NATURE’S FIRST LINE OF DEFENSE
Key Reasons To Protect And Restore Coastal Habitats
foreword
The Florida Wildlife Federation (FWF) is proud to present *Nature’s First Line of Defense: Key Reasons to Protect and Restore Coastal Habitats* to our members, coastal inhabitants and policy makers. We are proponents of coastal and floodplain policies that recognize both the natural and societal benefits of wetlands, barrier islands, and floodplains. In addition to providing superlative fish and wildlife habitats and places for sustainable outdoor recreation these areas provide natural buffers which reduce the intensity of storms and flooding. This publication describes the benefits of natural habitats, along the coast and waterways to our built environments. Depending on many factors such as storm intensity, direction, wind speed, the shape and slope of the shoreline, adjacent natural features such as sand dunes, maritime forests, and coastal wetlands including mangrove, oyster bar, coral reefs and other natural biological or geologic features can help protect homes, businesses and communities from storm winds and waves. The relative degree of protection in coastal areas varies with tidal phase, and the rising sea levels we are currently experiencing and which are predicted to continue to rise in response to our changing climate.

The Florida Wildlife Federation is a strong proponent of reducing the public’s exposure to storms and flooding. We believe it is prudent policy to reduce or eliminate taxpayer funded subsidies that result in intensifying development in low lying flood prone areas. An early and successful application of this concept in law is the Coastal Barrier Resources Act (CBRA), authored by U.S. Representative Tom Evans, a current Florida Wildlife Federation Director, and the late U.S. Senator John Chaffee. This bipartisan Act passed Congress 30 years ago with almost universal congressional support and was signed into law by President Reagan. CBRA has reduced or eliminated a variety of federal subsidies for 3 million acres of non-developed areas along the Atlantic and Gulf Coasts and the Great Lakes of the U.S. including 677,000 acres in Florida.

The Florida Wildlife Federation believes that reducing public subsidies on development in storm prone areas makes both environmental and economic sense. We also support building stronger and safer structures that are less vulnerable to storms and flooding. To foster these concepts and to apply them on the ground, FWF is a leader in a coalition of business, free market, public safety and conservationist who have come together in Florida known as the Stronger Safer Coalition. FWF is likewise working with a similar coalition in Washington, D.C. alongside the National Wildlife Federation. That coalition is known as the Smarter Safer Coalition. Smarter Safer likewise supports policies to both benefit taxpayers and to protect important habitats which help protect built areas from storms and flooding.

Natural features such as dunes, saltmarshes, oyster bars, reefs, mangrove stands, and freshwater wetlands, etc. can help buffer storm impacts. Storm losses can also be reduced by raising and strengthening existing structures in conjunction with protecting natural buffers. We also must work through the political processes to build public awareness and consensus so that the public is responsive to the best science concerning sea level rise and storm events. We should plan and implement safer human development and infrastructure along the Atlantic and Gulf Coasts with the assumption that we are likely to experience at least one meter or possibly higher sea level rise in the next 100 years. Doing so will reduce future risk to coastal communities and to our economy. Adapting our policies to sea level rise and storm intensification by sound planning, and public policy implementation is needed. This publication recommends the following adaptation efforts:

- Restoration of significant wetland systems both coastal and upland
- Appropriate consumer price signals on insurance products
- Adopt and implement a CBRA style program
- Conduct a community vulnerability assessment
- Participate in the Community Rating System

Florida is one of the most vulnerable areas in the world to the effects of rising seas and prudence suggests we must implement effective strategies to reduce our risks from inevitable major storms and rising seas. All though this publication focuses on certain recommendations, additional adaptation efforts are being implemented at the local, state and federal levels. Now is the time for communities to make decisions which consider the value of public investment dollars standing up to rising seas. Informed decision-making will lead to safer, more responsible, economically sound and sustainable communities.
executive summary
The financial and human costs associated with Sandy are still being counted more than one year since it made landfall. The dire impact to New York’s infrastructure has prompted the launch of a $20 billion storm hardening plan which includes restoring some shoreline areas to natural habitats. New Jersey Governor Chris Christie initiated an ambitious coastal rebuilding effort due to Sandy. As its centerpiece: the hardening of coastal structures. Even as hardening coastal infrastructure is an important goal, other states, such as Florida, must look to natural defenses, such as natural barrier islands, to prevent and mitigate economic and environmental damage.

Flood, wildfires, coastal storms and rising seas are now front and center in the marketplace of American politics and the debate over climate change. Some advocates tell us our nation can no longer afford to subsidize what has become a large and expanding debt exposure triggered by multi-billion dollar natural disasters. Others call for reforms to protect valuable wetlands and flood-prone natural buffers like coastal barrier islands. Meanwhile, development and real estate interests warn of dire financial consequences if we do not continue to promote our valuable coastal lifestyle.

It is clear the State of Florida has a direct and long-term interest in shaping the national debate about coastal policy. Those who call Florida home have a stake in shaping reasonable solutions and in identifying cost effective mitigation strategies. If you are a coastal property owner you have, perhaps, the most at stake. Yet, those residents who live inland are not immune to the choices we must make. Directly or indirectly all of us will be impacted by the policy choices we make.

Since 1936, FWF has worked to protect Florida’s remaining natural resources with the goal of seeing that all Floridians can continue to enjoy their natural heritage. In this publication, we hope to identify the value coastal habitats provide in protecting humans and our wildlife from the ravages of nature’s fury. By examining the value of natural barrier islands (“soft protections”) versus developed barrier islands (“exposures”, or those improvements which are insured and thus exposed to loss), we are providing the public and policymakers with a tool to evaluate the costs and benefits of future coastal development patterns. We must make wiser choices about the risks associated with coastal living. We need to determine if the value of shoreline coastal development is worth the enormous subsidies we currently pay. We need to ask if appropriate price signals (the costs of insuring) can be generated to cause future buyers of low lying properties to fully consider the trade-offs for living in harm’s way. Will consumers make wiser decisions about where they choose to build a home or a business? If they do choose to move back from areas subject to storm effects, thereby reducing their risks and costs, people can still continue to enjoy our coasts, wildlife will benefit, and Florida’s natural resource based economy can be maintained.
introduction
Florida, a state bordered by the Atlantic Ocean and the Gulf of Mexico, is the archetypal coastal state. It has more than 1,200 miles of coastline, almost 4,500 square miles of estuaries and bays, and more than 6,700 square miles of other coastal waters. The entire state lies within low lying portions of the Atlantic Coastal Plain, with a maximum elevation less than 400 feet above sea level.

Most of Florida’s 19.2 million residents live less than 60 miles from the Atlantic Ocean or the Gulf of Mexico. Three-fourths of Florida’s population resides in coastal counties that generate 79% of the state’s total annual economy. These counties represent a built environment and infrastructure whose replacement value in 2010 was $2.0 trillion and which by 2030 is estimated to be $3.0 trillion. With a current statewide population of 19.2 million and projected to be 35.8 million in 2060, Florida’s built environment and human population is especially vulnerable to sea level rise and events such as nor’easters, hurricanes and tropical storms (see Figure 1).

In Florida, our coastal habitats provide natural buffers for some of the most economically valuable and extensive shorelines in the nation. These coastal habitats provide varying levels of storm protection through storm and flood attenuation for the greatest number of people and property. Additionally, Florida derives immense value from our coastal regions as a source of tourism, recreation and from the wildlife that lives on and relies upon our near-shore environments for food, shelter and procreation. Because of these high value recreational opportunities and for storm protection services, it is imperative for communities to protect and restore these areas as valuable and naturally occurring first lines of defense.

Due to the changes in climate temperature, scientists predict storms will intensify. Sea levels are rising as well, with densely populated South Florida having experienced a rise of 1 inch per decade to date. While there have been a number of scenarios projected by a diverse group of scientists, governmental agencies and academics, a comparison of peer-reviewed research estimates for global sea level rise by 2100 range from 3.5 inches to 6.6 feet (see Figure 2). How this rise impacts a community depends upon its vulnerability.
For many coastal communities, the new normal consists of significant flood events as a result of the simple confluence of high tide and a modest summer shower. King tides, the highest predicted high tide of the year, can shutter businesses, causing economic loss and inconvenience to residents.\textsuperscript{10} While hardened engineering solutions (e.g., sea walls) may provide temporary relief, at what costs, and for how long?

Sea level rise will make today’s king tides become the future’s everyday tides. The Southeast Florida’s Resilient Water Resources Adaptation to Sea Level Rise and Other Impacts of Climate Change report includes an analysis of that region’s vulnerability to sea level rise. The report adopted an impact of 3 to 6 inches of rise because the assessment showed intrusion of saltwater intensifying into potable water sources and coastal flood control structures compromising and reducing their effectiveness by 20-40\% by 2030.\textsuperscript{11}

Rising seas and intense storms are a perfect recipe for costly disasters. We have already seen these costs burden our communities. Hurricane Katrina produced $80 billion in damages and seven years later Super Storm Sandy accumulated $75 billion in damage.\textsuperscript{12} Hurricane Andrew, in 1992, was another costly storm in U.S. history with estimated damages totaling $28 billion.\textsuperscript{13}

Now is the time for policymakers to make meaningful decisions that are financially responsible in the short and long term. Informed decision-making will lead to safer, more responsible, economically sound and sustainable communities. By doing a better job of guiding future development and encouraging mitigation of existing structures, policymakers can take important steps toward protecting human life and making our coastal landscape the natural storm barriers they have historically been. A corollary payoff to this strategy is the enhancement of natural wildlife habitat and recreational lands available for public use and enjoyment. The end goal is less public debt, fewer taxpayer-funded bailouts and a wiser and healthier plan for insuring people and places in harm’s way.
NATURE'S FIRST LINE OF DEFENSE  
Key Reasons to Protect and Restore Coastal Habitats

costal ecosystem services
The ability of Florida’s natural coastal habitats to serve as a first line of defense in protecting our communities from storms and sea level rise is an undervalued yet significantly beneficial service that comes at little cost to the taxpayer and provides a huge return, including recreation and wildlife habitat.

The following three ecosystem services are associated with coastal protection:

**wave attenuation**

Wave attenuation is the reduction of the wave height and wave energy as it passes through or over a type of habitat.

**floodwater attenuation**

Floodwater attenuation is the capacity a habitat has to reduce flood peak levels or flood durations through storage and drainage of floodwaters.

**shoreline stabilization**

Shoreline stabilization is the ability of a habitat to promote sediment deposition and stabilization as well as increase elevations.14

We often view ecosystems services from the perspective of ranch and farming operations. At a relatively low cost to the taxpayer, these lands often provide water storage and treatment for much less cost than public facilities.15 This same analogy can be used in describing the benefits provided by undeveloped coastal barrier islands and related natural features. By reducing storm impacts, undeveloped coastal zones serve a valuable purpose. When added to the recreational value they provide, we get a great return on the dollar.
NATURE'S FIRST LINE OF DEFENSE  

Key Reasons to Protect and Restore Coastal Habitats

florida’s coastal habitats
Florida’s saltmarshes are coastal wetlands that occur in the zone between low and high tides. Florida’s saltmarshes occur on the Gulf Coast from the Apalachicola River southward to Tampa Bay where they begin to intermingle with mangrove habitats. Moving from South Florida saltmarshes become more dominant from Daytona Beach northward on the Atlantic Coast. These wetlands not only help filter pollutants and provide critical habitat for fish and wildlife, they also protect coasts from storms.

Saltmarshes provide three services associated with coastal storm protection: wave attenuation, shoreline stabilization and floodwater attenuation. They are so effective in storm protection that they have been called self-maintaining “horizontal levees” and provide an array of other ecological ecosystems unlike the traditional vertical levees. Vegetative saltmarshes in comparison to tidal flats provide greater wave attenuation. Studies have shown for every 9 miles of saltmarsh there is a 3.3 feet reduction in storm surge. During Hurricane Andrew (1992), the storm surge was reduced by about 3 inches per mile of saltmarsh.

Overall the economic savings from saltmarshes in the United States for coastal protection is estimated at $23.2 billion per year.

During Hurricane Katrina, the scientific community saw the value of unaltered natural saltmarshes. On average, a standard unaltered one acre of wetland can store approximately one million gallons of water. The natural saltmarshes drained more efficiently compared to altered saltmarshes. The altered saltmarshes’ lack of efficiency increased flooding events on a regional scale. After Katrina hit, the lost storm protection value of those altered saltmarshes was valued at $11.1 billion.

Mangrove forests comprised of red, white and black mangrove species thrive in the southern coastal areas of the state. Florida’s mangrove forests provide nurseries and shelter for many fish and wildlife species. They also help protect the shoreline from erosion and trap sediments and debris.

Mangroves play a role in reducing the storm surge’s peak water levels. This is especially apparent when mangroves are present over a sufficiently large area – called a mangrove belt. Mangrove belts at a width of 547 yards are shown to be effective in reducing wave height between 50-99%. These mangroves slow the flow of water as the surge moves inland and reduce the waves riding on top of the surge which then decrease the water levels and the damage inshore from the mangroves.
oyster and coral reefs

Some of Florida’s most famous coral reefs are located in the southern part of the state along the Florida Keys. They are among the most unique and diverse habitats for fish and other marine life. In addition to providing shoreline stabilization and wave attenuation, they have significant economic and cultural value for the state of Florida. Millions of tourists and local residents enjoy scuba diving, snorkeling, and fishing on Florida’s coral reefs. This generates a significant source of income and jobs for Florida. It is estimated that reefs in Martin, Palm Beach, Broward and Miami-Dade counties generate $3.4 billion in sales and income and support 36,000 jobs in the region each year. Moreover, coral reefs can decrease wave energy and height by as much as 85%.

Oyster reefs are built primarily by the eastern oyster, *Crassostrea virginica*. Oyster reefs are built via the successive reproduction and settlement of larvae onto hard structures such as existing oyster reefs, pilings, rocks, downed trees and recycled oyster shell. Thus, with continued settlement and subsequent generational growth, oysters may form massive reef structures in estuarine systems. Among an array of services provided by oyster reefs, they provide wave attenuation and shoreline stabilization. Thus, they fortify wetlands to serve as horizontal levees that provide $23 billion worth of storm protection annually to Gulf Coast businesses and communities.

Oyster reefs also function as wave breaks and offer shoreline protection from storm events. By breaking powerful wave energy before it reaches the shoreline, oyster reefs play an important role in reducing shoreline erosion.

dunes

Dunes are the least expensive and most efficient defense against storm surge and erosion, making them one of Florida’s most resilient natural barriers to the destructive forces of wind and waves. Dunes are sand deposits located on the landward side of the beach. Large, thickly-vegetated dunes perform very well in response to storm surge. With Hurricanes Dennis and Floyd in 1999, large vegetated dunes protected the structures behind them as opposed to over 900 impacted structures that were not located behind dunes.

In Galveston Island, Texas, the dunes along the Gulf of Mexico are eroding at an alarmingly fast rate. The residents recognize the first line of defense the dunes serve. In response, they constructed artificial dunes rather than hardening their shoreline with a seawall. The artificial dunes proved to be very effective in restoring the natural dune as well as protecting the community behind it. During the 2002 tropical storm season, Pirate Bay experienced a 3-4 foot storm surge. The artificial dune protected the...
restored dune system which protected the private property behind it. During Hurricane Claudette (2003), 8-10 foot waves broke over the top of the restored dunes. Although the properties did flood behind it, they fared far better than the adjacent unprotected properties.26

**barrier island**

Barrier islands are naturally occurring strips of land that run parallel to the coast. In addition to serving as critical habitat for a number of species, barrier islands protect coastal communities by providing wave and floodwater attenuation. Barrier islands are also critical components of coastal wetlands.27 In many cases, barrier islands shelter wetlands from storm impacts which preserve the benefits of wetlands.28 There is overwhelming public recognition that barrier islands serve as hurricane protection. Prevention of further degradation and funding for restoration of barrier islands is widely supported by the general public. It is not only the coastal residents who see the benefit of barrier islands. A 2008 survey conducted in Mississippi showed a greater share of non-coastal residents citing hurricane protection than did coastal residents.29

The Coastal Barrier Resources Act of 1982 (CBRA), is a federal program that has recognized the value in undeveloped coastal barrier islands as a first line of defense. The Act prohibits federal subsidies for public infrastructure and federal flood insurance on barrier islands that have been designated as CBRA Units. Notably, the non-regulatory Act does not take away private development rights or prohibit private development in the CBRA Units. Property owners may choose to build on these flood and erosion-prone areas, but at their own risk. The Act makes it the personal responsibility of the private owners to assume the full financial responsibility for the inherent risks of their own properties and development. President Reagan, when signing the bill into law, wisely observed that: “The CBRA meets a national problem with less Federal involvement, not more . . . It simply adopts the sensible approach that risk associated with new private development in these sensitive [coastal] areas should be borne by the private sector, not underwritten by the American taxpayer.”

A 2002 U.S. Fish and Wildlife Service study showed, in what many regard as an underestimate, the Act has saved the American taxpayer over $1 billion and has continued to save our citizens significant money.30 In Florida the Act has protected 677,334 acres and 454 miles of shoreline (see Figure 3).31

**open space**

Open space may be defined as an area of land or water that remains in its natural state, free from intensive development consisting of residential, commercial, industrial or institutional use. Open space may be publicly or
privately owned. It includes forest land, undeveloped coastal and estuarine lands, undeveloped scenic lands, public parks and preserves.

Florida is fortunate to host an array of open space owned and managed by federal, state and local governments which may provide excellent public access opportunities to Florida’s waterways.

Open space is very effective in flood attenuation since designation of vulnerable areas as undevelopable areas reduces the amount of infrastructure that could be exposed. A national sample of communities with a significant open space component coupled with flood plain management in their land use plan, could save approximately $946,800 per community per year in flood losses.32 The figure is hypothetical. However, it underscores the economic value of open space as a flood planning tool.

Among the many attributes we can ascribe to open space is the fact that many residents and visitors frequent these areas as prime recreational opportunities. The economic impact of these natural amenities is enormous. In 2011, nearly 25 million people visited our state parks and trails.33 The top 10 visited state parks and trails were all in coastal areas.
adaptation efforts
Climatic events are already impacting coastal states like Florida. Decision makers need to arm themselves with information with which to make educated decisions for their constituents. The Florida Wildlife Federation offers the following recommendations:

1. **Restoration of significant wetland systems both coastal and upland**

   It should become a national priority to reclaim those riparian and coastal resources that we have lost. Rehabilitation work should commence to restore the natural buffers that those resources once provided. We should work to recognize and create an understanding of the short-term and long-term environmental impacts of existing flood and coastal protection measures and how those impacts can be mitigated.

2. **Appropriate consumer price signals on insurance products**

   Over the past few years, both experts and the media have exposed problems with Florida’s state-run insurance entities: Citizens Property Insurance Corporation (Citizens) and the Florida Hurricane Catastrophe Fund (Cat Fund). These entities are underfunded and rely on post-event debt supported by policyholder assessments, or hurricane taxes, from working families who rent their homes but have auto or other assessable policies, and from Florida’s businesses, charities, churches, local governments and school boards. Citizens and the Cat Fund offer their policies at actuarially unsound rates, thereby subsidizing risky development.

   “If you build it, they will come.” These words from the hit movie *Field of Dreams* could just as easily describe the allure of coastal living along the water. Most visitors to the coast have no idea of the inherent risks associated with living on the coast.

   “We proffer federally backed flood insurance at rates bearing no resemblance to the risks. Even more important, we go in after storms and write big checks so towns can put the roads, sewers and beach sand right back where they were. We are, in other words, using the federal Treasury to shield people from the true risks that they are taking by building on the coasts. Coastal development has soared as a direct consequence, and this rush toward the sea is the biggest factor in the rising costs of storm bailouts.”

   ~ Justin Gillis, New York Times reporter

When state and federally backed insurance is underpriced, a misleading price signal is sent to the unsuspecting buyer. The more appropriate answer is to price insurance at actuarially sound rates, reflecting the true cost of the associated risks.

In Florida, state subsidized homeowners’ insurance offered through Citizens has two highly problematic effects: 1) it acts as a driver for new development in the wrong places, and 2) keeps the private insurance market from growing and new capital from coming into the Sunshine State. Artificial rate suppression has caused financially stable insurers like State Farm and Cotton States Insurance to simply abandon the market.

Repairing the Florida insurance market will require extensive reform of Citizens and the Cat Fund so that prices are commensurate with risk. The 2013 Florida Legislature took initial steps in the right direction. Future Legislatures must build on this success.
On the federal level, Congress initiated a broad range of reforms to align National Flood Insurance Program premiums with the risk exposure in what is known as the Biggert-Waters Insurance Reform Act. The Act includes higher flood insurance rates in high-risk areas, among other reforms. Yet, no sooner had these measures gone into effect then opposing forces were at work trying to undo the needed reforms.

Reform of both state and federal insurance programs, through appropriate price signals, will encourage development away from vulnerable areas. This will help us move forward in protecting valuable coastal habitats and low-lying flood-prone areas as storm barriers and as wildlife habitat.

3 adopt and implement a CBRA style program

In 1982, Congress overwhelmingly passed, and President Ronald Reagan signed into law, the Coastal Barrier Resources Act (CBRA) establishing the Coastal Barrier Resource System. The purpose of the Act was to remove federal, taxpayer-funded subsidies (including federal flood insurance) for development on designated coastal areas referred to as CBRA units. Development is not prohibited within these areas and many of the units are partially built out. These units comprise low-lying, storm and flood-prone areas of high ecological value along the coast and on barrier islands.

In signing the Act, President Reagan stated, “The CBRA will enhance both wise natural resource conservation and fiscal responsibility.” Three important goals of the Act are to:

- minimize loss of human life by discouraging development in high risk areas
- reduce wasteful expenditure of federal resources, and
- protect the natural resources associated with coastal barriers.

Florida and federal lawmakers should consider a similar approach to either expanding CBRA in this state or providing a similar program that removes subsidies which encourage dangerous and fiscally imprudent behavior. Where appropriate, a buy-out of properties that have experienced multiple flooding events should be offered to willing sellers. Upon purchase these properties can become valuable waterfront access points and public parks.

4 conduct a community vulnerability assessment

Many regional and local governments are conducting vulnerability assessments to measure the communities’ vulnerability to sea level rise. These planning exercises look at community assets and estimated sea level rise projections to measure the level of vulnerability and how best to mitigate. Categories of community assets include: Bridges/Roads, Police/Fire, Electrical Substations, Water/Sewer Facilities, Schools, Public Buildings, Parks/Cultural Sites, Hospitals/Nursing Homes/Assisted Living Facilities, Churches and Mobile Home Parks.

We urge Congress not to delay the implementation of Biggert-Waters, but rather work to ensure that those most at risk can mitigate their risk. U.S. taxpayers cannot afford to subsidize insurance premiums regardless of need. According to GAO, 43 percent of subsidized properties are located in counties that have average home values in the top ten percent of the country—these counties have the highest home prices in the nation.

~ Smarter Safer Coalition
This planning exercise allows policymakers to make meaningful decisions that are financially responsible in the short and long term. Informed decision-making will lead to safer, more responsible, economically sound and sustainable communities.

participate in the community rating system

The National Flood Insurance Program’s Community Rating System (CRS) is a voluntary incentive program that recognizes communities for implementing floodplain management practices that exceed the Federal minimum requirements of the NFIP to provide protection from flooding.

In exchange for a community’s proactive efforts to reduce flood risk, policyholders can receive reduced flood insurance premiums. Their reduced premiums reflect the reduced flood risk resulting from community efforts toward achieving the three CRS goals:

1. Reduce flood damage to insurable property
2. Strengthen and support the insurance aspects of the NFIP
3. Encourage a comprehensive approach to floodplain management

looking down the road along florida’s coasts

As policymakers struggle with hard choices, it is apparent that a near-term and a long-term vision are needed to fully prepare our nation for a changing climate. While the near-term mitigation efforts are paramount and a strategy which “stops digging the hole further” is the correct approach, the long-term vision involves societal and geopolitical solutions. Rather than look at this from the glass half empty perspective, we must look at the opportunities inherent in a world of climate change and sea level rise.

One of the largest drivers for action is how sea level rise will degrade our coastal habitats, therefore diminishing their protective capacity. Based on historical data, a sea level rise of 1-2 cm/year will likely break up and down our coastal habitats.34 You can think about our adaptation efforts in the same timeframe as a mortgage. Today’s 30 year mortgage has a higher potential of being protected by our coastal habitat. Whereas our grandchildren’s mortgage (2090) may not be served by these first lines of defense. What technology and changing world politics will hold is anybody’s guess. As people who want to leave this planet a better place for future generations, it is our duty to plan and prepare for this new paradigm. One of the strategies we encourage is the gradual return of coastal flood-prone low lying land to public ownership through conservation buy-back programs. These can be funded through both conservation initiatives (like Florida’s once renowned Florida Forever Program and the proposed Florida Water and Land Legacy Amendment) and through legislative earmarking for buy-outs. We all gain by protecting open space and wildlife habitat. We should all find common ground to assist current waterfront owners in an organized and fair “retreat” from our most vulnerable coasts.

Adaptation is part of the American spirit. Early settlers to this country found a climate inhospitable to the crops they knew and they adapted. World War II prompted a migration from an agrarian society to an industrial juggernaut and the urbanization of much of America. Climate change and sea level rise will no doubt prompt a shift of this magnitude as well. It is this generation’s responsibility to set the stage and prevent further harm to our environment and our economy. It is the role of our generation of leaders to seize the opportunity to protect America’s coastline.

Average residential mortgage loan is 30 years
photography

Lou Kellenberger
Front cover and pages: 2, 4, 6, 9, 11, 16, 20

Betsy Kellenberger
Back cover and pages: 10, 13 lower right corner

Amy Massey, Florida Keys National Marine Sanctuary
Pages: 12, 13 upper left corner

Airphoto, Jim Wark
Page: 14

acknowledgments

Sarah Owen Gledhill and Jay Liles are the primary authors of this report. Significant support was provided by FWF Staff – Preston Robertson, Diane Hines, Michelle Hakemoller; Gary Appelson with the Sea Turtle Conservancy; Dr. Ken Lindeman at Florida Institute of Technology; Dr. Sergei Frolov with WeatherPredict; FWF intern - Mathew Bonano; and the GTM Research Reserve. Lou Kellenberger for photography. Michelle Ganeles did the report design and layout. Thank you to each and every one of you for helping to bring all this information together.