The Nature Conservancy
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Statement of Dr. Peter Kareiva
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I am Peter Kareiva, the Chief Scientist for The Nature Conservancy (TNC). Prior to taking a position at The Conservancy, I served as Director of Conservation Biology Division at the Northwest Fisheries Science lab in Seattle, which is part of NOAA. Prior to working for NOAA, I was a Professor at University of Washington and had pursued a twenty year career of research in conservation, agriculture, and resource management. I have dedicated my scientific career to using rigorous but practical analysis and synthesis of environmental information in order to effectively manage and use our lands and waters. I am here today to talk about the information needs for resource management in an uncertain world facing climate change and potential ecosystem degradation. I also want to describe some new decision-support tools and planning tools that have the potential to guide future human impacts in a way that provides a sustainable future for people and our natural assets.

The Nature Conservancy's on-the-ground conservation work is carried out in all 50 states and in 32 foreign countries and is supported by approximately one million individual members. The Nature Conservancy has protected more than 117 million acres of land and 5,000 miles of river around the world. Our work also includes more than 100 marine conservation projects in 21 countries and in 22 US states. The Conservancy owns and manages approximately 1,400 reserves throughout the United States—the largest private system of nature sanctuaries in the world. We use science to protect our investments, to manage our lands, and to make sure our natural assets will sustainably contribute to both biodiversity protection and to meeting human needs. To achieve our goals we routinely partner with government agencies, with other land trusts, with universities, and with private enterprise. As climate change has begun to show its impacts on lands and waters, and as the human footprint grows, we have found our responsibility increasingly challenging. It is my job as Chief Scientist to provide technical guidance and leadership so that the Conservancy is able to make smart decisions about marine, freshwater, and terrestrial conservation and management. There are two lessons we have learned as we seek to make sure that people and nature emerge as winners in the face of the many different and interacting threats to the environment.

1.) First we need to invest in data collection, information systems and performance measures that allow us to engage in adaptive management, which is a fancy phrase that means "learn by doing in as efficient a way as possible". There is nothing more essential to institutional, national, and environmental survival than learning and improving.
2.) Second we need to create and provide easy access to decision-support tools that can clarify for the public and decision makers the tradeoffs inherent in different

options. Honest assessments of tradeoffs will promote informed decisions that in some cases might mean sacrifices to certain stakeholders, but in other cases could actually be win-win's for all involved. Particularly needed are tools that help people to see the economic value of natural assets so that people do not make foolhardy decisions that at first glance seem like a good investment, but upon rigorous analysis turn out to be bad ideas.

I will focus in this testimony on concrete examples of tools and approaches that represent The Conservancy's experience at synthesizing information for adaptive management and developing decision support tools. We initiated development of many of these approaches before the impact of climate change was evident, but now feel a sense of urgency to improve our approaches given the rapid change and the uncertainty that the world faces.

Marine Regional Assessments

Over the last 10 years, the Conservancy has worked with a wide range of stakeholders and partners to complete marine regional assessments in nearly all U.S. waters and many waters internationally. Through these assessments, we have integrated databases and developed maps of the distributions of marine ecosystems, habitats, species, and human uses for most of the United States. This information, when used as part of a stake-holder process, provides a foundation to identify priority areas for conservation, restoration, and management. Examples of how these integrated data sets have been used range from helping to identify marine protected areas and no-trawl areas in California to developing comprehensive fish and wildlife management plans in Oregon and Florida to partnering with NOAA to assess priority sites for restoration throughout the country. We have also used regional planning information to provide guidance on energy siting decisions. We have shared these data and approaches through workshops, scientific publications, reports, and websites. Over the last several years, we have we have worked with partners to expand our conservation decision-support tools to directly address fishery, coastal hazard, and energy objectives jointly with conservation objectives. Examples of these approaches and current products are available at www.marineebm.org. The key to these mapping tools is identifying a smart mix of fishing, resource extraction, and nature protection.

Developing Multi-Objective Marine Management Approaches: Adapting to Protect Human and Natural Communities

One cannot promote fisheries over all other alternatives, just as one cannot just promote only conservation. The world is not that simple. Instead resource managers must move from single objective plans and management (e.g., just conservation or just fish production) towards approaches that look at the trade-offs among multiple objectives and services. The aim is to identify solutions that minimize conflicts and maximize benefits among these multiple objectives and services. The Conservancy and partners have been developing approaches for combining fisheries, hazard mitigation, energy siting, and conservation objectives together into common frameworks.

One of the areas where there are real opportunities for identifying win-win solutions for human and natural communities is in building approaches that combine hazard mitigation and biodiversity conservation in coastal zones. The goal here is to restore coastal ecosystems to preserve infrastructure and protect human communities. Coastlines have always been dynamic, but are now more so than ever because of changing storm patterns and sea level rise, placing human and natural communities at greater risk. The costs of these hazards to human and natural communities are increasing as coastal development continues and natural buffers, such as coastal wetlands and dunes, are lost.

Despite a growing awareness of the reality of these hazards, communities and local decision makers still have little access to information on likely changes in storm and flooding risk or tools to visualize the potential impacts and identify alternative scenarios. As a consequence, communities are unable to integrate sea level rise and coastal hazard risk into decision-making regarding natural resource protection and land use management. This information is needed to protect human communities from the dramatic changes that are underway. The Conservancy has contributed to the development of two different examples of tools and approaches that can help address these services and objectives jointly in the Florida panhandle (www.marineebm.org/32.htm) and a more advanced and developing decision support tool for the southern shores of Long Island (http://www.coastalresilience.org).

The salt marshes, sea-grass beds and oyster reefs of Florida's Gulf Coast harbor manatees, sea turtles, piping plovers and many other threatened species, as well as serving as nurseries for economically important shrimp, crab and red snapper. These habitats also provide protection from storm surges that accompany hurricanes. Yet strategies to defend and restore coastal ecosystems—which could simultaneously assist people and expand habitats for threatened and economically valuable species—have largely been ignored in favor of engineering projects (diking, building levees, and hardening the coastline) that accelerate erosion and habitat loss. Working with scientists from the National Oceanic and Atmospheric Administration, TNC recently combined maps of critical habitats and threatened species in the Florida Panhandle with maps of anticipated storm surges and of human communities most physically and socio-economically vulnerable to storm damage. By overlaying these data sets, they were able to identify areas in which restoration should simultaneously protect the most vulnerable human populations as well as many of the area's most important species.

On the south shore of Long Island, we have developed an interactive web mapping tool to explore flooding scenarios from sea level rise and storm surge for the south shore of Long Island, New York. The aim of the project is to support evidence-based decision making to better understand the risks to human and natural communities from climate change and to inform management options. The website (http://www.coastalresilience.org) presents IPCC climate scenarios for flooding from sea level rise and storms and identifies some of their ecological, social, and economic impacts using models developed by NOAA and FEMA. We have incorporated management options such as the creation of buffers into the map server and there will be a full policy options report (and web summary) from the Pace University Land Use Law Center forthcoming. This interactive web-tool includes a set of alternative future scenarios that will help decision-makers keep the environment and public safety in

mind as sea levels rise and coastal hazards increase. A wide range of partners across academia, government, and non profits are directly included in this effort. The partners include TNC, NOAA, NASA-Goddard, Association of State Floodplain managers (running FEMA models), University of California Santa Barbara, and University of Southern Mississippi, among others. There is a compelling need to expand this approach to the entire US coastline. This is crucial to environmental protection and environmental justice.

Marine mapping and spatial planning: Key Points & Advice

The Conservancy has worked on marine regional plans for more than 10 years and with partners- including NOAA, EPA, USWFS, and many state agencies (e.g., Washington State Department of Natural Resources, Oregon Department of Fish and Wildlife) - has completed more than 15 regional plans around the US and internationally. You cannot manage marine habitats and ecosystems if you don't know where they are and for most coastal ecosystems, decent maps of even habitat distribution do not exist. In New York, the maps that are currently used for statewide salt marsh management are from 1974. In the Gulf of Mexico, the distribution of oyster reefs was better document in the 1880s than it is today. The technology for mapping habitats nearshore is becoming quick and cheap and a concerted investment in this sort of mapping will have a high payoff. There is not a lot of sense in having comprehensive spatial management tools if the base of information does not exist.

In addition to the need for multi-objective plans described earlier, a second key element for the future of marine spatial management is in interactive decision support. We at TNC think the future is not in the prioritization tools per se but in our ability to examine alternative management scenarios interactively with stakeholders. The interactive decision support shown at www.marinemap and www.coastalresilience.org are two examples of useful approaches for the future. There is no one right answer to how to jointly manage the needs of natural and human communities. Interactive and scenario based tools allow stakeholders to examine alternatives and identify approaches.

There is no common database(s) or clearinghouse for marine information to be used in decision making. There does not need to be just one common framework and database for marine information, but a common framework would serve us all well. For example, we support the efforts to develop a multipurpose marine cadastre.

Methods and tools that help us manage freshwater systems for people and nature

Human alterations to natural stream and river flow patterns take a serious toll on the plants, animals, and freshwater ecosystems that people depend on. *Environmental flows* are the amount and timing of water flows required to maintain healthy freshwater ecosystems and their benefits to human communities. A well-managed water resource is appropriately allocated to people's immediate needs and to environmental flows. Conservancy scientists have pioneered the field of environmental flows and developed tools that help water managers understand how much water a river needs in each season as well as across years to support important ecological functions and biodiversity. We have developed Indicators of Hydrologic Alteration, a software program that provides

useful information for those trying to understand the hydrologic impacts of human activities or trying to develop environmental flow recommendations for water managers. We have also collaborated with the U.S. Army Corps on Engineers on a software program called the Regime Prescription Tool (HEC-RPT) to assist in the development of ecologically sustainable recommendations for dam operations.

We are also developing specific tools that assess the effect of land use changes on freshwater ecosystems**.** In particular**,** Water for Tomorrow, a web-based tool being developed in partnership with IBM, will provide a modeling and visualization platform to allow users to assess the water and sediment yields of a landscape from current and projected scenarios of land cover. This project is set to conclude in April of 2010, resulting in a free-standing and broadly accessible product.

From The Conservancy's perspective, society is at a crossroads in water management and freshwater conservation. If society chooses to continue as it has, the health of our freshwater ecosystems will continue to decline at an alarming rate. But we can choose a different path, one which addresses human and ecosystem needs for water, one in which critical water quantity patterns are protected along with water quality. Capitalizing upon this opportunity, The Conservancy is contributing to the development of two certification programs that will promote sustainable water use, dam planning and operations, and catalyze the engagement of corporate leaders, water utilities and the hydropower industry. Please go to http://allianceforwaterstewardship.org/ for more information about one of these efforts.

Valuing Natural Capital in order to make smart decision about development, infrastructure, and land or water use

Long ago The Conservancy realized that the world is not divided into pro-environment and anti-environment. Rather, everyone seeks a better world and the trick is to have tools that help us see the consequences of our decisions with as complete a cost-benefit analysis as possible. As a partnership with Stanford University and World Wildlife Fund, we have developed spatially explicit mapping and valuation tools, called InVEST (see http://www.naturalcapitalproject.org/InVEST.html). The motivation for this approach is simple: relative to other forms of capital, assets embodied in ecosystems are often poorly understood, scarcely monitored, and undergoing rapid degradation. Often the benefits that natural ecosystems deliver to humans are recognized only upon their loss. For example, Hurricane Katrina brought broader recognition of the importance of coastal ecosystems in dissipating the energy of large waves that occur during storms. Natural capital and the "ecosystem services" that flow from nature are typically undervalued – by governments, businesses, and the public – if indeed they are considered at all.

Two fundamental changes need to occur to replicate, scale up, and sustain the pioneering efforts underway to give ecosystem services weight in decisions. First, the science of "ecosystem services" (the delivery of benefits from natural ecosystems to humans) needs to be advanced rapidly. In promising a return on investments in nature, the scientific community needs to deliver knowledge and tools to quantify and forecast this return. Second, ecosystem services must be explicitly and systematically integrated into

decision-making by individuals, corporations and governments. Without these advances, the value of nature will remain little more than an interesting idea captured in small, scattered, and idiosyncratic efforts.

The tool we have been developing (InVEST) is a suite of models that uses land use and land cover patterns to estimate levels and economic values of ecosystem services, biodiversity conservation, and market value of commodities provided by the landscape. Examples of the ecosystem services and commodity production that InVEST can model include water quality, water provision for irrigation and hydropower, storm peak mitigation, soil conservation, carbon sequestration, pollination, cultural and spiritual values, recreation and tourism, timber and non-timber forest products, agricultural products, and residential property value. InVEST can be run at different levels of complexity, making it sensitive to data availability and an understanding of system dynamics. Results can be reported in either biophysical or monetary terms, depending on the needs of decision-makers and availability of data. We have been applying InVEST in Hawaii, California, Washington State, China, and Colombia. This approach has already proven to be influential with decision-makers and has brought a common currency to bear on discussions among private enterprise, government, and environmental groups regarding development projects and land use.

Synthesis and Presentation of Environmental and Resource Information

When you work internationally as I do, you quickly realize we in the USA have the best data and best information on soils, topography, land cover, stream flows, climate data and so forth anywhere in the world. We could also have the best data on ecological processes and biodiversity with modest increases in investment. But we do not get the full benefit of our information advantage. Information on something as critical as climate change, past and future, is not readily accessible to decision makers or land and water-use planners. It is for this reason that TNC scientists have begun to develop a tool called "Climatewizard" (see www.climatewiz.org) that allows one to pick any state in the USA or any country in the world and get records of past temperature and precipitation trends as well as future projections under different scenarios.

There is so much environmental and ecological information out there, that decision-makers and the public get overwhelmed. For that matter, even scientific experts can be overwhelmed. There are two tiers of information and data synthesis needed. One tier concerns the simple tools The Conservancy has been using. Importantly, one must understand the limitations and biases of those tools. For that reason serious scientific research aimed at modeling and synthesis across disparate datasets (such a population distribution, wealth, climate vulnerability, freshwater flows, and biodiversity) are essential. Much of The Conservancy's success at developing practical tools is due to a "hidden" support base of analysis by researchers at universities, and especially the National Center for Ecological Analysis and Synthesis (see http://www.nceas.ucsb.edu/). The nation desperately needs centers such as NCEAS. NCEAS has supported resource management and conservation around the world through its synthesis of environmental data and development of prototype models that resource management institutions can then tailor to everyday practical decisions.

We live in a time of rapid population growth, dramatic climate disruption, economic stress, and critical resource decisions. In spite of these challenges we still have many options. In the United States we have vast areas of intact ecosystems and some of the world's cleanest rivers. Energy development, coastal development, infrastructure development, agriculture and forestry can be done smartly in a way that gives us a sustainable future. But this will happen only with science-based decision-support tools, easy access to wide-ranging datasets, institutions that support synthesis and analysis, and monitoring of the environment in critically vulnerable regions. By combining climate change models with models of ecosystem services and human vulnerability it is possible to pinpoint sentinel sites for the monitoring of our national well-being. While The Conservancy can help develop practical tools, we cannot collect the early-warning data that the nation needs. We encourage the nation to invest in sentinel sites that track changes in our most vulnerable ecosystems. To do otherwise would be irresponsible. Moreover, as we develop the information systems and decision-support models, we can lead the world –other nations are hungry for the tools that we are developing.

Access to data and easy-to use decision support tools are the keys to smart choices about our future. We know how to do this – we need only to invest in expanding these efforts.