The Economic Value of Resilient Coastal Communities

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NOAA activities support science, service, and stewardship that protect life, health, and property and create economic value, income, and jobs. Across the agency, we have begun collecting data on the economic importance of the sectors we support, the costs of natural environmental hazards, and the value of NOAA activities that help society and commerce prepare for a constantly changing coastal and marine environment. Below you will find our current knowledge of the economic value of the sectors we serve, societal risks we face, and our emerging understanding of the economic and societal value of our work as it relates to the nation's oceans and coasts. The information is organized by (1) What is at Risk and 2) the Value of NOAA's Products and Services. If you know of other NOAA data that may be useful in your work, but are not in this document, please feel free to contact Dr. Linwood Pendleton (Linwood.Pendleton@noaa.gov); we can verify the validity and rigor of the information. The document will be updated frequently, please check back frequently for updates or e-mail Charlie Morris (charlie.morris@noaa.gov) to receive update announcements.

What is at Risk: The Socioeconomic Context of Resilient Coastal Communities and Economies

NOAA touches the lives of everyone in the nation in some way. The National Ocean Service (NOS) manages our coastal and ocean resources from which the nation derives economic and social benefits, safe navigation for maritime freight and transport, as well as numerous other functions through the dissemination of our products and services. The following are examples of the kinds of things that would be at risk if not for the efforts of NOS.

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The Coastal Economy and Population

In 2010, 164 million people – a little more than 50 percent of the nation's total population –

resided within the coastal watershed counties of the United States and territories, including the Great Lakes, an area that accounts for only 17 percent of U.S. land area (excluding Alaska). From 1970 to 2010, U.S. population in these coastal watershed counties increased 45 percent, or approximately 51 million people. Averaging more than 300 persons per square mile, this coastal area is currently five times more densely populated than inland areas. The population density at the coast is expected to continue increasing into the future, further intensifying the pressures on these ecologically sensitive and economically important areas.

Source: NOAA's State of the Coast Web site, U.S. Population Living in Coastal Watershed Counties
Available at: http://stateofthecoast.noaa.gov/population/welcome.html

In 2010, 58 percent of our nation's Gross Domestic Product (GDP), valued at $8.3 trillion, was generated in the coastal watershed counties of the United States and territories, including the Great Lakes. This economic production supported approximately 66 million jobs and $3.4 trillion in wages. If the nation's coastal watershed counties were considered an individual country, they would rank number two in GDP globally, only behind the U.S. as a whole.

Source: NOAA's State of the Coast Web site, The Coast – Our Nation's Economic Engine
Available at: http://stateofthecoast.noaa.gov/coastal_economy/welcome.html

In 2009, ocean and Great Lakes dependent business accounted for more than 140,000 establishments that employed 2.6 million people (2.0 percent of the total U.S. employment), paying over $90 billion in wages and producing $245 billion in goods and services (1.7 percent of the U.S. GDP).

Source: NOAA's Economics: National Ocean Watch (ENOW) data
Available at: http://www.csc.noaa.gov/enow

The average annual value of all commercial marine fisheries landings from 2008 to 2010 was approximately $4 billion. There were approximately 1 million jobs associated with the U.S. commercial fishing industry, yielding over $32 billion in income.

Source: NOAA's State of the Coast Web site, Commercial Fishing – A Cultural Tradition
Available at: http://stateofthecoast.noaa.gov/com_fishing/welcome.html

In 2010, 71 million recreational fishing trips were taken in the U.S. In 2009, recreational fishing generated $73 billion in total economic impact and supported over 327,000 U.S. jobs. Note: these statistics exclude TX, AK, and the Great Lakes states.

Source: NOAA's State of the Coast Web site, Recreational Fishing – An American Pastime
Available at: http://stateofthecoast.noaa.gov/rec_fishing/welcome.html

Nationally, the non-market value for marine recreational fishing ranges from $17 per person

day in Delaware to $146 per person day in Alaska (in 2005 dollars).

Source: Pendleton, L.H. and J. Rooke. (2006). Understanding the Potential Economic Impact of Marine Recreational Fishing: California.
Available at: http://www.dfg.ca.gov/mlpa/pdfs/binder3di.pdf

Resilient Coastal Communities that can adapt to the Impacts of Hazards and Climate Change

Every dollar invested in the mitigation of storm-surge effects on coastal communities saves the U.S. taxpayer four dollars in losses from natural hazards.

Source: Multihazard Mitigation Council, 2005: Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities. Volume 1: Findings, Conclusions, and Recommendations. National Institute of Building Sciences, Washington, DC.
Available at:
http://www.floods.org/PDF/MMC_Volume1_FindingsConclusionsRecommendations.pdf

Hurricane Katrina destroyed 350,000 homes, which was more than 12 times the number destroyed by any previous natural disaster in the nation's history.

Source: National Association of Home Builders. (2005). Rebuilding Katrina-Destroyed Homes at Least a Year Away. Nation's Building News.
Available at: http://www.nbnnews.com/NBN/issues/2005-10-10/Front+Page/index.html

One hundred percent of Gulf oil production (approximately 1.5 million barrels per day) was secured and taken out of production during Hurricanes Katrina and Rita in 2005, and 94 percent of gas production (10 billion cubic feet of gas per day) was out of production during Katrina. More than 90 percent of the manned platforms and 85 percent of working rigs were evacuated at one time.

Source: U.S. Mineral Management Service. (2006, January 19). Impact Assessment of Offshore Facilities from Hurricanes Katrina and Rita. Press Release.
Available at: http://www.boemre.gov/ooc/press/2006/press0119.htm

Safe, Efficient, and Environmentally Sound Marine Transportation

Over $1.9 trillion in imports came through U.S. ports in 2010, and U.S. commercial ports directly supported over 13 million jobs.

Source: NOAA's State of the Coast Web site, Ports – Crucial Coastal Infrastructure
Available at: http://stateofthecoast.noaa.gov/ports/welcome.html

Improved Coastal Water Quality that Supports Human Health and Coastal Ecosystem Services

Coastal wetlands in the United States have been estimated to provide $23.2 billion worth of

storm protection services each year.

Source: Costanza, R. O. Pe´rez-Maqueo, M. L. Martinez, P. Sutton, S. J. Anderson and K. Mulder, 2008. "The Value of Coastal Wetlands for Hurricane Protection." *Ambio*. Vol. 37, No. 4. 241-248.

The economic impacts of harmful algal blooms in the U.S., based on a subset of outbreaks from 1987 to 2000, was (in 2005 dollars): Commercial Fisheries Impacts, $38 million; Public Health Costs of Illness, $37 million; Recreation and Tourism Impacts, $4 million; Coastal Monitoring and Management, $3 million; for a total of $82 million.

Source: Hoagland P, Scatasta S. 2006. The economic effects of harmful algal blooms. In E Graneli and J Turner, eds., Ecology of Harmful Algae. Ecology Studies Series. Dordrecht, The Netherlands: Springer-Verlag, Chap. 29.

Lost sales of shellfish in Maine and Massachusetts due to closures imposed as a consequence of a 2005 harmful algal bloom are estimated to be $18 million for the months of June and July in Massachusetts and for the months of May through September in Maine.

Source: Jin D, Thunberg E, Hoagland P. 2008. Economic impact of the 2005 red tide event on commercial shellfish fisheries in New England. Ocean and Coastal Management. 51(5): 420-429.

In 2000, an estimated 63.7 million Americans from the civilian, non-institutionalized population 16 years of age or older visited a saltwater beach for outdoor recreation and spent 878.7 million days at the beach. This was projected to increase to 70.9 million participants spending 969.6 million days at the beach in 2010.

Source: Leeworthy, V.R., J.M. Bowker, J.D. Hospital, and E.A. Stone. 2005. Projected Participation in Marine Recreation: 2005 & 2010. NOAA, SEA Division, National Ocean Service.

During 2000, the expenditures associated with beach recreation across the country were likely to be between a low of just under $6 billion and a high of nearly $30 billion annually.

Source: Leeworthy, V.R. and P.C Wiley. 2001. "Current Participation Patterns in Marine Recreation" National Survey On Recreation And The Environment 2000. US Department of Commerce. National Oceanic and Atmospheric Administration. National Ocean Service.

In 1999-2000, nearly 15 million people spent an estimated 341 million days enjoying bird viewing along U.S. shores. More than 13 million people spent 341 days watching other marine and coastal wildlife.

Source: Leeworthy, V.R. and P.C. Wiley. 2001. "Current Participation Patterns in

Marine Recreation" National Survey On Recreation And The Environment 2000. US Department of Commerce. National Oceanic and Atmospheric Administration. National Ocean Service.

Recreational Expenditures on Outdoor Activities in the Florida Keys: Baseline measurements were taken in 1995-96 and replicated in 2007-08 for visitors to Monroe County/Florida Keys. In 1995-96, 2.54 million recreating visitors spent 13.3 million person-days participating in recreation activities in the Florida Keys/Key West. Recreating visitors increased 18.5% over the 12-year period to 3.01 million, but person-days of activity declined 3.61% to 12.82 million. In 2008 dollars, visitor spending in Monroe County/Florida Keys increased from $1.63 billion to $1.99 billion over the 12-year period or about 22 percent. Including multiplier impacts, this spending generated output/sales of $1.82 billion in 1995-96 and $2.23 billion in 2007-08 or about a 22.5 percent increase. Total income generated increased from $693 million to $970 million or a 40 percent increase, while the number of full and part-time jobs supported increased from 21.8 thousand to 32 thousand or a 46.8 percent increase. As a percent of the total Monroe County/Florida Keys economy, visitor spending and multiplier impacts accounted for about 60 percent of total output/sales in both time periods. As a share of total income, the proportion increased slightly from 45 to 46.9 percent, while the share of employment increased significantly from 46.5 to 57 percent.

The export portion of resident spending (spending on recreation in Monroe County/Florida Keys from sources of income not derived from Monroe County)—thus not double-counting spending from other basic or export industries such as visitor tourism, commercial fishing, and the military), declined from $129 million to about $114 million in 2008 dollars or about a 12% decline. Including multiplier impacts, this lead to a decline of 12% in total sales/output and a 33% in the number of jobs supported.

Source: Leeworthy, V.R. 2010. Linking the Economy and Environment of the Florida Keys/Key West, Visitor Study: Selected Comparisons 1995-96 and 2007-08. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Ocean Service, Office of National Marine Sanctuaries, July 2010. Available at: http://sanctuaries.noaa.gov/science/socioeconomic/floridakeys/pdfs/comparisons_9596_0708.pdf

Recreational Participation in Outdoor Activities in the Florida Keys. Baseline measurements were taken in 1995-96 and replicated in 2008 for residents of Monroe County/Florida Keys. In 1995-96, the population of Monroe County/Florida Keys living in households was 79,380. This declined to 68,771 in 2008 (13% decline). Although the population declined, the percent of residents participating in outdoor recreation in Monroe County/Florida Keys increased from 77% to 82.5%, which offset to some extent the decline in participation in use. Total participants in water-based activities declined from 55,338 participants to 41,542 participants (25%), while

participants in land-based activities declined from 70,324 participants to 38,476 participants (45%).

Source: Leeworthy, Vernon R. 2010. Linking the Economy and the Environment of the Florida Keys/Key West, Monroe County Resident Recreation: Selected Comparisons 1995-06 and 2008. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Ocean Service, Office of National Marine Sanctuaries, October 2010. Available at: http://sanctuaries.noaa.gov/science/socioeconomic/floridakeys/pdfs/resident_comaprison08.pdf

Across all national marine sanctuaries, about $4 billion annually is generated in local coastal and ocean dependent economies from diverse activities like commercial fishing, research and recreation-tourism activities and 50,000 jobs are supported.

Source: Leeworthy, Vernon R. 2011. National Marine Sanctuaries Socioeconomics Fact Sheet. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Ocean Service, Office of National Marine Sanctuaries. Available at: http://sanctuaries.noaa.gov/science/socioeconomic/pdfs/onmssocioeconomicsummary2011.pdf

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The Value of NOAA's National Ocean Service (NOS) Products and Services:

NOAA provides ocean and coastal science, tools, and services to address threats to coastal areas such as climate change, population growth, port congestion, and contaminants in the environment, all working towards healthy coasts, coastal populations and coastal economies. The societal impact of these products, services and activities are highly diverse, both in terms of the sectors and populations impacted and in the nature of the impacts. The NOAA mission includes such elements as safe navigation, a national coordinate system, management of and research on coastal and ocean resources, restoration and response, and the provision of data, tools, and technical assistance for coastal zone management. The impacts of these activities reach a significant cross-section of society, domestically and internationally.

The following statistics illustrate the types of benefits that are derived through NOAA's products and services, as well as estimates of their value. These are not comprehensive or representative, but are intended to provide examples of the value that NOAA provides to the nation.

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Navigational Products and Services

The National Ocean Service's Center for Operational Oceanographic Products and Services has installed Physical Oceanographic Real-Time Systems (PORTS®) at 20 locations around the United States consisting of real-time water levels, currents, and meteorological sensors. Economic benefit studies conducted at four locations (Tampa,

Houston/Galveston, New York/New Jersey, and the Lower Columbia River) estimate a combined benefit of $50 million per year by reducing ship groundings by up to 50% and improving the efficiency of commerce from observations provided by PORTS®.

Source: Kite-Powell, Hauke. 2005. Estimating Economic Benefits from NOAA PORTS® Information: A Case Study of Tampa Bay, Tampa Bay Harbor Safety & Security Committee.
Source: Kite-Powell, Hauke. 2007. Estimating Economic Benefits from NOAA PORTS® Information: A Case Study of Houston/Galveston. The Port of Houston Authority.
Source: Kite-Powell, Hauke. 2009. Estimating Economic Benefits from NOAA PORTS® Information: A Case Study of the Port of New York/New Jersey. Report prepared for the Center for Operational Oceanographic Products and Services (CO-OPS), NOS, NOAA.
Source: Kite-Powell, Hauke. 2010. Estimating Economic Benefits from NOAA PORTS® Information: A Case Study of Lower Columbia River, Houston/Galveston and Tampa Bay. Port of Portland.

The lower Columbia River area receives an estimated annual economic benefit of $6.4 million in savings and direct income from the operation of the Physical Oceanographic Real-Time System®, according to a NOAA sponsored study. The report details the economic benefits of the navigational decision support system, which is operational at 20 locations throughout the United States. Economic benefits result from increased cargo carried per transit, reduced delays, reduced risk of groundings and collisions, and improved environmental planning and analysis, including hazardous spill response. The information made available by PORTS® results in economic benefits because it is used by decision makers to make choices that affect economic well-being.

Source: Kite-Powell, Hauke. 2010. Estimating Economic Benefits from NOAA PORTS® Information: A Case Study of Lower Columbia River, Houston/Galveston and Tampa Bay. Port of Portland.

Estimates of the value of the PORTS® vary by location. In 2005, the Tampa Bay Harbor Safety and Security Committee estimated there was $2.4 to $4.8 million in direct annual economic benefit attributed to the Tampa Bay PORTS®.

Source: Kite-Powell, H., 2007. Estimating Economic Benefits from NOAA PORTS® Information: A Case Study of Tampa Bay. Tampa Bay, FL: Tampa Bay Harbor Safety and Security Committee.

In 2007, the Port of Houston Authority estimated that there was $11.9 million in direct annual economic benefit attributed to the Houston/Galveston PORTS®. The direct benefits were estimated based on avoided groundings, increased draft, reduced delays, and improved spill response. Each location also estimated an additional several million dollars in indirect benefit from reduced boating distress cases and improved weather and storm surge forecasts.

Source: Kite-Powell, Hauke. 2007. Estimating Economic Benefits from NOAA

PORTS® Information: A Case Study of Houston/Galveston. The Port of Houston Authority.

The traditional users of Coast Survey paper chart products – maritime transportation and the US military – account for a shrinking fraction of the total user base. The number of recreational boats has been growing substantially. These trends contributed to reduced overall demand for NOAA paper charts. Because of its scale, the recreational user community will account for a significant fraction of the total benefit derived by the nation from OCS chart making activities.

Source: Kite-Powell, H., 2004. The Changing Footprint of NOAA Coast Survey Products in the US User Community: Transition to Digital Products and Processes, 1980 to 2003. Woods Hole, MA: Woods Hole Oceanographic Institute, Marine Policy Center.

In a study updating previous estimates of expected safety benefits from the use of electronic chart systems on commercial vessels operating in US waters, it was concluded that the update is generally consistent with the 1997 study. The projected present value of avoided accident costs using electronic charts at an intermediate level of effectiveness for the 15-year period from 2004 to 2018 is about $2.3 billion. This conclusion depends critically on the assumption that a certain fraction of accidents are "electronic chart addressable."

Source: Kite-Powell, H., 2004. Expected Safety Benefits from the Use of Electronic Chart Systems on Commercial Maritime Vessels in US Waters: An Update. Woods Hole, MA: Woods Hole Oceanographic Institute, Marine Policy Center.

In a study that derives a lower bound estimate of the economic value (social surplus) generated by the production, sale, and use of nautical charts in the United States based on the contingent value methodology, it was concluded that the consumer surplus associated with nautical charts is about $15.3 million/year for recreational users and $27.5 million/year for commercial users, for a combined consumer surplus of $42.8 million/year. This is a lower bound estimate on the total consumer surplus associated with nautical charts because the user base does not include military users, commercial fishing vessels, or marine resource managers, among others. Producer surplus, derived primarily from the activities of value-added resellers of NOAA charts and data, is probably on the order of $2 million/year. This results in a combined lower bound estimate of total social surplus of $44.8 million/year for NOAA nautical charts.

Source: Kite-Powell, H., 2007. Use and Value of Nautical Charts and Nautical Chart Data in the United States. Woods Hole, MA: Woods Hole Oceanographic Institute, Marine Policy Center.

The National Spatial Reference System (NSRS), managed and maintained by NOAA's National Geodetic Survey (NGS), provides $2.4 billion annually in estimated socio-economic benefits to the nation. The Continuously Operating Reference Stations (CORS) Network, one component of the NSRS, provides annual estimated benefits of $758 million. NGS' 'Gravity for the Redefinition of the American Vertical Datum (GRAV-D)' initiative,

a program to update the vertical component of the NSRS, will provide $522 million in annual estimated benefits to the nation once completed, with $240 million in annual estimated benefits resulting from improved floodplain management alone. It is estimated that the NSRS (including CORS and GRAV-D) directly supports between 170,000 and 200,000 surveying and mapping jobs.

Source: Leveson, I. 2009. Socio-Economic Benefits Study: Scoping the Value of CORS and GRAV-D. Silver Spring, MD: National Oceanic and Atmospheric Administration.

Deep draft ports by volume account for over 99 percent of all import and export traffic through U.S. ports. NOAA and U.S. Army Corps of Engineers (USACE) have been given the responsibility by the President and Congress to maintain vital waterways through surveying, dredging, mapping and sensing activities. Relatively little research into estimation of the value added to the economy from import and export container activities run by the $570 billion dollar railroad and motor carrier transportation industries has been undertaken the results of which can assist NOAA in its allocation of scanning and mapping resources.

This analysis suggests value added to Gross Domestic Product (GDP) from surface transportation increased from $6 billion in 1984 to nearly $62 billion in 2008 and proposes the need for a more balanced use of existing resources as well as augmented funding. Employing annual expenditures of approximately $3 billion for NOAA surveys and mapping activities, USACE dredging and port authority capital improvements, a net benefit-cost ratio of 19.5 is estimated.

Source: Wolfe, K.E. 2010. Value Added to GDP from International Containerized Freight by Surface Transportation. Silver Spring, MD: National Oceanic and Atmospheric Administration.

Every dollar invested in mitigation of storm-surge effects on coastal communities saves the U.S. taxpayer four dollars in losses from natural hazards.

Source: Multihazard Mitigation Council, 2005: Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities. Volume 1: Findings, Conclusions, and Recommendations. National Institute of Building Sciences, Washington, DC. Available at: http://www.floods.org/PDF/MMC_Volume1_FindingsConclusionsRecommendations.pdf

Water Quality and Restoration

NOAA's Oceans and Human Health Initiative (OHHI) provides a HAB Forecasting Bulletin to the Washington State Departments of Health and Fish and Wildlife who use the bulletin to help prevent unnecessary or excessive harvest closures, reduce public health risks, and minimize economic impacts such as the estimated $22 million in lost revenue to coastal counties if a year-round closure in recreational razor clam digging was to occur.

Source: Dyson, K., Huppert, D.D. 2010. Regional economic impacts of razor clam

beach closures due to the harmful algal blooms (HABs) on the Pacific coast of Washington. *Harmful Algae* 9, 264-271.

The NOAA Marine Debris Program's Fishing for Energy partnership affects the commercial fishing and energy sectors by providing a no-cost solution to fishermen to dispose of old, derelict or unusable fishing gear which has resulted in 500 tons of gear collected between 2008 and 2011. One ton generates enough electricity to power a home for 25 days.

Source: Fishing for Energy (FfE) and Covanta Energy, the firm who converts the debris into electricity.