaboration, including addressing ongoing information and public outreach needs.

Web Resources

- **EcoAdapt. 2010. Climate Adaptation Knowledge Exchange (CAKE).**
<http://www.CAKEX.org>. The Climate Adaptation Knowledge Exchange (CAKE) is an innovative community website initiated by EcoAdapt and Island Press. This is a free online resource of data, tools, and best practices for adaptation. CAKE provides access to: case studies; a virtual library to support adaptation planning; adaptation community expertise, discussion, and opportunities; a directory of individuals and organizations working on adaptation; and tools for adaptation planning.



EcoAdapt