

1. Project Title: MARINE DEBRIS FROM LAND TO SEA: HOLISTIC CHARACTERIZATION, REDUCTION AND EDUCATION EFFORTS IN NEW HAMPSHIRE

2. Project Description

This project involves a collaboration between myself and Blue Ocean Society for Marine Conservation (Director, Jen Kennedy), a local NH non-profit organization.

A recent focus of marine debris research is to identify and target pollution sources so that solutions to the problem can be developed through policy and education. This project hopes to expand upon this focus by also examining public attitudes toward marine debris and using this information with cleanup data to systematically implement and test community mitigation techniques. The objectives of this project are to:

1. Examine current community marine debris cleanup and reduction efforts in New Hampshire (as a baseline) by analyzing beach cleanup data and evaluating people's behavior,
2. Implement new community marine debris reduction efforts specifically targeted to issues revealed in the first objective, and
3. Evaluate the efforts in objective two by measuring impacts and outcomes.

4. BACKGROUND INFORMATION/STATEMENT OF THE ISSUES/PROBLEM

At 18 miles, New Hampshire's coastline is short, but that tidal coastline increases to 150 miles when the Great Bay National Estuarine Research Reserve (NERR) is included. Reduction of debris in this project includes much of the 18-mile coastline and will focus on expanding debris reduction along the lengthy coastline of the Great Bay estuary. Past cleanup years have resulted in the removal of thousands of pounds of debris from the NH coastline, and therefore there is a high potential to remove a significant amount of debris. One of the greatest contributions of will be the ability to reduce and prevent marine debris, which will occur in Objective 2. The aim of this project is to systematically examine and evaluate marine pollution data to determine how it can be used to develop the most appropriate reduction and prevention tactics. Then, those tactics will be implemented and evaluated. We expect our outreach efforts to educate thousands of beachgoers and New Hampshire residents through stimulating beach displays, interactive educational programs, and participation in the survey and actual beach cleanups.

Habitats in the Gulf of Maine, which includes the seacoast New Hampshire region, support a variety of fish and wildlife, are important to the economy, and enhance quality of life. A 1997 report by Porter Hoagland and Hauke L. Kite-Powell entitled *Characterization and Mitigation of Marine Debris in the Gulf of Maine* (<http://www.gulfofmaine.org/library/debris/gomdeb.htm>) reported on the need for increased data on marine debris and the effects of weather and other factors on the prevalence of marine debris. The report also stated that Maine and Massachusetts had received reduction of some types of waste, such as plastic bottles, while New Hampshire had not, and recommended a range of policy approaches, including targeting onshore recreationists and improving cleanup procedures and supporting research to improving understanding of the marine debris problem and investigation into optimal approaches to

controlling litter from beach visitors. Although this report was produced several years ago, there is still not a lot of information on the effects of different factors on marine debris and the optimal means of controlling litter in the Gulf of Maine and coastal areas, and we hope to contribute to knowledge in this area, thereby enhancing protection of the productive New Hampshire coast and hopefully transferring this area to other important habitats in the Gulf of Maine and beyond.

The Great Bay NERR is a part of the National Estuarine Research Reserve System (NERRS), which is a nation-wide network of state owned and managed coastal protected areas. The areas are designated and supported by NOAA, which has identified these sites as being representative of the diverse estuarine systems along America's coasts, preserving them for long-term research and management. According to NOAA, the mission of the Reserves is to promote informed management through linked programs of stewardship, public education, and scientific understanding. The New Hampshire Fish and Game Department under the Marine Fisheries Division manages the Great Bay NERR. Designated in 1989, the Reserve's primary purpose is to promote the wise use and management of the Great Bay Estuary, which encompasses over 10,000 acres of tidal waters.

According to U.S. Fish & Wildlife, the Gulf of Maine is home to many species at risk, including the piping plover, leatherback sea turtle, finback whale and humpback whale. Many of these species are also found in New Hampshire, such as the piping plover, which uses some of the beaches in this project as breeding habitat (permission has been granted to conduct cleanups in these areas). In addition, the Gulf of Maine, NH state coastal waters, and the Great Bay NERR provide habitat for a variety of commercially and recreationally-important fish and shellfish species, such as cod, striped bass, crabs, mussels and clams. As marine debris has been shown to be a threat to marine animals and seabirds, this project will contribute to protection of a number of endangered or threatened species along with economically-valuable species.

5. PROJECT DETAILS

Goals and Objectives: The objectives of this project are to

1. Examine current community marine debris cleanup and reduction efforts in New Hampshire (as a baseline) by analyzing beach cleanup data and evaluating people's behavior,
2. Implement new community marine debris reduction efforts specifically targeted to issues revealed in the first objective, and
3. Evaluate the efforts in objective two by measuring impacts and outcomes.

Target Population/Audience: New Hampshire Beach goers (general public).

Methods: The first part of the project (encompassing the first four months) will review existing marine debris monitoring data collected by the Blue Ocean Society for Marine Conservation over the past four years. Cleanups have been conducted by the organization at eleven different New Hampshire sites during this time. At each cleanup, volunteers track debris items of interest using Blue Ocean Society-provided data cards. Currently, data are stored and entered into a Microsoft Access database. As a part of this review, marine debris composition (e.g., land-based, ocean-based, primary or most pervasive components) will be mapped in Geographic Information Systems

(GIS) along with significant influencing factors such as, marinas, ports, most visited beaches, and sensitive coastal and estuarine areas. Besides mapping the marine debris quantity and composition per collection site, the powerful component to GIS is that any potential influencing data available can be tied to all of these locations. Some of the available data that may be useful in the evaluation include weather data, population density, tourist visitation estimates, water levels and currents, and water quality. The full integration of all available data will allow the researchers to examine trends and correlations in marine debris data with a myriad of potential influences.

Also in this first objective, people's attitudes and behavior toward marine debris will be evaluated using a questionnaire implemented to beach goers and residents in coastal New Hampshire areas. In particular, questions will assess respondents' knowledge of marine debris, thoughts about the debris and their particular feelings regarding marine debris disposal. Using this information, the researchers will gain knowledge on the varying reasons why people may dispose of certain types of debris over others, and in different areas. This information will serve as a tool in the evaluation, indicating which education and prevention methods may be the most effective and allowing the researchers to correlate the influence of human attitudes on the prevalence of marine debris.

Since the start of this project encompasses working with existing data, the project team can easily commence the project within a six month period. Also, since beaches that are currently monitored will be utilized for both the existing and future marine debris data, safety issues have been resolved and no new permits will be required. The state Department of Environmental Services, New Hampshire Coastal Program is the main contact/regulatory agency for this project and has expressed support for the project (see attached letter of support with the application). The contact for the Great Bay National Estuarine Research Reserve, where historical and future data will also be obtained, is Brian Smith, who has expressed support (see attached letter) for the project as well. Communications with NHCP and NERR will assure that the project will meet all federal, state and local environmental laws.

The purpose of the examination in the first objective is to allow the researchers to target marine debris reduction efforts more efficiently. For example, some of the questions that may be answered in the first objective are: there are plenty of solid waste receptacles at this beach, but why aren't people using them? Are the most heavily visited beaches the dirtiest? Do storms and weather influence the quantity or composition of marine debris? Also for example, if cigarette butts are the most pervasive component at one beach and not another, that debris component should be targeted for reduction at some beaches, but maybe not all, and perhaps monofilament fishing line is more of a problem near ports and marinas than in other areas. Although many of these questions have been asked before and often qualitatively answered, this project proposes to develop a systematic method for quantitatively evaluating (through GIS and a multi-component decision tree) where and how to most efficiently target marine debris reduction efforts.

The second objective of the project (completed within the first nine months) is to implement marine debris reduction efforts and education, which go hand-in-hand, starting at three specific locations. These actions may include cigarette butt disposal receptacles, innovative and aesthetically pleasing waste and recycling containers, monofilament line recycling receptacles, signage on trash receptacles and beaches,

displays for local science centers and information kiosks, advertisements, talks/lectures at local primary and secondary schools and UNH. The GIS mapping tool will be used to educate the community, by posting maps/signs at beaches which are cleaned. Volunteers who clean up the beach will be trained to read and interpret these maps to educate the rest of the community as well. Further details on how this project will encompass community involvement, education and outreach are provided in Section 5.

The last objective of this research (update completed in the last 4 months) is to evaluate the marine debris reduction efforts implemented in objective two. Although there are many complex variables involved in the quantity and quality of marine debris as presented earlier, the researchers will measure outcomes and impacts from objective two by continuing to monitor and analyze the marine debris data as it is collected. Trends and correlations can be taken into account in determining if marine debris reduction actually occurred at the sites where marine debris reduction efforts were implemented. This type of analysis is dynamic and evolutionary. For this project, an initial assessment will be made to see if progress occurred, and published in the final report. But this project will establish tools which would enable future mapping and evaluation, allowing the reduction and education programs to evolve to address the most pressing needs. Continued analysis and evaluation of the monitoring program will facilitate the ultimate goal of each monitoring location becoming cleaner, allowing a new location or issue to be addressed. Since marine pollution problems appear to be on the rise in this area, one of the most rapidly growing areas in the U.S., a systematic approach to pollution analysis and prevention is needed to combat the challenges the area will face into the future.

Evidence of External Collaboration and Partnership: Jen Kennedy and I submitted two proposals to NOAA that were successfully funded and have a project website: http://www.crrc.unh.edu/marine-debris/systematic_approach_reduction_efforts.htm

Expected Impact:

There are several ways that this project will deliver tangible, specific results. Data will be available from this project as to the number of cleanups conducted, number of volunteers participating, items collected, pounds of debris collected and length of coastline cleaned. We will also use GIS to pinpoint more closely debris locations, providing data on the prevalence of debris at different locations and how factors such as weather, sea conditions, coastline characteristics and beach visitation may impact the prevalence of debris in one area over another. Using the GIS analysis, we can affectively identify problem areas and prioritize different areas for further reduction techniques and outreach programs. In addition, we will be conducting a survey regarding attitudes toward the coastline and marine debris (targeting at least 500 respondents), which will give us data to offer insight into why debris is a problem in some areas and what mitigation techniques and educational tactics would most likely be used by visitors. Once reduction techniques are implemented, we will continue to use cleanup data and parameters to evaluate the effectiveness of these techniques, therefore we also hope to have results on which mitigation techniques are most effective and in what scenarios they work best (for example, if recycle bins are used but cigarette butt receptacles are not).

This project also complements and hopes to enhance existing marine debris reduction programs – we hope to be able to use the results to complement existing cleanups conducted by BOS and other organizations, expand outreach activities planned by the NH DES Beach Program, and contribute to other pollution monitoring/mitigation activities with the development of a strategic method for analyzing and mitigating marine debris that can be applicable in many areas. Although the issue of marine debris is heavily influenced by local issues, this overall method could be utilized by others to develop strategies for efficient marine debris reduction programs both nationally and internationally.

Scholarly Connection:

This research has a scholarly connection in both the engineering and social science worlds. The plan is for this research to produce two papers: one with an engineering focus (targeted at an engineering journal) with me as the primary author and Jen Kennedy as a second author, and one paper with a social science focus, with Jen Kennedy as the primary author and me as the secondary author.

4. EVALUATION PLAN

Because the partnership between UNH-BOS has proven successful with two grants funded by NOAA (one in 2006 and one in 2007), the evaluation will be determined by the publishing of the two papers mentioned above, as well as future funded proposals/projects. It is our hope that the collaboration will be a long and fruitful one.