Executive Summary

This report documents results of a study commissioned by the National Oceanic and Atmospheric Administration (NOAA) to improve methods for measuring the economic values that the U.S. public places on the protection and restoration of coral reef ecosystems. The work focused on the coral reefs of Hawaii. These reefs are obviously of economic importance to both the state and the nation, yet there has been less economic research focused on the reefs of Hawaii compared to other parts of the United States, particularly Florida, in the past.

Several human activities impinge on Hawaii's coral reefs. In order to gain insights into the public's values for coral reef protection and restoration, the study focused on impacts from fishing and damage to reefs from ship accidents.

Minimizing impacts from fishing served as a case study to evaluate how the public would value steps to protect and restore reefs at the ecosystem level. More specifically, for our impacts of fishing case study, we focused on the potential value of increasing the size of no-fishing zones, a specific type of Marine Protected Area (MPA) around the main Hawaiian Islands, from the current 1% of reefs to 25%. This would be done in order to achieve broader ecosystem benefits from ecosystem protection and restoration. The figure of 25% was based on the judgment of NOAA scientists regarding a threshold where substantial benefits to fish and the larger ecosystems would start being achieved. Thus, although there is currently no proposal to increase MPAs around the Hawaiian Islands by such a magnitude, expanding no-fishing zones to 25% was a convenient, science-based case study to evaluate how much the public values large-scale coral reef ecosystem protection and restoration.

We also studied the potential value of repairing 5 acres of reefs per year damaged by ship accidents. This served as a case study of the public's values for restoring coral reefs after localized, traumatic injuries, which can result not only from ship strikes but also from relatively small, localized spills of oil and toxics and other localized pollution events. There is currently no specific proposal to repair such damage in Hawaii; NOAA scientists estimate that 5 acres is a rough, current estimate of average annual damages from ship accidents. Restoration of ship-damaged reefs would reduce recovery time by 40 years compared to natural recovery.

Recent advances in environmental economics have called attention to the possibility that people hold both direct use and passive use values for environmental resources. Direct use values stem from personal use of environmental resources and personal consumption of products derived from them. For example, people may derive value from snorkeling over a coral reef or from consuming fish produced by coral reef ecosystems. But people may also receive positive values for reasons that are not related to direct use. For example, people may value restored ecosystems

as part of their legacy to future generations. Early research involving focus groups indicated that many people from across the United States do hold passive use values for Hawaii's coral reef ecosystems. Hence, *the goal of the study was to estimate the total value – including both direct use and passive use values – for the U.S. population.*

Many services provided by ecosystems occur outside of organized markets. This is certainly true of the passive use services associated with restoration of coral reef ecosystems. Market prices are not available as a basis for estimating total values in such cases. For this reason, where passive use values are expected to be a significant component of total values, environmental economists apply so-called stated-preference (SP) methods to estimate total values. SP methods use carefully crafted surveys to quantify economic values.

The earliest and most widely applied SP method is contingent valuation (CV). A typical CV survey asks respondents about their values for one proposed action compared to the status quo. For example, a conventional CV exercise in the current context might have asked respondents about their values for expanding MPAs in Hawaii to 25% of coral reefs compared to the current 1%.

Since 1963, more than 6,000 studies involving CV have been published in the United States and other countries, including many in the peer-reviewed literature. CV – and other SP methods – are still evolving and hence continue to generate scientific discussion and research. Nevertheless, enough has been learned to gain wide acceptance of CV. It is commonly applied by a number of federal agencies. In fact, the Office of Management and Budget and the U.S. Environmental Protection Agency have published guidelines for its application in policy analyses. NOAA and the U.S. Department of the Interior have approved CV for natural resource damage assessments involving releases of oil and toxics into the environment.

In considering CV for the current study, some limitations of CV as it is usually applied became apparent. Our goal was to evaluate three alternatives: increase MPAs to 25% or repair 5 acres of ship-damaged reefs or both. Valuing more than one proposal in the same CV survey has significant potential pitfalls. Conducting three separate CV studies, each focused on one of the alternatives, also has some undesirable features.

To address these issues, we looked to the other main branch of SP methods, the so-called attribute-based methods (ABMs). In ABM surveys, respondents are presented with two or more alternatives. Each alternative is described in terms of its features or "attributes." Dollar values are included by making one of the attributes the cost of each alternative to the respondent. Several alternatives can be introduced by varying the attributes. Respondents are asked to either choose their most preferred alternative or to rank the alternatives.

As the project evolved, we were able to develop a new, hybrid SP approach that combines the simplicity of CV with the ability of ABMs to value more than one proposal in the same survey.

A second innovation was to employ internet survey technology in a way that led respondents to rank four alternatives: the status quo, expanding MPAs to 25%, repairing 5 acres of ship-damaged reefs, or doing both. A third innovation of the study was to administer the survey over the internet to two internet panels in order to evaluate the potential impact of different panel recruitment methods on the willingness-to-pay estimates.

We estimated that protection and restoration of degraded ecosystems, as exemplified by increasing MPAs in the main Hawaiian Islands to 25%, is worth about $224.81 per year to the average U.S. household. Restoration of coral reefs after localized injuries, as exemplified by repairing 5 acres of reef per year after ship strikes, is worth about $62.82 per year. This makes the estimated value of doing both about $34 billion per year when aggregated over the entire number of households in the United States.