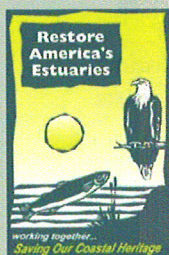


"America's oceans and coasts are priceless assets. Indispensable to life itself, they also contribute significantly to our prosperity and overall quality of life. Too often, however, we take these gifts for granted, underestimating their value and ignoring our impact on them."

An Ocean Blueprint for the 21st Century Final Report of the U.S. Commission on Ocean Policy, Recognizing Ocean Assets & Challenges, Chapter 1, page 1



THE ECONOMIC AND MARKET VALUE OF COASTS AND ESTUARIES: What's At Stake?

Executive Summary

By Linwood Pendleton

Our nation was built from the coast. Americans, like people around the world, are drawn to the coast because of its beauty, productivity, and because our coasts are gateways to the world. The coast nurtures our frontier spirit, our need for outdoor recreation, and the constant American appetite for sweeping ocean views and quiet bayfront vistas. Coasts, coastal oceans, and estuaries are essential to ocean fisheries and aquaculture. Coasts and their waters also generate oxygen, sequester carbon dioxide, and provide habitat to plants and animals both marine and terrestrial.

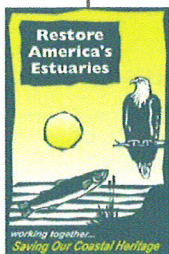
Unfortunately, we have a poor track record when it comes to taking care of our coasts and estuaries. Years of badly planned coastal housing have led to heroic, and sometimes desperate, measures to hold back the forces of nature by using engineering rather than ecological stewardship. Seawalls have transformed once natural coasts into marine hazards unfit for the basic activities that first drew homeowners to the sea – swimming, boating, and fishing. Estuaries too have been under siege. Bays once filled with fish and oysters have become dead zones filled with excess nutrients, chemical wastes, and harmful algae. Wetlands, especially coastal salt marshes, have not fared better. America has lost millions of acres¹ of these once productive marshes as we converted them to farmland or building sites, ditched and drained them to control mosquitoes, or overwhelmed them with polluted runoff. The result has been a degradation of much of our coastline and a loss of more than half of the nation's wetlands over the last two hundred² years.

The damage and destruction borne by our coasts and estuaries has created more than physical and biological losses for our country. This damage also has diminished the economic productivity of the nation and the economic wellbeing of the millions of Americans who visit, use, and depend on the coast and the goods and services that it provides. We are only now coming to grips with the enormity of the economic value and potential that lies in our coastal resources; we are only now beginning to understand the potential economic losses we suffer each year because of underinvestment in coastal protection and restoration.

In the fall of 2006, Restore America's Estuaries convened a panel of internationally renowned experts to help us understand the economic value of coastal and estuary resources. These authors were asked to summarize the state of the art in our knowledge of coastal economic value. Their findings were astonishing – far beyond commercial fishing and tourism, healthy coasts and estuaries are essential for pro-

¹ Dahl, T.E. & Allord, G.J. Undated. *Technical Aspects of Wetlands. History of Wetlands in the Conterminous United States*. National Water Summary: Wetland Resources. US Geological Survey Water-Supply Paper 2425.

² <http://www.nmfs.noaa.gov/habitat/habitatprotection/wetlands/index2c.htm>



tecting more than \$800 billion of trade each year, tens of billions of dollars in recreational opportunities annually, and more than 45 percent of the nation's petroleum refining capacity. Coasts and estuary regions support a disproportionately large share of the nation's economic output and population. The growing body of research shows that environmental damage places these values at risk, yet promoting environmental protection and expanding habitat restoration efforts are likely to increase these values substantially.



In this executive summary, we highlight some of the key findings of our panel.

The Economic and Market Value of Coasts

Economic and Employment Growth in Estuary Regions

Dr. Charles Colgan of the University of Southern Maine reports that with only 13 percent of the land area of the continental U.S., the estuary regions of the U.S. comprise a hugely disproportionate share of the national economy, with 43 percent of population, 40 percent of employment and 49 percent of output. In eight states, the estuary regions comprise 80 percent or more of the state's economy and these regions comprise more than half of the state's economy in fourteen states. Between 1998 and 2004, population growth in estuary regions was far less than non-estuary regions (5.2 percent compared to 9.3 percent), but economic growth was almost the same (29.1 percent compared to 29.8 percent). If the Great Lakes are excluded, the economic growth rate in marine estuary regions actually exceeds that for non-estuary areas (31.4 percent)

*In eight states,
the estuary regions
comprise 80 percent or more
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Coastal Recreation

*Beach going in the U.S.
may contribute between
\$6 billion and nearly
\$30 billion annually to
economic wellbeing.*

More than 43 percent of all adult Americans visit a sea coast or estuary at least once each year to participate in some form of recreation (Leeworthy and Wiley 2001). The coasts of the Southeastern United States and California alone serve as destinations for tens of millions of Americans annually. During any given year, as many as one in ten Americans will visit coastal Florida; just over 8 percent will visit California coasts and beaches. Every coastal state hosts more than one million coastal visitors each year. Recreation not only generates

economic income for coastal businesses, but people tend to value these experiences well beyond what they pay – a concept known as non-market value. Non-market values capture our willingness to pay to use and protect coastal recreational resources, like beaches and harbors, and thus represent the net economic contribution of these opportunities to our wellbeing. Dr. Linwood Pendleton of The Ocean Foundation and the University of California estimates that, for the United States, beach going may contribute between \$6 billion and nearly \$30 billion annually to economic wellbeing. Recreational fishing is estimated to contribute between \$10 billion and \$26 billion per year and coastal wildlife viewing may generate between \$4.9 billion and \$49 billion dollars each year (See Table 1.).



Table 1: Estimated Annual Value of Selected Coastal Recreation
(millions of US\$)

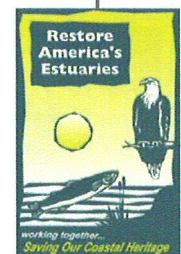
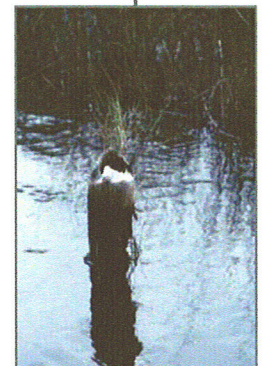
	Beach Going		Recreational Fishing		Wildlife Viewing	
	Low	High	Low	High	Low	High
Far-Western U.S.	\$218	\$653	\$800	\$3,866	\$463	\$4,633
Western Continental U.S.	\$1,845	\$9,226	\$687	\$2,750	\$957	\$9,574
Gulf-shore Southern U.S.	\$1,185	\$11,848	\$5,645	\$9,408	\$1,151	\$11,508
Southeastern U.S.	\$1,769	\$4,424	\$1,632	\$2,720	\$645	\$6,449
Northeastern U.S.	\$933	\$3,732	\$1,109	\$7,393	\$1,661	\$16,606
U.S. Total*	\$5,950	\$29,883	\$9,873	\$26,136	\$4,877	\$48,770

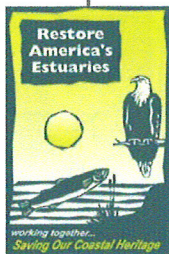
*Note, some double counting may occur when adding across states, but this double counting is likely to be a small compared to estimation error. More serious double counting could occur when adding values across different recreational activity types.

Coastal Energy Infrastructure: The Gulf of Mexico

While the coast is quickly becoming home for new forms of energy - including wind, wave, and tidal power - the coastal wetlands of the Gulf of Mexico continue as sites of more traditional fossil fuel infrastructure. David Dismukes of Louisiana State University's Center for Energy Studies reports that approximately 30 percent of the United States' crude oil production, 20 percent of its natural gas production

30 percent of the U.S.' crude oil production and over 45 percent of its petroleum refining capacity lies within the coastal zone of the Gulf of Mexico.





and over 45 percent of its petroleum refining capacity lie within the coastal zone of the Gulf of Mexico – most within just a few miles of the coast.

Coastal Ports

Estuaries are the marine gateways that link American producers and consumers to the world's economy. In 2003, the last year for which we have complete data, more than \$841 billion in trade passed through America's ports.

Regions	Import Value	Export Value	Total Value
California & the Pacific Islands	232,203	45,512	277,715
Northeast Atlantic	160,266	49,139	209,405
Gulf of Mexico	103,816	53,464	157,280
Southeast Atlantic	48,973	24,140	73,113
Northwest Pacific	52,491	20,411	72,903
Florida	29,817	17,504	47,321
Great Lakes	1,697	1,977	3,675
Total	629,262	212,149	841,411

Table 2: U.S. Waterborne Foreign Trade by Region 2003
(millions of US\$, adjusted to 2005)

Commercial Fishing in American Estuaries

While often overshadowed by major deep ocean fisheries, coastal waters and estuaries continue to be important areas of commercial fishing. In his chapter, Doug Lipton of the University of Maryland finds that a large share of the ten billion pounds of U.S. commercial fish landings, worth over \$3.8 billion unprocessed, are species that are dependent on estuarine conditions for at least some stage of their life history³. In a 1993 study, Houde and Rutherford put the share of estuarine-dependent commercial landings at just over 50 percent, but the Environmental Protection Agency puts the figure closer to 75 percent⁴.



Coastal Housing Values

To date, there are no systematic estimates of the value of coastal housing. Nevertheless, in her chapter, Judith Kildow of the Monterey Bay Aquarium Research Institute finds that a number of researchers have estimated the contribution to hous-

³Landing statistics are for 2004 from the National Marine Fisheries Service website. http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html. The unprocessed value, known as ex-vessel value, refers to the price paid directly to fishermen; the total value added of the U.S. seafood industry is \$31.6 billion.

⁴<http://www.epa.gov/nep/about1.htm>

ing values of proximity to coasts, estuaries, and oceans. A study by Major and Lusht (2004) found that beachfront proximity increased the value of a home by 207 percent compared to a property two blocks away; a bayfront location added 73.2 percent.

The Economic Consequences of Environmental Change



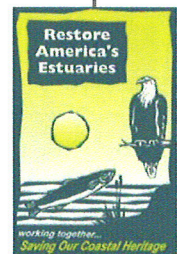
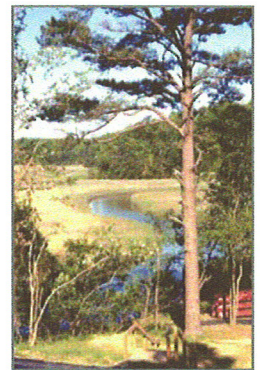
The economic value and productivity of our coasts and estuaries depend upon the ecosystem health of these sometimes fragile areas. In their research, our authors examined a growing body of literature that reveals the economic consequences of environmental change in coastal and estuary ecosystems. During the last two centuries, much of the environmental change in coastal America has been in

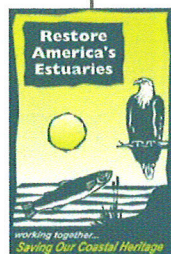
the form of habitat loss, fecal and nutrient contamination, and sedimentation. More recently, the coastal environment has started to change for the better – restoration programs, conservancies, and improved coastal management have helped to protect pristine areas and restore those that have been degraded. Here we note a few examples of the economic impacts of environmental change in coastal areas. In doing so, we hope to highlight the potential economic value that could come from coastal and estuary restoration and the potential cost that could be avoided by better coastal and estuary protection.

Coastal Conditions and Home Prices

Several studies have estimated the link between coastal conditions and home values. Frech and Lafferty (1984) estimated the work of the California Coastal Commission raised the value of local housing in two ways: by preserving a positive externality (the coastline) that would otherwise be destroyed; and by reducing the amount of land available for housing. In 1986, the Maryland Critical Areas Commission limited residential development on land abutting the Chesapeake Bay. Prices of housing with water frontage in the “critical areas” increased by 46 to 62 percent (Parsons 1992). Housing prices in the “critical areas” without water frontage increased from 14 to 27 percent. Even as far as three miles from the “critical areas,” there was a 4 to 11 percent price increase (Polis Project 2001).

A one-unit (mg/L) increase in dissolved inorganic nitrogen, a contributor to eutrophication, had a negative impact on the average housing price in the watershed of \$17,642.





Recent research also shows just how important water quality is to home values. Researchers working in Maryland studied 494 waterfront homes and found that if water quality conditions were improved from levels found at the time of the study to the EPA/state standards the potential economic benefits would have been \$12.15 million with a 95 percent confidence interval of \$3.789 million to \$20.501 million (Leggett and Bockstael 2000 p. 142). Poor et al. (2007), also working in Maryland, found that a one unit (mg/L) increase in total suspended solids (TSS) had a negative impact on the average housing price within the watershed of \$1,086. A one-unit (mg/L) increase in dissolved inorganic nitrogen, a contributor to eutrophication, had a negative impact on the average housing price in the watershed of \$17,642 (Poor et al. 2007).

The Costs Of Dredging and Damage to Trade

Keeping ports and waterways open for business has always been of prime importance to our nation's economy. Increasingly, though, sedimentation from poor land use practices and a loss of estuary habitat has made ensuring the navigability of ports physically and fiscally difficult. Di Jin, of the Woods Hole Oceanographic Institution's Marine Policy Center, reviewed the literature to find out what little is known about the potential benefits of reduced sedimentation. Dr. Jin reports that a study by Sohngen and Rausch (2001) found that a sediment reduction program in Toledo harbor would lead to a 15 percent reduction in sedimentation rate and, in turn, a 15 percent reduction in dredging cost with a total economic benefit of \$1.3 million per year.

Dr. Jin writes that if Sohngen and Rausch's findings were extended to the national level, the resulting benefits may be considerable⁵. According to U.S. Army Corps of Engineers, for fiscal year 2005 the total cost for maintenance dredging in U.S. waterways was \$598 million. Dredging as a result of Hurricane Katrina alone required the removal of an additional 1.3 million cubic yards at \$4.29 per cubic yard (a total cost of \$5.5 million).

Energy Infrastructure At Risk: Wetlands Loss and Storm Surge

Dr. Dismukes reports that wetland and coastal habitat loss in Louisiana threatens much of the nation's petroleum refining and production capabilities. Louisiana lost approximately 1,900 square miles of coastal land from 1932 to 2000 and is projected to lose approximately 700 square miles between 2000 and 2050 (absent restoration efforts).



⁵A detailed analysis of dredging costs should also consider beneficial use of dredged materials. For studies on beneficial use of dredge materials in different port areas, see Wagner (2000), Marcus (2000), and Yozzo et al. (2004).

A wide range of potentially at-risk energy infrastructure exists in the coastal areas of the state (See Figure 1.). There are two major refineries in this area, seven major petrochemical facilities, three gas processing facilities and numerous pipeline segments. Many of the potentially at-risk pipelines in the area are responsible for moving a major share of natural gas produced in the GOM to consuming areas in the eastern half of the country including New York, Philadelphia, and Washington, D.C., to name a few.

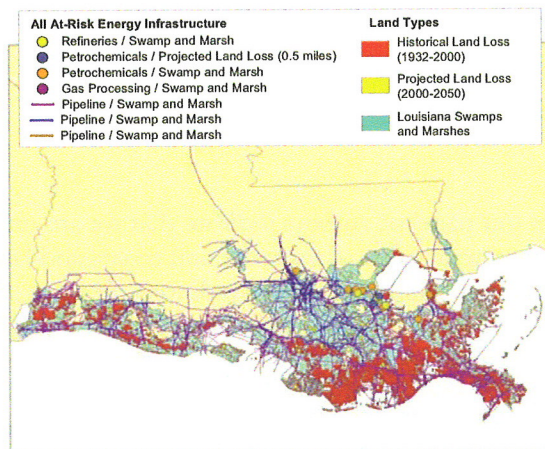


Figure 1: Potential At-Risk Energy Infrastructure

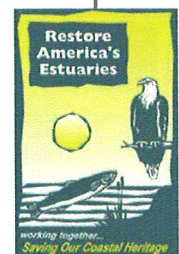
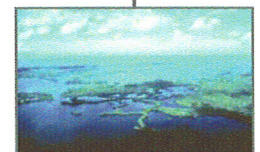
Source: (Dismukes' Construct; USGS, 2007(c); IHS Energy, 2004; Pennwell, 2004.)

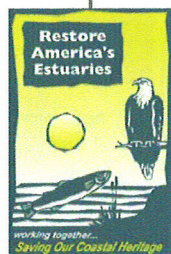
Storm surge, like that experienced during 2005's Hurricane Katrina can be seriously exacerbated by wetland and coastal habitat loss. Storm surge is indiscriminate in damaging both households and industry. Figure 2, for instance, provides two photographs, one during Hurricane Katrina, and one immediately afterwards, that shows the degree of storm surge and flooding at a major South Louisiana petrochemical facility.



Figure 2: Storm Surge and Flooding Post-Katrina at Petrochemical Facility

Source: (Provided to Dismukes courtesy of Air Products and Louisiana Chemical Association)





Conjectures during and since the time of the 2005 tropical season have blamed coastal erosion for aggravated storm surge levels (Stokstad, 2005).⁶ In other words, had some or all of the historic land loss not occurred, storm surge impacts would have been far less than what was experienced. Increased storm surge exposure is another potential risk to energy infrastructure along the Gulf of Mexico.

Two major refineries, seven major petrochemical facilities, three gas processing facilities and numerous pipeline segments are at risk of damage from storm surge through degraded wetlands in Louisiana.

Conclusion

The findings from our panel of authors indicate that we are only beginning to understand the full economic value of estuaries and coasts and how these values depend upon environmental and ecological conditions. Even with limited knowledge, one thing is clear – the value of coasts and estuaries is high, perhaps much higher

The high value of coasts and estuaries, and the environmentally dependent nature of so many sectors of the coastal economy, call for careful and forward thinking environmental stewardship of these resources – especially through protection and restoration.

than previously imagined. The high value of coasts and estuaries, and the environmentally dependent nature of so many sectors of the coastal economy, call for careful and forward thinking environmental stewardship

of these resources – especially through protection and restoration. Unfortunately, much of the coast is degraded; wetlands have been destroyed and many coastal waterways do not meet the basic standards for use set by the Clean Water Act.

Moving Forward

This report demonstrates two things: 1) the economic value of coastal and estuary protection and restoration is likely to be in the many hundreds of billions of dollars, if not more and 2) scientific research that shows exactly how protection and restoration have affected and could affect economic outcomes is lacking. Clearly, more research is needed to understand how habitat protection and restoration can be best designed to maximize the economic value and contribution of our coasts and estuaries.

Building on the work of the authors, Restore America's Estuaries, The Ocean Foundation's Coastal Ocean Values Center, and the NOAA Restoration Center are embarking on a series of pilot projects to develop and implement a system of economic indicators that will show how restoration events have affected human uses,

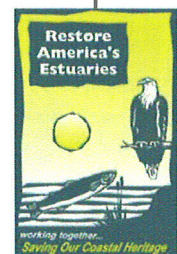
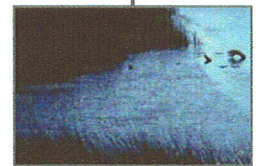
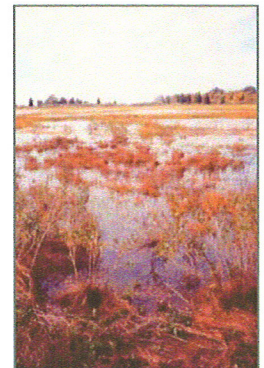
⁶While anecdotally, one could conclude that increased storm surge create by coastal erosion increased the damage suffered by many types of physical infrastructure, a comprehensive analysis has not been done to date.

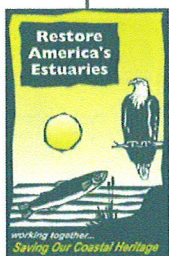
and thus the economic values, associated with coastal and estuary areas. Human use indicators measure activity (e.g. beach days), output (e.g. fish catch), and the economic impacts and values associated with human use. Much like environmental monitoring programs, indicators of human use will help to track the changing ways in which coastal conditions influence human use of the coast, understand how past restoration events have affected coastal uses, monitor the effectiveness of new restoration and protection, and identify areas where the return on restoration and protection will be the highest.



Through this empirical research, Restore America's Estuaries, The Ocean Foundation's Coastal Ocean Values Center, and the NOAA Restoration Center hope to better integrate human needs and values, both economic and social, into coastal management and restoration decision making.

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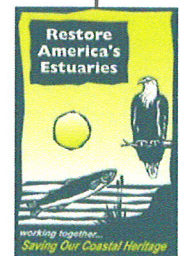
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Dr. Linwood Pendleton is a Senior Fellow, Director of Economic Research at The Ocean Foundation. He is an expert in marine and coastal economics and policy. Before joining The Ocean Foundation, Dr. Pendleton was a tenured Associate Professor of Environmental Science and Engineering at UCLA and retains an adjunct position there. Dr. Pendleton has advanced degrees in Ecology from Princeton, Public Policy from Harvard, and a doctorate from Yale's School of Forestry and Environmental studies.

Table of Contents

- Forward: Linwood Pendleton
- Chapter 1: "Understanding the Economics of the Coast"
Linwood Pendleton
- Chapter 2: "Accounting for Ecosystem Goods and Services in Coastal Estuaries"
Matthew Wilson and Stephen Farber
- Chapter 3: "Estuaries in the U.S. Ocean and Coastal Economies"
Charles S. Colgan
- Chapter 4: "Estuarine Restoration and Commercial Fisheries"
Douglas Lipton and Stephen Kasperski
- Chapter 5: "The Economic Value of Coastal Preservation and Restoration on Critical Energy Infrastructure"
David E. Dismukes, Michelle L. Barnett, and Kristi A. R. Darby
- Chapter 6: "Economic Benefits of Coastal Restoration to the Marine Transportation Sector"
Di Jin
- Chapter 7: "Coastal Housing and Construction"
Judith Kildow
- Chapter 8: "The Non-market Value of Coastal and Estuarine Recreation"
Linwood Pendleton



*It is the mission of
Restore America's Estuaries
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.*

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