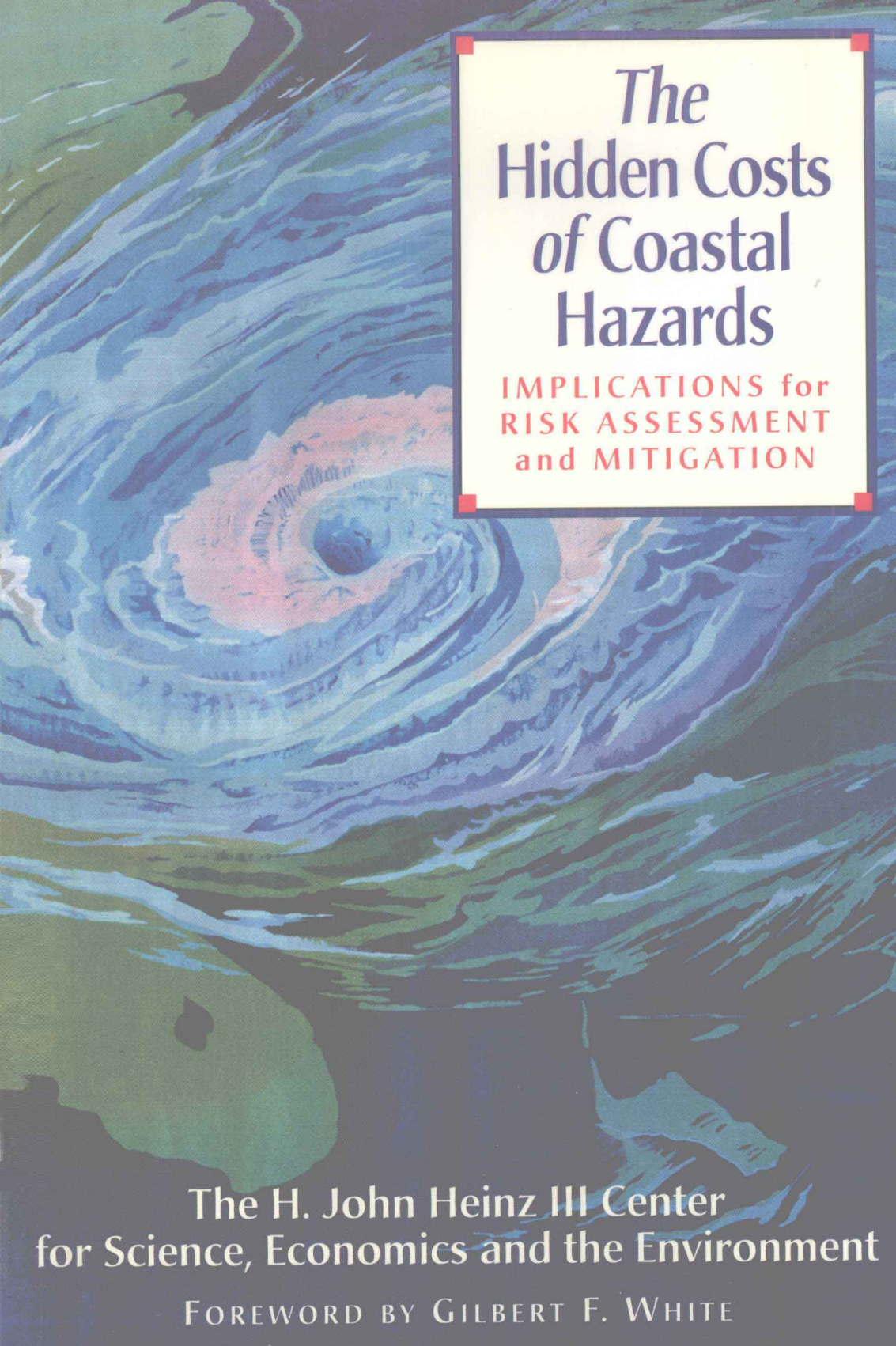

The Hidden Costs of Coastal Hazards

IMPLICATIONS for RISK ASSESSMENT and MITIGATION

The H. John Heinz III Center for Science, Economics and the Environment

FOREWORD BY GILBERT F. WHITE

The Hidden Costs *of* Coastal Hazards

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The following poem was written in the aftermath of 1989's Hurricane Hugo.

Carolina Umbra

by Marjory Wentworth

Boats fly out of the Atlantic
and moor themselves in my backyard
where tiny flowers, forgotten
by the wind, toss their astral heads
from side to side. Mouths ablaze, open,
and filling with rain.

After the Hurricane, you could see
the snapped-open drawbridge slide
beneath the waves on the evening news.
You go cold imagining
such enormous fingers of wind
that split a steel hinge until
its jaw opens toward heaven.

Above the twisted house,
above this island, where the torn
churches have no roofs, and houses
move themselves around the streets
as if they were made of paper;
tangled high in the oak branches,
my son's crib quilt waves its pastel flag.

But the cribrail is rusted shut.
And you can't see my children
huddled together on the one dry bed
of this home filling with birds

that nest in corners of windowless rooms,
or insects breeding in the damp sand
smeared like paint over the swollen floors.

The storm will not roar in your sleep
tonight, as if the unconscious
articulations of an animal aware
of the end of its life were trapped
in the many cages of your brain.

The tedium of nights
grows beyond the absolute
black of this world without light,
where human beings, born on the mud
floors of unnamed cages, are exposed
to eternal, unforgiving winds.

You can't see grief darken the wind
rising over Sullivan's Island. Tonight,
as the burning mountains of debris
illuminate the sky for hundreds of miles,
I see only the objects of my life
dissolving in a path of smoke.

All the lost and scattered hours
are falling completely out of time,
where endless rows of shredded trees wait
with the patience of unburied
skeletons, accumulating in the shadows.

Foreword

The Hidden Costs of Coastal Hazards is a ground-breaking analysis of methods for understanding the full impacts of coastal hazards, and of what this could mean for measures to deal with them constructively.

While it focuses on problems in the coastal zone, the same approach is appropriate for hazards in other parts of the nation. If the steps recommended by The Heinz Center were to be pursued, the public policy on dealing with natural hazards would be improved in at least three basic ways: methods of estimating costs and benefits of extreme events would be improved, the analysis of risk and vulnerability would be defined, and the measures necessary for achieving genuine community mitigation would be advanced.

Some observers would note that the first U.S. effort to lay the groundwork for national land-use planning was in the Coastal Zone Management Act of 1972. Much was accomplished under that legislation in establishing appropriate state agencies and supporting activities by the National Oceanic and Atmospheric Administration, but a truly comprehensive program did not emerge. Now, after 27 years, the specifications for such an effort are outlined.

In addition to its detailed appraisal of concrete experience with Hurricane Hugo in the Charleston area, the report draws from a wide variety of hazard and land-use studies for the entire country. Many of the findings and recommendations are applicable to noncoastal areas. The suggestions made, for example, to prepare more nearly precise estimates of social and health effects and losses sustained by the business community would be useful in computing the losses from inland floods or tornadoes.

If this report were to lead only to the design and operation of a more comprehensive and accurate estimation of the social and environmental losses from coastal natural hazards it would be highly useful. However, its potential significance is far greater. It could inspire genuine improvements in

methods of estimating losses, in examining risk and vulnerability, and in down-to-earth planning of mitigation measures. The recommended steps could lead to truly disaster-resistant and sustainable communities.

GILBERT WHITE
University of Colorado at Boulder

Preface

In 1996, representatives of The H. John Heinz III Center for Science, Economics and the Environment and the National Oceanic and Atmospheric Administration's Coastal Services Center (CSC) began discussions of the need for an improved understanding and accounting of all costs associated with weather-related coastal hazards. Both The Heinz Center and the CSC place a strong emphasis on partnerships with local, state, and federal officials and on fostering collaboration among industry, environmental organizations, government, and academia.

Because of the traditionally limited mission objectives of government agencies and the confidential nature of much insurance industry information, The Heinz Center and the CSC decided to convene a panel of experts who could help identify and develop new strategies to reduce costs associated with rapidly increasing coastal development activities. In the course of determining the scope of the work involved in such a study, the U.S. Geological Survey (USGS), the Andrew W. Mellon Foundation, and the Federal Emergency Management Agency (FEMA) became sponsors and supporters of the project's goals as well.

Project Management

The H. John Heinz III Center for Science, Economics and the Environment is a nonprofit institution dedicated to improving the scientific and economic foundation for environmental policy. The center is committed to fostering collaboration among four sectors—industry, environmental organizations, government, and academia—each of which plays an important role in solving environmental problems. The center concentrates its efforts on emerging issues; that is, environmental problems likely to confront policy makers within two to five years. This commitment made

the center ideally suited, to bring all parties to the table to conduct this study.

The CSC works to provide information, education, and technology transfer services to the coastal community for improved decision making. With a strong emphasis on partnerships, the CSC works with local, state, and federal officials to determine specific coastal management issues or challenges. The CSC helps these organizations by providing training, data, or information that was previously unavailable or underutilized.

Working as partners with the CSC, in October 1997 The Heinz Center appointed the Panel on Risk, Vulnerability, and the True Costs of Coastal Hazards to carry out the study and research necessary to address the tasks outlined in the following section on the scope of work. The 23 members of the panel volunteered their time to work on this project and met four times during the study period.

After two meetings, the panel decided to focus on one large coastal hazard event in gathering data and information on direct and indirect costs and impacts. The panel chose Hurricane Hugo, a major disaster that struck the South Carolina region in 1989. A draft risk, vulnerability, and cost assessment framework was developed after the first meeting and continued to evolve as more information was gathered. The panel was divided into four working groups to focus on four categories of costs: costs to the natural environment, costs to the built environment, social and family costs, and business costs. A workshop was held in March 1998 in Charleston, where approximately 30 persons were interviewed (see appendix B) about the direct and indirect impacts and costs associated with Hurricane Hugo. Each working group developed a list of questions, which were sent to the invited participants prior to the workshop (see appendix A) and used during the interview sessions in Charleston. After the panel's third meeting, the members developed their report outline and began drafting this report.

The Heinz Center provided the primary project management for the study, with the generous assistance and cooperation of the staff of the CSC. The CSC also furnished cost data, photos, and maps related to Hurricane Hugo. The USGS and FEMA also assisted the panel by providing maps, figures, and data.

Scope of Work

The Heinz panel's task was to develop an improved framework for community-level risk and vulnerability assessment that factors in relevant economic, social, environmental, and regulatory issues not now considered. Particular

emphasis was given to developing an understanding of the full range of unreported or hidden economic cost categories associated with weather-related hazard events. Traditional risk and vulnerability assessment methods used by coastal communities generally have not incorporated such unreported or hidden costs to families, natural resources, or community support systems, even though these are important components of the total cost of extreme events, nor have evaluations of potential measures for mitigating future losses taken these impacts into account.

It was envisioned that an improved understanding of the full range of economic costs, including normally unreported costs, would allow for more cost-effective and appropriate public and private investment in hazard mitigation. Tasks for the panel included:

- identifying the full range of cost categories associated with weather-related coastal hazards;
- analyzing existing community-based risk and vulnerability assessment methodologies and identifying their strengths and weaknesses;
- developing an improved, comprehensive framework for standardizing community-level risk and vulnerability assessment methods incorporating the full range of associated costs; and
- suggesting the types of mitigation strategies that might be considered to reduce future costs resulting from coastal hazards.

Because of the breadth and diversity of knowledge needed to approach these tasks, the panel included 23 whose combined expertise spanned the four sectors of government, industry, academia, and environmental organizations. The individual expertise represented on the panel included economics, environmental science and engineering, ecology, coastal geology, emergency preparedness, architecture, geography, oceanography, statistics, sociology, state emergency management, meteorology, coastal engineering, law, and ecosystem restoration.

While The Heinz Center study was under way, the National Research Council (NRC) Board on Natural Disasters appointed a committee to conduct a study on the losses resulting from natural disasters. The NRC report includes recommendations on which losses should be included when estimating the total costs of a natural disaster. The NRC report, *Impact of Natural Disasters: A Framework for Loss Estimation* is available through the National Academy Press, Washington, D.C.

We would like to take this opportunity to thank the staffs of The Heinz Center, NOAA's Coastal Services Center, FEMA, and the USGS, who helped locate the data, maps, and other information needed by the panel during the

study. We especially thank Margaret Davidson, Paul Scholz, Sandy Ward, and Caroline Kurrus of the CSC, who initiated the study and contributed data and other information to the panel. Special thanks go to Rud Platt, who served as vice chair of the panel and made sure that we recognized the current status of public policy with respect to coastal hazards; Allison Sondak, research assistant at The Heinz Center, who took the lead in writing chapter 2 and assisted in organizing the panel's meetings, workshop, and other activities; Jim Good, who took the lead in writing chapter 3 and helped organize the Charleston workshop; and Roger Pielke Jr., who took the lead in writing chapter 4. Four other panel members played a key role in coordinating, analyzing, and writing material for the four-sector analysis: Don Geis (built environment), Molly Macauley (business community), Betty Morrow (social, health, and safety), and Virginia Burkett (natural resources and ecosystems). Sheila David, The Heinz Center project manager, deserves special thanks for the way she organized the panel and its activities, meetings, and report with both good humor and firmness. She made working on the project an enjoyable, productive, and rewarding experience for all panel members.

This report is directed to decisionmakers—both policymakers and planners—who are interested in learning about the categories of costs and risk associated with weather-related coastal hazards. This audience includes legislators who establish broad policy and programs and local government officials who develop and implement specific mitigation strategies and policies, such as land-use planning, building codes, and evacuation plans. Another key audience is private-sector decision makers, including lenders, investors, developers, and insurers of coastal property. In addition, social and natural scientists may be interested in the research needs outlined in this report.

HOWARD KUNREUTHER
Chair

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Many individuals assisted the panel in its task by participating in panel meetings, providing cost data, recommending individuals to be interviewed about the impacts and costs of Hurricane Hugo, and providing background information to the panel. We express our appreciation to the following people for their unique contributions to this project:

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Panel on Risk, Vulnerability, and the True Costs of Coastal Hazards

Howard Kunreuther, Chair, The Wharton School, University of Pennsylvania, Philadelphia, PA

Rutherford Platt, Vice Chair, University of Massachusetts, Amherst, MA

Stephen B. Baruch, Stephen B. Baruch & Associates, LLC, Los Altos, CA

Richard Bernknopf, U.S. Geological Survey, Menlo Park, CA

Michael Buckley, Federal Emergency Management Agency, Washington, DC

Virginia Burkett, U.S. Geological Survey, Lafayette, LA

David Conrad, National Wildlife Federation, Washington, DC

Todd Davison, Federal Emergency Management Agency, Atlanta, GA

Ken Deutsch, American Red Cross, Falls Church, VA

Donald E. Geis, Geis Design-Research Associates, Potomac, MD

James Good, Oregon State University, Corvallis, OR

Martin Jannereth, Michigan Department of Environmental Quality, Lansing, MI

Anthony Knap, Bermuda Biological Station for Research, Inc., Ferry Reach, Bermuda

Hugh Lane Jr., The Bank of South Carolina, Charleston, SC

Greta Ljung, Institute for Business and Home Safety, Boston, MA

Molly Macauley, Resources for the Future, Washington, DC

Dennis Mileti, Natural Hazards Center, Boulder, CO

Todd Miller, North Carolina Coastal Federation, Newport, NC

Betty Hearn Morrow, Florida International University, Miami, FL

Joseph Myers, Florida Division of Emergency Management, Tallahassee, FL

Roger A. Pielke Jr., National Center for Atmospheric Research, Boulder, CO

Anthony Pratt, Delaware Department of Natural Resources, Dover, DE

James T. B. Tripp, Environmental Defense Fund, New York, NY

Heinz Center Project Management Staff

Sheila D. David, Project Manager

Allison Sondak, Research Assistant

National Oceanic and Atmospheric Administration Coastal Services Center Project Staff

Margaret Davidson, Director

Paul Scholz, Coastal Management Services Branch Chief

Sandra Ward, Coastal Hazards Program Manager

Caroline Kurrus, Coastal Planner

Russell Jackson, Coastal Hazards Program Analyst

Executive Summary

The coastal regions of the United States include some of the most diverse and dynamic environments on earth. From the rugged, rocky shores of Washington's Olympic coast to the coral reefs of southern Florida, the nearly 88,000 miles of U.S. ocean, estuarine, and Great Lakes shorelines exhibit a stunning array of physical, natural, and human diversity. Much of this physical and natural diversity is associated with global, regional, and local geologic processes. The physical and natural environment are, in turn, further shaped by weather events and patterns operating at a variety of spatial and temporal scales. Familiar examples include hurricanes, nor'easters, winter storms along the west coast, and El Niño–related storms, floods, and droughts. Along undeveloped coasts, these natural events constantly reshape shorelines as they have for centuries, cutting new inlets, eroding some areas, and accreting new beaches in others. However, once a coastal area has been developed and become a home to humans, these weather events can become deadly and costly, and in this context the terminology is transformed: what were once mere weather events become coastal hazards or, even worse, coastal disasters.

Historically, settlements were drawn to the coasts for convenient pursuit of fishing and whaling, as ports serving ocean trade routes, and as centers of social interaction and civilization along waterways. Many of the world's leading cities, such as New York, San Francisco, London, Tokyo-Yokohama, Hong Kong, Singapore, and Shanghai, are located near the water's edge. As of 1998, eight of the ten largest American cities were situated on the oceans or Great Lakes. Beyond the cities that have evolved around deepwater harbors and protected waterways, the tide of humanity has flowed to all parts of the U.S. coastline. People are drawn by the millions to the elemental, visually pleasing, and emotionally restorative shores of the oceans and the Great Lakes.

Those stretches of the coast not held in public or conservation status at-

tract residential, commercial, and recreational investment. Ribbons of intense development follow the narrow strands of beaches and encroach on estuarine wetlands and maritime forest. In addition to the many benefits of living on the coast, population growth and development have brought many problems in their wake: pollution of nearshore waters, loss of valuable coastal wetlands, degradation of major fisheries, traffic congestion, visual blight, and overcrowding of recreational areas. Such development has also invited ever-rising costs, both economic and nonmonetary, imposed by weather-related coastal hazards. This book explores the implications of this increased vulnerability of the United States to coastal disasters.

As coastal communities have grown, the nation has experienced higher property losses, relief costs, more business interruptions and failures, social disruption and dislocation, and natural resource damages associated with coastal hazards. Given the clear trends—continued human migration to the coast, burgeoning growth in coastal tourism, and dramatically escalating investment in hazardous coastal locations—the prospects for controlling these costs are not good. A greater loss of life associated with weather-related coastal hazards has been seen in the mid- to late 1990s, both in the United States and globally. Although better forecasts and warning processes have helped save lives by providing more lead time to evacuate, the tremendous growth of development and human population in coastal regions is proceeding so rapidly that an increase in the loss of life related to coastal disasters can be expected in the future. Implementation of mitigation measures to prepare for and reduce the impacts of coastal disasters in threatened communities has not followed the growth of development on U.S. coasts. Although a hurricane landfall at any particular coastal location is relatively rare for the U.S. and Gulf coasts, hurricane landfalls somewhere in this region are almost certain every year. Fundamental changes are needed to address the risks of weather-related coastal hazards and the increasing vulnerability of coastal communities' economies, social systems, and governmental and private institutions.

The costs currently reported are typically limited to insured and uninsured property losses and official disaster relief expenditures. Even these limited cost data are uneven in availability and consistency. A much broader understanding of the categories and range of coastal hazard costs is needed. These include not only the losses to the built environment but also additional impacts, such as

- uninsured business interruption costs,
- social and family disruptions and health costs, and
- costs of the damages to natural resources and ecosystem services.