MODELING SUCCESSFUL REGIONAL COASTAL ZONE MANAGEMENT: A CASE STUDY OF LOCAL COASTAL ZONE MANAGEMENT AT KOTOHIKIHAMA IN KYOTO

Asami Shikida, Kanazawa Institute of Technology

Abstract

Coastal zone management is seen as one of the best solutions to achieve sustainable use of the relatively undisturbed local coastal environment. Nevertheless, little attention has been given to why and how a successful coastal zone management has developed in a particular region. This case study attempts to analyze the development of regional coastal zone management in Amino-cho, Kyoto. The authors propose a circuit model that explains transformational changes in a management system by focusing on knowledge creation. The model can provide a useful, evolutionary design for adaptive management by introducing, sharing and creating knowledge autonomously. The authors believe that the model can be a unique and useful tool for designing a local coastal zone management system. This study may be the first to describe an appreciation of knowledge creation to coastal zone management development.

RESTORING HABITATS IN THE GULF OF MAINE

Kachmar, J.L., Maine State Planning Office, Maine Coastal Program
Gulf of Maine Council on the Marine Environment, Habitat Committee,
Restoration Subcommittee

Introduction

Habitat restoration in the Gulf of Maine is occurring at an ever-increasing pace. Impacts to coastal and marine habitats that may have gone unnoticed in the past are now becoming more apparent as restoration efforts become commonplace. Local communities, state and Federal governments and nongovernmental organizations are all involved with efforts to restore the functions and values of impacted habitats. Such impacts may start at the head of a coastal watershed such as a dam in a river system. Dams, for instance, can alter the flow of river systems and reduce natural habitat value by creating impoundments that act as ponds rather than flowing rivers. In addition dams, roads, or other barriers can block the passage of migratory fish that historically used the rivers for spawning purposes. Salt marshes have been significantly altered due to filling, diking, and ditching practices over the years. Additionally, the flow of the natural tidal cycle has been reduced or eliminated in many locations by roads, causeways and other development. Without regular inundation of the tides, salt marshes begin to lose the unique characteristics that provide estuaries with nutrients, cover for juvenile marine species, flood control, and recreational opportunities for people. Restoration efforts not only improve natural systems, but also promote opportunities for sustainable economic development as well as social benefits resulting from more functional habitats.

Gulf of Maine Council / NOAA Habitat Restoration Partnership

The Gulf of Maine Council on the Marine Environment and NOAA's National Marine Fisheries Service (GOMC / NOAA Partnership) are currently completing a three year partnership for restoring coastal habitat in the Gulf of Maine. During 2002 and 2003, this partnership funded 22 restoration projects in Massachusetts, New Hampshire, Maine and Nova Scotia, with another grant award planned for April 2004. The types of projects funded include pre- and post-restoration monitoring and planning; removal of tidal restrictions; and dam removal or modification allowing fish passage. In 2002, $236,469 was expended through the restoration grant program to enhance habitat in the Gulf of Maine. These grants leveraged a minimum of a 1:1 nonfederal match from local, state, or private sources, with some projects leveraging a considerable amount above the minimum. During 2003, $275,866 was granted towards restoration projects in the Gulf, again with some projects providing greater match than the required 1:1 ratio.

Restoration Projects Funded in the Gulf of Maine
2002 and 2003

State	Coastal Wetland	Riverine Restoration	Anadromous Fish Habitat*	Other	Total
Maine	3	2		1	6
Massachusetts	7	2	2	2	13
New Hampshire		1		1	2
Nova Scotia	1				1
Total	11	5	2	4**	22

* Anadromous fish habitat restoration is a primary goal of most of the coastal and riverine restoration projects. ** The four "other" categories are monitoring programs.

Regionally Significant Restoration Projects in the Gulf of Maine

The following potential restoration projects in the region have been identified by the Gulf of Maine Council Restoration Subcommittee as having regional significance within the Gulf of Maine. These sites are by no means an exhaustive listing of degraded habitats in the Gulf in need of restoration. Nonetheless, this listing of sites identifies at least one regionally significant project within each of the Gulf's five jurisdictions.

Riverine

- Penobscot River, Maine—The Penobscot River historically supported a considerable Atlantic salmon population. However, dams have impacted diadromous fish runs on the river and greatly reduced usable habitat. There is currently an agreement among interests to reduce the number of dams on the Penobscot and improve fish passage where needed to improve habitat for native fishes. This location represents an opportunity to restore a significant salmon population in the Gulf of Maine.

- St. Croix River, Maine and New Brunswick—The St. Croix presently has dams that impede diadromous fish runs as well as low water quality, resulting in highly degraded habitat. Also, riverine habitat along river has been severely altered due to past and present industrial uses of the river. This location represents an opportunity to restore a sizable river and estuary along the international boarder between the US and Canada.

- Ipswich River, Massachusetts—This highly impacted river is currently undergoing assessment for fisheries restoration. The Ipswich River is currently listed as one of the most endangered rivers in the US due to flow alteration, low dissolved oxygen and other factors.

Intertidal

- West Branch Pleasant River, Addison, Maine—The tide gate in Addison on the West Branch of the Pleasant River, in place since 1940, has restricted saltwater from reaching a nearly 2000 acre salt marsh behind the gate.

- Herring River, Wellfleet, Massachusetts--The Herring River and associated salt marshes in Wellfleet represent the largest riverine / estuarine system within the Cape Cod National Seashore. The local conservation commission is supporting a marsh restoration plan that will address a tidal restriction resulting from a dike and tide gate, taking flooding and infrastructure into consideration.

- Cheverie Creek, Cheverie, Nova Scotia—This is a highly restricted salt marsh due to an undersized road culvert. The marsh is the gateway to 30 acres of salt marsh habitat for Gulf of Maine species. This project represents a pilot for GOMC / NOAA Partnership funding for restoration efforts in Canada.

- Petitcodiac River, Moncton, New Brunswick—This tidal river system has been highly impacted by a causeway that has eliminated the influence of the tidal waters carrying sediment upstream of the structure. The upstream reach of river is impounded behind the causeway that has altered this section of river to a pond environment, disconnecting the once tidal river from the ocean. Considerable amounts of marine sediment have deposited downstream of the causeway causing an unnatural accumulation. The Avon River Causeway in Windsor, Nova Scotia, represents a similar situation in which the river has been disconnected from the ocean, altering habitat that once benefited the Gulf.

Subtidal

- Great Bay and Little Bay, New Hampshire—This area has undergone eelgrass distribution assessments to determine the extent and health of the resource, as well as a reseeding program to restore eelgrass to once productive habitat. Additional restoration efforts are needed to restore and protect eelgrass resources in Great Bay and Little Bay.

Gulf of Maine Habitat Restoration Strategy

The Council's Restoration Subcommittee is completing a Gulf of Maine Regional Habitat Restoration Strategy that identifies critical habitat in the Gulf from a regional perspective, including riverine; intertidal; subtidal; and beaches, dunes, and islands above high water. The strategy considers the need to restore habitat based on the migratory fish, birds, and mammals that utilize the Gulf of Maine during some portion of their lifecycle. The Gulf is critically important to the health of several species. As an example, most of the global population of Semipalmated Sandpipers, roughly 1 million birds, migrate through the upper Bay of Fundy in order to feed on the mudflats in New Brunswick and Nova Scotia (Hamilton and Diamond, 2000).

Restoration projects in the Gulf have been occurring as opportunities arise or based on existing organizational capacity, which may be based on socioeconomic conditions and not necessarily regional habitat needs. This unplanned approach does not facilitate consideration of the regional implications of habitat restoration. For example, what impacts will restoring a salt marsh in Massachusetts have on the migratory fish, birds and mammals that spend a portion of their lifecycle in the Bay of Fundy? Once completed, the Strategy will provide a blueprint to begin understanding the types of regionally significant habitats found in the Gulf of Maine, the resources that depend on such habitats, and a listing of potential restoration projects in each jurisdiction that will provide region-wide benefits.

The Strategy identifies policy recommendations for improving the restoration capacity of organizations in the region. These recommendations include the need to develop a detailed inventory of potential and completed restoration sites, improve the organizational capacity of governments and citizen groups to plan and implement projects, enhance education and understanding of restoration at the state and local levels, develop improved technical mapping and web resources, and create protocols for monitoring each habitat type in order to measure restoration successes and failures.

References

Hamilton, D. and A.W. Diamond (2000). *Shorebirds, Snails and* Corophium: *Complex Interactions on an Intertidal Mudflat*. In Chopin, T. and P. Wells (eds.) Opportunities and Challenges for Protecting, Restoring and Enhancing Coastal Habitats in the Bay of Fundy. Proceedings of the 4th Bay of Fundy Science Workshop, September 19-21, 2000, published by Environment Canada.

Jon Kachmar
Maine State Planning Office / Maine Coastal Program
38 State House Station
Augusta, ME 04333
Ph (207) 287-1913
Fax (207) 287-8059
jon.kachmar@maine.gov

DIFFUSION OF INNOVATION IN COASTAL MANGEMENT

James W. Good, Oregon State University

How do coastal managers learn about and apply innovative and successful processes, practices, and tools for coastal problem solving? How can the governmental and nongovernmental organizations that support them be more responsive in providing that information in useful forms and assisting in its adaptation to local situations and needs? These questions were the focus of a recent study conducted by the Heinz Center, a Washington, DC-based environmental policy organization. The Heinz Center's report—Innovation by Design—was prepared by an eleven-member committee representing government, academia, industry, and environmental organizations, and supported by Center staff (THC 2004). The author chaired the committee, but the report on which this paper is based was written collectively.

The study was commissioned by NOAA's Office of Ocean and Coastal Resource Management (OCRM), the national leader for 35 coastal states and territories eligible for participation in the national coastal zone management program. OCRM provides its clients with policy guidance, grants, evaluation, and technical assistance. The agency's principal objective for this study was to identify ways that it could enhance its technical assistance functions.

The study had three objectives. First was to clearly define the problem by documenting how coastal managers today share innovative practices in government, academic, business, and not-for- profit sectors. Second was to identify the strengths, limitations, and outlook for present information-sharing approaches. The final objective was to identify ways to improve information sharing and learning, drawing on the experiences of those within and outside the coastal management community. Study methods included the collection of data through structured interviews with coastal managers; a coastal manager workshop, designed to explore questions raised in the survey in more depth; and a review of the literature and what similar communities of practice were doing to address these issues. Case examples of innovative practices and information-sharing techniques were used to illustrate study findings.

How Coastal Managers Learn Today

When coastal managers need to learn about innovative practices and problem solving elsewhere, they cast a broad net. New and evolving technologies such as the Internet, the World Wide Web, and powerful search engines like Google® play an increasingly important role in this process. However, tapping into personal and organizational networks is even more important. Coastal managers seek out those they know and trust first—people and organizations that are part of their personal networks. Often, client coastal managers seek information

about innovative approaches from their program sponsors. Although logical, this "stovepipe" approach may inhibit the flow of innovative ideas among similar programs elsewhere. Coastal managers also seek information from organizations whose raison d' être is to provide data, technical assistance and outreach services—university-based Sea Grant extension programs and the NOAA Coastal Services Center were often-cited examples.

What drives diffusion and adaptation of good ideas in coastal management? Public policy is one important driver—examples cited included EPA's National Estuary Program and NOAA's 1990 Coastal Zone Enhancement Grants Program. Conferences, like those of The Coastal Society and the biennial Coastal Zone meetings, build and sustain the formal and informal networks and personal relationships that are so important for information sharing, not just during the events, but for years afterwards. More focused workshops are important as well, but here more in-depth, specialized learning takes place.

Looking ahead, coastal managers envisioned significant changes in how they learn about and apply new ideas to solve increasingly complex problems, mostly in the role that technology might play. They also see the need to maintain and strengthen traditional mechanisms for information and innovation transfer—conferences and targeted workshops for example, but also more and better use of new networking technologies, such as video conferencing and Internet streaming. Coastal managers would like to see a reliable consulting service available as well, with technical assistance to adapt and tailor ideas to their particular situations. Information purveyor networks—Sea Grant, the Coastal Services Center, and Estuarine Research Reserves—will remain vital and play some of the roles noted above, but will need to be better integrated across agencies, organizations, and levels to be most effective. Coastal managers also noted barriers and constraints to optimizing the development and diffusion of innovations in coastal management practice. Major problems that need to be addressed include information-overload, the "stovepipe" problem noted earlier, limited resources for travel to conferences and workshops, the risks of experimentation, and bias against reporting on failures.

Learning Networks and Coastal Management

Networks are ubiquitous in all collective human endeavors. In coastal management, there are hundreds, perhaps thousands of networks, often self-organizing and sustaining. Some networks are about issues like natural hazard mitigation or habitat restoration, and are inherently multidisciplinary. Other networks are based on professional identities and training; thus we have disciplinary organizations for planners, engineers, or wetland ecologists. Sectoral networks, based on broad institutional networks, are another type—fishing industry organizations or government agencies concerned with pollution control are examples. Political networks of all varieties operate in the coastal management as well, attempting to affect public policy and promote agendas.

Political networks overlap considerably with other kinds of networks. Issue networks, for example, are usually strongly linked to particular problems and policy solutions. Virtually all of these networks have learning as one of their principal functions—thus the term 'learning networks'.

Distinctions can be drawn among learning networks by their structure, purpose, membership, formality, type of governance, and other features. Recognizing and transferring useful innovations and information to others, and learning about, acquiring, and adapting or tailoring the innovations of others, are key functions of an effective learning network. But they are not necessarily simple functions. They often require the time and energy of a network's most experienced, savvy members. Learning network members need to be able to understand the importance of context to the successful adaptation of an innovation. They need to be aware of the substitutability of institutions (or otherwise) from one location to another, the resources needed to transfer an innovation, and the relative complexity of both the innovation and the transfer process.

Coastal management has many networks in place and most probably function fairly well with respect to innovation—learning, adapting, and sharing ideas and information. However, few have been seriously examined for their ability to serve as true learning networks, as characterized in the Heinz report. Most coastal management organizations address innovation issues intuitively, that is, in an ad hoc, haphazard manner, unconscious of their role as a learning network. Although this seems to work at some level, it is intriguing to imagine what a more conscious, deliberate approach to building effective learning networks within the coastal management community might accomplish. The continuing rapid development of information technologies makes such an approach feasible. The significant coastal problems we face also make it attractive.

Technology and Coastal Management

The practice of coastal management is being transformed by remarkable developments in advanced communications, and information and remote sensor technologies. The Internet, the World Wide Web, data processing and visualization tools like GIS, real-time observing systems, and other technologies enhance learning and even create new methods for learning. The resulting explosion in the numbers and types of learning networks available to coastal managers, and the deluge of information—some relevant and useful to coastal problem solving, much of it not—has evoked a variety of responses. Some coastal managers and organizations have embraced the new technologies, while others have tried to turn down the volume, creating personal and virtual firewalls. The challenge for coastal managers is to incorporate these new technologies into their existing learning networks in ways that enhance, rather than degrade, the learning and information sharing process. This will require much more attention to the interfaces between people, organizations, and new technologies. Although the direction of technological change is impossible to

predict, the advent of wireless communications, artificial intelligence, software agents, and ever-increasing computing power will continue to transform the practice of coastal management. Suitable governance arrangements for the use of technology and the documentation, processing, and use of coastal data and information will be needed.

Study Recommendations

Many opportunities exist for improving the learning potential of the myriad networks that comprise the community, and these opportunities are expanding daily as technology changes. However, barriers and constraints need to be removed to take fuller advantage of these opportunities. Incentives to generate and accurately document innovative practices are needed. Standards are also needed, so that best practices can be validated as accurate and dependable. More concerted attention to diffusion of innovations is also needed, with provisions for collecting, for facilitating the searching process, and for adapting and tailoring to local contexts. The recommendations below address these and other issues the Heinz committee identified in its report. They represent a beginning set of ideas to move coastal management practice toward a goal of being 'innovative by design'—where learning through our myriad networks is fully integrated into organizational cultures and individual practice.

Recommendation 1. Strengthen existing coastal management learning networks. We recommend that the NOAA Coastal Services Center, in collaboration with ORCM, EPA, Sea Grant, and academic programs in marine affairs and policy, develop a training program for coastal management leaders that emphasizes knowledge-based problem solving and the roles of learning networks in the innovation process.

We further recommend that the NOAA Coastal Services Center investigate and begin the establishment of a conscious, multi-nodal learning network for identifying, documenting, validating, collecting, searching for, and tailoring best coastal management practices to local contexts (See Recommendation 5).

Recommendation 2. Increase the use of communication technology for real-time, distributed workshops and conferences. We recommend increased experimentation with the design and execution of large-scale video conferencing to expand the audience and access to national conferences and workshops on coastal management practice. Specifically, we recommend that national coastal management agencies—NOAA, EPA, and others—work with their local clients to develop a five-year plan for advancing the use of current and emerging communication technologies in new, modified, or expanded learning networks.

Recommendation 3. Institutionalize a learning process about technology-coastal management interactions. Rapid advances in communication, information, and sensor technologies have both predictable and unpredictable implications for the

practice of coastal management. We recommend that the NOAA Coastal Services Center, OCRM, EPA, and Sea Grant collaborate to establish and deliver a workshop series on Coastal Management and Emerging Technologies. A bi- or triennial event is envisioned, bringing together practicing coastal managers (and their information needs and desires), applied coastal management technologists (e.g., CSC staff), and pure technologists. Themes might differ from workshop to workshop, but the general purposes would be to learn from one another, match needs and desires with potential technological solutions, develop pilot project proposals, develop diffusion strategies for pilot-project-proven technology applications, and so on.

Recommendation 4: Expand coastal management personnel cross-training to broaden mutual understanding of coastal management problems, practices, and use of technology. We recommend that NOAA, EPA, and other federal coastal agencies, in collaboration with the Coastal States Organization, and nongovernmental organizations, expand the use of the federal Intergovernmental Personnel Act (IPA) in the field of coastal management to include professionals from states, local government, NGOs, academia, industry, and others who might be eligible. A guide to IPA opportunities in coastal management should be developed and a program established to coordinate short-term assignments. Transfers should be two-way, ideally switching specific jobs.

Recommendation 5. Develop and manage a compendium of case examples and studies of best coastal and ocean management practices, supported by network of experts. We recommend that NOAA, in collaboration with multiple partners, establish a compendium of peer-reviewed case studies of innovative and/or successful coastal management practices—best coastal and ocean management practices or BCOMPs. Specific mechanisms for establishing this new learning network, a proposed structure, and other issues are addressed in the full report.

References

The Heinz Center (THC). 2004. Innovation by design: Improving learning networks in coastal management. The H. John Heinz III Center for Science, Economics, and the Environment. Washington, DC.

James W. Good
Professor, College of Oceanic and Atmospheric Sciences
Oregon State University
104 Ocean Admin Building
Corvallis, OR 97331-5503
Ph (541) 737-1339
Fax (541) 737-2064
good@coas.oregonstate.edu; jwg4@yahoo.com

MAPPING SOCIAL CHANGE IN U.S. COASTAL COUNTIES: A SOCIAL ATLAS OF COASTAL NORTH CAROLINA

Thomas E. Fish, NOAA Coastal Services Center
Rhonda H. Crawley, Perot Systems Government Service, NOAA Coastal Services Center
Jack F. Thigpen, North Carolina Sea Grant Program

Introduction

Coastal areas across the United States are changing, in terms of both their natural and cultural environments. The people that live and work in coastal communities are struggling to adapt and survive amidst such changes. At national, regional, state, and local levels, policy makers and resource management agencies are challenged with developing programs, regulations, and incentives to optimize the coast's human, economic, and environmental well being. To accomplish these tasks, decision makers need information about past and present conditions, changes over time, potential future conditions, and implications of social change to quality of life.

This presentation describes a project to examine social change in twenty North Carolina coastal counties. The project uses the "human ecosystem" model as an organizing framework for assessing changes related to population, demographics, housing, socioeconomics, and natural resources in coastal counties across time and space. Data were compiled in a geographic information system (GIS) to analyze and depict static past and present conditions and changes over the past thirty years for select social indicators. The final product consists of a social atlas for North Carolina coastal counties, which includes descriptions of social indicators, maps of conditions for 1970, 1980, 1990, 2000, and changes from 1970 to 2000, case studies illustrating changes in select coastal communities, and a CD-ROM with data resources and a catalog of digital social change maps.

Background

The complexion of the coast is changing. Yet, the changes to physical and cultural landscapes are not homogeneous. The natural amenities found at the coast (e.g., water, beaches) draw increasing numbers of new people to coastal areas each year. Rapid residential and commercial development has transformed the landscape in some areas as more and more people choose to make the coast their home. In some cases, the growth rate has been as much as three times the national average (Clark 1996). In other areas, participation in a wide variety of coastal and aquatic leisure activities and the associated advancement in equipment technologies place increased pressure on coastal ecosystems and coastal communities. Some areas have experienced continually

declining populations, with outmigration of resident youth and attendant loss of labor as family farms and resource-dependent industries disappear or are transformed into large-scale operations. Changes in the composition of the resident and seasonal populations often result in a loss of social capital and original community character, transformation of natural landscape features, and displacement of long-term residents, businesses, and traditional user groups. These changes create new challenges for natural resource managers and other decision makers.

This project used key social attributes as indicators of changing social conditions. Social indicators are typically statistics measured over time to inform policy and management decision-making. The social indicators included in this pilot effort are aligned with components of the Human Ecosystem Framework (Force and Machlis 1997; Machlis, Force, and Dalton 1994; Machlis, Force, and Burch 1997). The human ecosystem framework relates strongly to a holistic ecosystem-based management framework where people and resources (both biophysical and sociocultural) are contained within a given spatial or temporal extent. The selected indicators used here represent examples of the "critical resources" included in the human ecosystem framework (Figure 1) to demonstrate how changes in the human ecosystem can be explained by monitoring key indicators over time.

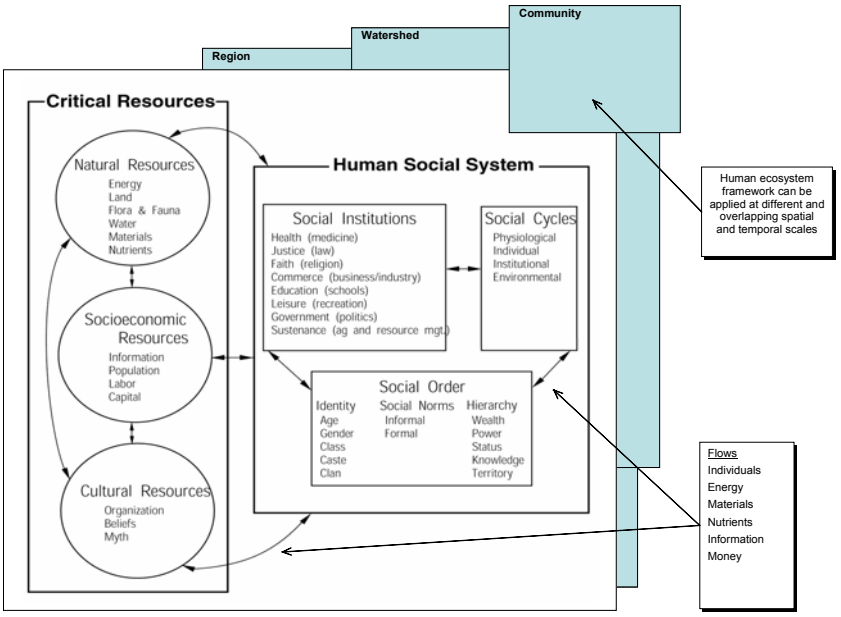

Figure 1. Human ecosystem model (adapted from Machlis, Force, and Dalton 1994).

"Social indicators can be effective in presenting the 'basic facts' about the people of a region. Such basic facts are important to ecosystem management, and can be used in many ways: assessing the potential impact of government policies, developing effective resource management plans, increasing public involvement in the planning process, and so forth. Like measures of water quality, wildlife populations, or timber supply, social indicators provide managers and citizens with information needed to make sound decisions concerning public resources" (Machlis, Force, and McKendry 1995, page 2).

Social Atlas

Recognition of change is often based on personal observations and anecdotal evidence, however the change that occurs over time can be difficult to visualize on a day-to-day basis. While much data exists concerning various aspects of the social environment (e.g., U.S. Census of Population and Housing, National Social Survey), much of the information necessary to assess social change can be spatially and temporally fragmentary, site- or time-specific, and disparate in content and format. One useful method to help visualize the change occurring along our nation's coasts is to depict changes in various social indicators in a social atlas.

The social atlas approach uses a GIS to organize, analyze, and present data about social conditions. Data are presented in the form of choropleth maps with gradations in color to depict ranges along a scale of values. This format allows decision makers to visualize information for specific geographic areas (e.g., counties) and uncover patterns of change across geographies. Some studies have used this approach to present social indicator data for specific areas (Machlis, Force, and McKendry 1995; SAMAB 1996), but few have compared conditions over time to represent changes and trends or identify unique patterns of change (McKendry, Novak, and Machlis 2003; Davis and Radtke, 1994). As more agencies operate under a system of ecosystem-based and ecoregional management, considerations of the changing social environment are critical to effective management. This information can be used to identify specific community needs and issues to help inform planning and program development.

Methods

For this project, a GIS was created for the twenty North Carolina coastal counties that are under the jurisdiction of the North Carolina Coastal Area Management Act (CAMA) of 1974. North Carolina coastal counties serve as a pilot for this approach. Data are presented for the twenty CAMA counties for each decadal census as well as changes from 1970 to 2000. Case studies illustrating changes in select attributes are also included for subsets of counties. The GIS was constructed using Environmental Systems Research Institute's (ESRI) ArcView version 3.2. Data for the GIS comprised data compiled chiefly from the U.S. Census of Population and Housing from 1970, 1980, 1990, and

2000. Land cover changes for the project were calculated using 30-meter resolution NOAA Coastal Change Analysis Program data from 1991 and 1997. Calculations of land cover change are presented for a suite of counties containing barrier island components to illustrate areal losses in specific land cover classes.

Virtual Regions

Coastal Communities and Economies is one of the central themes for the National Sea Grant Program. This theme focuses on the balance between maintaining and protecting environmental quality and fostering sustainable economic growth toward improved quality of life. Staff from state Sea Grant programs across the country work to enhance coastal communities through partnerships, technical assistance, and technology transfer related to coastal population growth and "communities in transition." While the knowledge and expertise within the Sea Grant community is extensive, identifying potential collaborations across programs to work together to address coastal development problems can be difficult. Even at the regional or state level, variability in social changes across coastal counties presents similar challenges related to location and availability of Sea Grant staff expertise and experience to address particular issues. This project looks at patterns of change to identify commonalities across variables and geographic areas to identify "virtual regions."

The virtual region concept and practice relies on thematic rather than geographic delineations; that is, the virtual region may consist of numerous counties with common issues and needs, but no common political boundaries. This approach is used to examine common threads across counties and minor civil divisions to identify patterns of change. The virtual region concept originated, and is currently practiced, in the form of cross-border networks of cities and trade markets to facilitate inter-municipal decision-making and exchange of experiences and information (Boisier 1993). In central South America, the Mercociudades network, beginning with a membership of eleven cities in 1995, now comprises the common interests of seventy-nine cities in Argentina, Bolivia, Chile, Paraguay, and Uruguay (URB-AL/INFO 2001).

The handbook includes descriptions of the social indicators and maps depicting changes in each indicator from 1970 to 2000. In this North Carolina example, virtual regions represent networks of constituent groups—cities, counties, or communities—based on common issues or needs arising from social changes in coastal counties. Identification of common issues across counties can aid Sea Grant staff and allied decision makers in information exchange and program planning to address specific constituent needs.

References

Boisier, S. 1993. "Post-modernismo territorial y globalización: Regiones pivotales y regiones virtuales." Serie Ensayos. Documento 93/19. Chile: ILPES.

Clark, J. 1996. Coastal Zone Management Handbook. New York: Lewis Publishers.

Davis, S. W., and H. D. Radtke. 1994. A Demographic and Economic Description of the Oregon Coast. Salem, OR: Oregon Department of Land Conservation and Development.

Force, J. E., and G. E. Machlis. 1997. "The human ecosystem, part II: Social indicators in ecosystem management." Society and Natural Resources. Volume 10. Pages 369 to 383.

Machlis, G. E., J. E. Force, and W. R. Burch, Jr. 1997. "The human ecosystem, part I: The human ecosystem as an organizing concept in ecosystem management." Society and Natural Resources. Volume 10. Pages 347 to 367.

Machlis, G. E., J. E. Force, and S. E. Dalton. 1994. Monitoring Social Indicators for Ecosystem Management." Moscow, ID: University of Idaho. Available online: <http://www.icbemp.gov/science/machlis.pdf>

Machlis, G. E., J. E. Force, and J. E. McKendry. 1995. An Atlas of Social Indicators for the Upper Columbia River Basin. Moscow, ID: University of Idaho.

McKendry, J. E., A. J. Novak, and G. E. Machlis. 2003 A Socioeconomic Atlas for the Blue Ridge Parkway and its Region. Washington, DC: National Park Service.

Southern Appalachian Man and the Biosphere (SAMAB). 1996. "The southern Appalachian assessment: Social/cultural/economic technical report." Atlanta, GA: U.S. Department of Agriculture, Forest Service, Southern Region.

URB-AL/INFO. 2001. "When networks are holding hands." URB-AL/INFO. Number 14 (July-September). Page 7.

Thomas E. Fish
Human Dimensions Specialist
NOAA Coastal Services Center
2234 South Hobson Avenue
Charleston, SC 29405
Ph (843) 740-1271
Fax (843) 740-1313
Email: Tom.Fish@noaa.gov

BALANCING VISITOR USE WITH RESOURCE PROTECTION IN COASTAL AND MARINE PROTECTED AREAS

Thomas E. Fish, NOAA Coastal Services Center
Theresa G. Coble, Stephen F. Austin State University

Introduction

Most of the world's population lives within the coastal zone. In the contiguous United States, this represents more than half of the population; yet an estimated 99 percent of the U.S. public relies on the provision of public (or private) access to the coast. Growing demand and participation in outdoor leisure activities and advancement in recreation equipment technologies create increased pressure on coastal and marine ecosystems and their representative protected areas. As more people choose to live, work, and play along our nation's coasts, coastal and marine resource management professionals are challenged with balancing the changing demands of the public with the management of the resources under their care. Success in this delicate balancing act is aided by the use of consistent, systematic, and collaborative decision-making tools. In the absence of such tools, management decisions surrounding visitor use are often fragmented, reactionary, and less defensible.

This presentation describes efforts related to a series of training workshops conducted to equip coastal resource management professionals with a process for managing visitor use at coastal and marine protected areas. The process includes steps to identify, plan for, manage, and monitor visitor use and its associated biophysical and social impacts. To date, the workshops have been offered in eight coastal states and territories. The workshops have provided a mechanism for introducing the visitor use management process, and for identifying visitor use management issues in different regions of the country to inform the development of a companion visitor use management handbook for coastal management professionals.

Initial impetus for the workshops came from needs expressed by the coastal management community--both directly to the authors and through various data collection mechanisms (e.g., needs assessments, surveys). Additional impetus came from the recent redevelopment of a visitor use management handbook that presents visitor use planning frameworks and management methods, originally developed for terrestrial protected areas (e.g., national parks, national forests), in a coastal environment context.

Workshop Components

The workshop presents a process that includes problem identification and problem specification, identification of measurable indicators of visitor use and

associated impacts, selection of management strategies and tactics to address particular unacceptable visitor use impacts, and the development of management action implementation and monitoring plans.

The problem identification portion allows participants to reflect and articulate the various visitor use issues facing their particular protected area or region. Open discussion relevant to the identified issues often ensues and aids in the prioritization of issues. Priority issues are used in the workshop to allow participants to apply the process to their specific scenarios. The problem specification exercise guides participants through a series of steps to specify the exact scope of the problem and its attendant impacts to the resource and to other visitors' experiences. This is the point where the nonspecific problem "dogs" is transformed into the more clearly defined problem of "noncompliant behavior on the part of dog owners at the beach during plover nesting season." Another part of this exercise is listing the presumed root causes of the impacts, identifying measurable indicators that can be used to gauge the severity of impacts, defining standards, or minimum acceptable conditions, and a rating of current conditions.

The management strategy and tactic selection exercise allows participants to determine what management actions could be employed to address the situation. The management strategies comprise five key strategies to address unacceptable impacts to resources and visitor experiences: (1) modify the character of visitor use by controlling where use occurs, when use occurs, what type of use occurs, and how visitors behave; (2) modify the resource base by increasing resource durability or maintaining/rehabilitating the resource; (3) increase the supply of recreation opportunities; (4) reduce use in the entire area or in problem areas only; and (5) modify visitor attitudes and expectations (Anderson, Lime, and Wang 1998).

The management tactics comprise more than two dozen actions in five categories, including: (1) site management (e.g., providing facilities and structures, use of physical barriers, closing areas or facilities); (2) rationing and allocation (e.g., limiting access using reservations, limit access using merit/eligibility system, charge fees); (3) regulations (e.g., restrict access to specific locations [zoning], restrict/or prohibit particular activities, limit allowable trip duration); (4) deterrence and enforcement (e.g., provide signs, sanction visitors who engage in noncompliant behavior, provide law enforcement personnel); and (5) visitor education (e.g., educate visitors about appropriate behaviors, develop visitor codes of conduct, certification programs).

Once management actions are selected, they are evaluated in terms of effort, cost, and expertise relative to the degree of improvement of the problem. To further aid selection, additional selection criteria questions are used pertaining to the benefits and limitations of particular management actions. For example, does

the action to alleviate one impact result in a new impact or a whole new problem?

Once the management tactics are pared down, management implementation and monitoring plans can be created to use as springboards for action. These are meant as a rough guide to the implementation of specific actions, with descriptions of timelines, personnel, budget, and equipment needs. This exercise enables participants to see how the process would look on the ground.

Implications

Effective management of growing visitor use and tourism is becoming a mainstream concern for many coastal and marine protected areas. A systematic process for measuring the level of use and impacts is needed. Adoption of such a process that employs indicators and standards at a local or regional level can aid decision making and decision defensibility as well as provide a framework for long-term monitoring of impacts and adaptive management. The workshops have been well received and continue to raise new visitor use management issues. The visitor use management handbook will include a number of different marine and coastal scenarios based on issues identified during workshops held in different regions of the U.S. and exemplify different management agencies and associated management goals. The handbook will be available in late 2004.

References

Anderson, D. H., D. W. Lime, and T. L. Wang. 1998. Maintaining the Quality of Park Resources and Visitor Experiences: A Handbook for Managers. TC-777. St. Paul, MN: University of Minnesota Extension Tourism Center.

Thomas E. Fish
Human Dimensions Specialist
NOAA Coastal Services Center
2234 South Hobson Avenue
Charleston, SC 29405
Ph (843) 740-1271
Fax (843) 740-1313
Email: Tom.Fish@noaa.gov

WORKSHOP

THE ECOLOGY OF GOVERNANCE: INTERGOVERNMENTAL ASPECTS OF ECOSYSTEM MANAGEMENT

Tim Hennessey, University of Rhode Island

This panel will focus on the intergovernmental requirements of coastal ecosystem management. Mark Imperial from the University of North Carolina at Wilmington will give a paper entitled "Expectations and Reality: Making Watershed Management Work" which examines the challenges of controlling nonpoint source pollution in a watershed context through an analysis of the implementation of the 6217 program. Tim Hennessey from The University of Rhode Island will deliver a paper entitled "The Paradox of Watershed Management" which examines the efforts in the Chesapeake Bay Program to deal with nonpoint source pollution from agricultural sources. Lawrence Juda from the University of Rhode Island will give a paper which focuses on "Governance Designs for Large Marine Ecosystems."

Tim Hennessey
Dept. of Political Science &
Coastal Resources Center
University of Rhode Island
Kingston, RI 02881
Hennessey@uri.edu

TECHNIQUES FOR RAPID ASSESSMENT OF POPULATION DENSITY AND BODY SIZE OF THE LAND CRAB *CARDISOMA GUANHUMI* (LATTREILLE, 1825) IN PUERTO RICO

Yogani Govender and Concepción Rodríguez-Fourquet,
University of Puerto Rico

Abstract

Crab population status inferred from fisheries statistics of the Department of Natural and Environmental Resources in Puerto Rico indicates declining numbers for the land crab *Cardisoma guanhumi* since the 1960's (Matos, 1997). Available information for this species in Puerto Rico has focused only on its biology and economic importance (Feliciano, 1962). In order to determine the status of *C. guanhumi* populations in Puerto Rico, a rapid assessment technique was required. In this study we compared two techniques, a burrow count method and trapping method, in order to assess the potential of burrow counts as a reliable rapid assessment technique for estimating population density. Furthermore, we investigated the relationship between burrow width and biometric variables (carapace width, carapace length, crab weight, and pellet width) to determine population structure of *C. guanhumi*. Within six sites, 112 crabs were trapped and 108 burrows counted, population estimates were 0.19 crabs / m^2 and 0.18 burrows/ m^2 respectively. Our results showed no significant difference in estimating population size using the different sampling methods. Size class distribution using carapace width and burrow width was unimodal, dominated by individuals of size class 50-60 mm for both methods used. There was no significant difference in determining crab size using carapace width and burrow width. We showed that the burrow count method and burrow width measurements provides sufficient information about population size and structure to be useful for resource managers and biologists interested in monitoring *C. guanhumi* populations in Puerto Rico.

Introduction

Crab population status inferred from fisheries statistics of the Department of Natural and Environmental Resources of Puerto Rico indicates a decline in numbers for the land crab *Cardisoma guanhumi* since 1960's (Matos, 1997). Few comprehensive studies are available for this species in Puerto Rico. Available information has focused on its biology and economic importance (Feliciano, 1962) and the impact of harvesting on declining population numbers (Rodríguez-Fourquet, unpublished). Both of these studies used trapping methods and were restricted to a few sites, thus providing limited information about the population status of *C. guanhumi* for the island of Puerto Rico. In this study we compared two methods, burrow counts and trapping, in order to assess the potential of burrow counts as a reliable rapid assessment technique for

estimating population density of *C. guanhumi* for Puerto Rico. Furthermore, we investigated the relationship between burrow width and biometric variables (carapace width, carapace length, crab weight, and fecal pellet width) to determine population structure of *C. guanhumi*.

Methods

Study Sites

Six sites were used around Puerto Rico to trap crabs from August to October 2002, a period when crabs are most active (Feliciano, 1962) (Fig. 1). A 100 m^2 plot was set up in each of the sites in areas inhabited by land crabs.

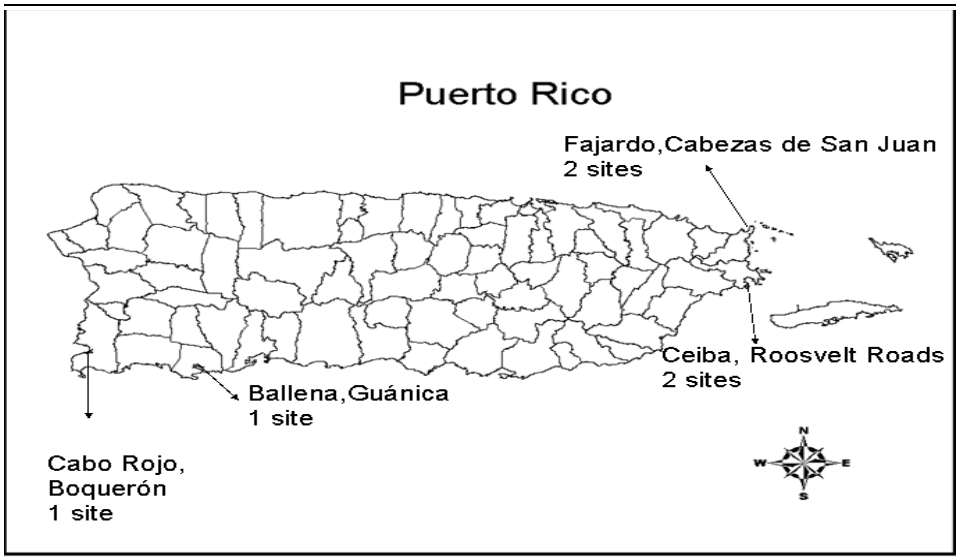

Figure 1: Six study sites in Puerto Rico where different methods for population estimates were tested

Burrow Count

Since other studies showed that counting all burrows within a specified area overestimated population size (Green, 1997), we randomly selected 10 x 1 m^2 quadrates within a 100 m^2 plot in each of the six sites, to estimate population size of crabs. Within each 1 m^2 plot the total number of burrows was counted. Burrows were categorized as having or not having fecal pellets. Fecal pellets are indicative of an occupied burrow. Burrow count was done only once per study site.

Trapping Methods
We placed PVC traps in all burrows larger than 4 cm in diameter within the 100 m^2 plot. Traps were left for 14 to 18 hours; trapping was done only once at each site. The total number of crabs trapped was recorded and the following biometric measurements were taken using a caliper and a Pesola macroline spring scale: carapace width (mm), carapace length (mm) and weight (g). Burrow width (mm) and fecal pellet width (mm) were measured for each crab trapped. Pellet width was added to the biometric variables measured to test if it was related to the size of the crab.

Non-parametric statistics were used to determine differences in the two methods used. Crab population density per m^2 was first calculated and a Mann-Whitney U Test was used to compare population density estimate between the two sampling methods. Linear regressions were used to determine the precision of the population estimate for total burrows counted, burrows with fecal pellets and burrows without fecal pellets.

To compare size structure, we used burrow width and carapace width of only the crabs trapped. Size structure was compared using two-sample Kolmogorov-Smirnov test. Linear regression analysis was used to test for the relationship between burrow width and biometric variables (carapace width, carapace length, crab weight, and size of fecal pellets).

Results

Estimating Population Density
A total of 486 traps were placed during the study (Table 1). A total of 112 crabs (100 m^2) were captured using trapping method (trapping efficiency of 23 %) and a total of 108 burrows (10 x 1 m^2) were counted within the six sites.

Table 1: Population density of *Cardisoma guanhumi* using counting burrows and trapping method in 100 m^2 plots for six sites in Puerto Rico.

Sites	Total # of traps placed in 100 m^2 plot	Total # of crabs trapped (per)	Total # of burrows with fecal pellets	Total # of burrows w/o fecal pellets	Total # of burrows counted (crab/ m^2)
Boquerón	137	28	26	17	43
Ballena	42	12	4	8	12
Fajardo 1	54	6	4	3	7
Fajardo 2	163	50	22	8	30
Roosevelt 1	36	8	7	3	10
Roosevelt	54	8	6	0	6

2					
Total	486	112	69	39	108
Mean (± SD)	81 (54.5)	18.6 (17.3)	11.5 (9.9)	6.5 (6.0)	18 (15.1)
Popn Est. Crabs/ m^2		0.186crabs/ m^2	0.115crabs/ m^2	0.065crabs/ m^2	0.18crabs/ m^2

Two burrow count methods, total burrows with fecal pellets and total burrow count, were significant in predicting population size when compared to trapping method. However in the linear regression analysis burrow count with fecal pellet was more precise.

The linear regression for population estimate (PE) using trapping methods and the different burrow methods was: PE = 3.0458 + 0.7358 * Total burrows counted ($r^2 = 0.7678$, p= 0 .0220) and PE = 2.9779 +1.1468 * Total burrows with fecal pellets, ($r^2 = 0.8315$, p = 0.0113). Burrows without fecal pellets was not significant in the regression analysis ($r^2 = 0.332$, p = 0.2602).

Population Structure

The average burrow width for the 112 individuals captured in the six sites was 60.2 mm (SD± 21.28). The average carapace width and length was 56.4 mm (SD± 15.44) and 46.6 mm (SD± 12.66) respectively. The average weight was 117 g (SD± 76.2). Size distribution was unimodal for both carapace width and burrow width of all crabs trapped, with greatest number of individuals occurring

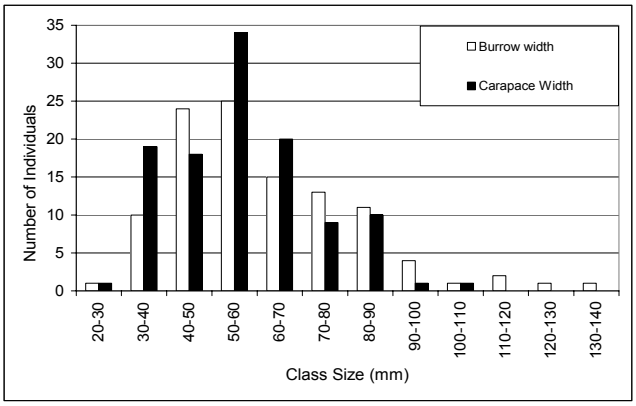

Figure 2: Size frequency distribution for *C.guanhumi* using carapace width for the trapping methods and burrow width for the burrow count method, in six study sites in Puerto Rico.

in the 50 mm to 60 mm size range. Both methods measured equal number of individuals in the size range 20 mm to 30 mm but the burrow count method recorded a greater number of individuals that were larger than 90 mm in size

(Fig. 2). The two size frequency distributions are not significantly different (two sample Kolmogorov-Smirnov test, z = 0.761, p = 0.9436).

Relationship Between Burrow Width And Biometric Variables
There is a significant positive correlation between biometric variables, carapace width and carapace length, weight and burrow width. There was no significant relationship between pellet width and other biometric variables. Therefore, pellet width was not used in the regression analysis to predict crab size. Since carapace width, carapace length and weight are auto-correlated, only carapace width was used in the regression analysis. In the regression analysis, carapace width explained 89 % of burrow width variability (Fig. 3).

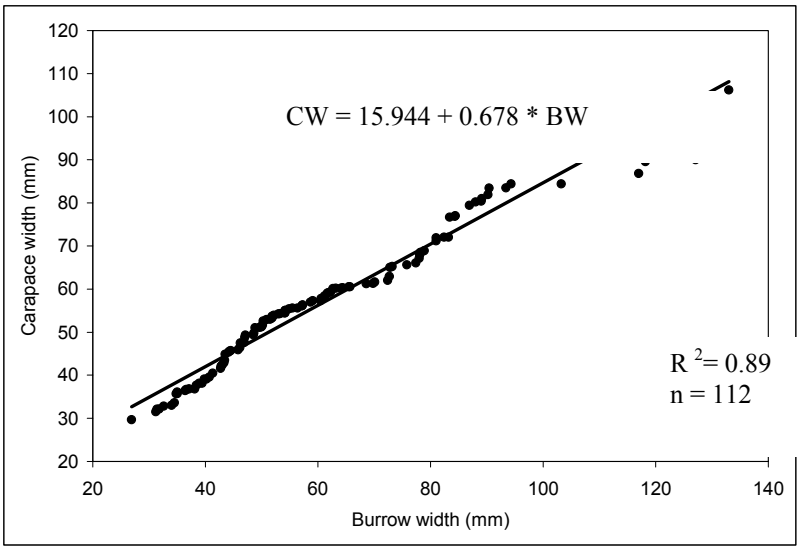

Figure 3: Linear regression analysis of burrow width (mm) with carapace width (CW) for *C.guanhumi* in six study sites in Puerto Rico.

Discussion

Our study shows that counting burrows with fecal pellets provided the most reliable estimate of population size and thus can be used as a rapid assessment technique to estimate of population density of *C. guanhumi* in Puerto Rico. Fecal pellets are reliable indicators that an active crab inhabits the burrows. Burrows with no fecal pellets present in the population are considered uninhabited. We think that these burrows are abandoned due to collapsing, migration or harvesting by humans.

C. guanhumi is found in coastal areas with other crab species such as *Ucides cordatus*. The burrows of *C. guanhumi* are not confused with burrows of, *U.cordatus* because *U. cordatus* rarely or never enter fresh water. Also *U.cordatus* burrows are found in low lying land or along muddy banks of

estuaries while burrows of *C. guanhumi* are found on the drier margins of muddy soils close to mangrove areas, river banks in coastal and subcoastal areas (Chace and Hobbs, 1969).

When *U. cordatus* and *C. guanhumi* overlap in the wetter and muddy margin of a mangrove forest usually dominated by *Rhizophora mangle,* burrows of *C. guanhumi* are easily distinguished by the presence of a mound of dirt found on the sides of the burrow which is absent for *U. cordatus* (Burggen and McMahon, 1988). When estimating population density by counting burrows with fecal pellets near the margins of the wettest and muddiest areas of mangroves, care must be taken to ensure that the burrow belongs to *C. guanhumi*.

Our method of measuring burrow width allows for a reliable estimate of crabs size frequency distribution in the population. Size frequency distribution reflects effects of continuous recruitment, constant mortality rates and behavioral differences in a population (Diaz and Conde, 1989). A similar study done on Christmas Island with *Gecarcoidea natalis*, a closely related species (Green, 1997) confirms the relationship between burrow width and carapace width. Furthermore the study uses carapace width to determine changes in the biomass of the population. Thus, gaining information on size frequency distribution is important for the management of natural populations and decision making.

Acknowledgements

The authors want to acknowledge the following people for their contributions to this work: Dr. A. Sabat (Department of Biology, University of Puerto Rico Rio Piedras), Miguel Figuerola (Fisheries Laboratory, DNER), Vanessa Torres and Monica Aymat, undergraduate students. Further we would like to thank the following institutions for funding this project: the Department of Biology, and the AGEP Program, University of Puerto Rico Rio Piedras.

References

Burggren, W. and B.R. McMahon. 1988. Biology of Land Crabs. Cambridge University Press. New York.

Chace, F. Jr. and H.H. Hobbs, Jr. 1969. The freshwater and terrestrial decapod crustaceans of the West Indies with Special Reference to Dominica. Smithsonian Inst., U.S. Natl. Mus. Nat. His. Bull. 292

Diaz H. and E. Conde. 1989. Population dynamics and life history of the mangrove crab *Aratus pisonii* (Brachyura, Grapsidae) in a marine environment. *Bul. Mar Sci*. 45(1): 148-163.

Feliciano, C. 1962. Notes on the Biology and the economic importance of the land crab *Cardisoma guanhumi* (Latreille) of Puerto Rico. Department of Agriculture, Mayaguéz, Puerto Rico.

Green, P. 1997 Red crabs in rain forest on Christmas Island, Indian Ocean: activity patterns, density and biomass. *J. Trop Biol*.13: 17-38.

Matos, D. 1997. Puerto Rico/MNFS Cooperative Fisheries Statistics Program 1994-1997 Final Report to NMFS. Department of Natural and Environmental Resources. 74 p.

Yogani Govender
Department of Biology, University of Puerto Rico
P.O. Box 23360,
Rio Piedras, San Juan, 00931-3360
Ph (787) 764-000 x 2847
yoganig@yahoo.com

RESULTS OF HEALTH SURVEYS IN TWENTY WESTERN ATLANTIC REEF AREAS

Robert N. Ginsburg, UM - Rosenstiel School, Philip Kramer, The Nature Conservancy, Judith C. Lang

Abstract

This Report presents highlights of results of twenty assessments of condition of corals, fish and algae made at 302 sites on Western Atlantic reefs between 1997 and 2000. Trained divers made the assessments using the well-established AGRRA protocols (http://coral.aoml.noaa.gov/agra). The twenty assessments are from the Bahamian Archipelago (4), Gulf of Mexico (2), Brazil (1), western Caribbean (4), central Caribbean (2), southern Caribbean and (4) eastern Caribbean (3).

- Remote reefs show as much evidence of reef degradation as reefs adjacent to populated and/or developed coastal areas.
- Mean live coral cover of all 20 areas is 26% for reefs at depths of 5-25 m Recent partial-colony mortality of corals that are ³ 25 cm is less than 4 %, and average total mortality (including completely dead) colonies is 28%.
- Bleaching and diseased-induced mortality from the 1998 ENSO event were most conspicuous in the western Caribbean and Bahamas.
- Acanthurids and scarids predominate on all reefs; seranids are less than 1% of fish on shallow reefs and 4% on deeper reefs.
- The small numbers of sightings for larger-bodied groupers and snappers (<~1/100 m2) suggest the entire region is over-fished for many of these more heavily targeted species.
- Herbivore density (or biomass) and macroalgal index (a proxy for macroalgal biomass) are not correlated at the scale of the entire region.

The analysis of 300 additional sites is underway; with these, the AGRRA Database will allow for multi-scale comparisons across the entire region and provide a standardized baseline against which to evaluate major changes through future revisits.

MONITORING POTENTIAL WATER QUALITY IMPACTS OF COASTAL CONSTRUCTION PROJECTS

Steve Wolf, ENSR International

Abstract

Coastal stewards are faced with decisions on many large projects that involve construction within and adjacent to coastal areas. Projects such as channel dredging or installation of submerged pipelines may cross many miles of coastal waters and may take place over extended timeframes. As part of the permitting for these projects, assessments can be made of the potential for water quality and benthic impacts using sophisticated computer models that predict the release and transport of sediments and any associated chemical constituents. Once a project is through the permitting phase, monitoring of actual impacts during construction can pose a formidable set of challenges.

This paper will provide a primer on water quality monitoring. It will include a review of the types of impacts (physical and chemical) and will focus on technological advances in monitoring equipment that allow for a comprehensive and often real-time assessment of potential impacts. Monitoring techniques that will be reviewed include the multi-parameter water quality meter, the acoustic Doppler current profiler, underwater video camera, and sediment-profile imaging camera. Application of these techniques will be presented for a range of recent coastal projects including channel maintenance dredging in Providence RI, remediation dredging in New Bedford MA, and natural gas pipeline installations in Long Island Sound and Massachusetts Bay.

Steve Wolf
ENSR International
2 Technology Park
Westford, MA 01886
(978) 589-3000 (main);
589-3187 (direct);
589-3282 (fax)
swolf@ensr.com

A HAWAIIAN PILOT AQUATIC SPECIES INVENTORY AND AN EARLY DETECTION, WARNING, AND INFORMATION SYSTEM FOR INVASIVE SPECIES

Donna Turgeon, Gus Rassam, Lu Eldredge, Joe Stinus, Gary Matlock

Abstract

Managers need to know when a species is introduced to their region and where they can get information to help formulate response strategies. National Ocean Service, AFS, and many other partners initiated in FY02, a project that will produce an up-to-date inventory of U.S. and Canadian aquatic species, a reporting and verification system for species not on the inventory, timely warnings for species new to aquatic ecosystems, risk assessments, and other information on alien species. That project, A Hawaiian Pilot Inventory and Warning System, is being tested and data from another region should be added in FY04. A draft U.S. and Canadian inventory and warning system could be ready as early as FY08.

Visitors to the Pilot website can check new collections against an inventory of U.S. and Canadian species, map distributions, and get in-depth information on invasive species. If a species not on the inventory is confirmed as alien, a warning will be posted automatically to managers. With such warnings and information, managers will be better prepared to prevent alien species and mitigate impacts. Reducing the potential for a species becoming established in aquatic ecosystems should also help maintain habitat structure, function, and diversity for critical fisheries habitats.

WETLAND LOSS OR WETLAND GAIN: PLANNING FOR RISING SEA LEVEL IN COASTAL WILDLIFE REFUGES

Roger Barlow, Curt Larsen, Greg Desmond, Glenn Guntenspergen, and Tom Yanosky, U.S. Geological Survey

Abstract

The current rates of relative sea level rise as well as an anticipated acceleration in rates associated with increasing global temperatures threaten a degree of inundation of low-lying coastal wildlife refuges along the U.S. East and Gulf Coasts. Inundation of present wetlands is commonly perceived as a loss of wetland area attributed to the inability of marsh surfaces to accrete vertically in keeping with the rate of sea level rise. Little attention is given, however, to the potential gain in wetland area created by the shoreward displacement of zoned vegetation that is propagated at the advancing edge of brackish to saline water onto adjacent upland land surfaces as sea level rises. Both loss and gain of wetland habitat need to be taken into account for any long- and short-range decision making affecting coastal wildlife refuges. If sustainable wetland resources are to be a desired objective, then adequate planning tools, based on sound science, need to be used to determine to compute the balance of loss versus gain in low-lying landscapes. Highly detailed elevation data called Light Detection and Ranging (LIDAR) has been collected for 3 National Wildlife Refuges (Blackwater, Prime Hook, and Bombay Hook) and decadal inundation models for sea-level rise have been created for review and analysis to plan future Refuge management strategies. A fourth Refuge, Loxahatchee has had high-accuracy elevation data collected using the USGS developed helicopter based Airborne Height-Finder, and modeled results will be displayed on that data for this Refuge.

PANEL

WILDLIFE HABITAT CONSERVATION AND THE NATIONAL ESTUARY PROGRAM

Greg Colianni, EPA Ocean & Coastal Protection Division

Abstract

The National Estuary Program (NEP) was established in 1987 to identify, restore, and protect nationally significant estuaries of the United States. Unlike traditional, regulatory approaches to environmental protection, the NEP targets a broad range of issues and encourages communities to develop common solutions. Staff scientists, policy analysts, and outreach coordinators work with local communities to identify problems and create consensus-based actions to address problems facing their watersheds. The cornerstones of the NEP, drawn from predecessors such as the Chesapeake Bay Program, include a focus on watersheds as the basic environmental management unit, the integration of good science with sound decision-making, a collaborative approach to problem solving, and the critical role of public participation. Wildlife habitat conservation is a priority issue for many NEPs, as coastal counties continue to be the fastest growing areas of the country and already contain over half the U.S. population. Growth has been accompanied by a substantial loss of important habitat in many regions. Various NEPs are employing innovative and successful methods to protect and restore vital habitat lost from development. To showcase some of these activities, a panel of NEP representatives from around the country will discuss ongoing efforts to assess the health of their estuaries and present useful strategies to manage important coastal resources. Topics will include developing and implementing successful monitoring programs, methods for identifying and protecting threatened systems, developing habitat restoration plans with measurable goals, defining and managing critical habitat, and discussing challenges associated with managing large natural systems.

NATIONAL COASTAL CONDITION REPORT II

Barry Burgan

Summary

Coastal waters in the United States include estuaries, coastal wetlands, coral reefs, mangrove forests, and upwelling areas. Critical coastal habitats provide spawning grounds, nurseries, shelter and food for finfish, shellfish, birds, and other wildlife. Coastal resources also provide nesting, resting, feeding, and breeding habitat for 85% of waterfowl and other migratory birds. Estuaries are bodies of water that provide transition zones between fresh water from rivers and the saline environment of the ocean. This interaction produces a unique environment that supports wildlife and fisheries and contributes substantially to the economy of the United States.

The first National Coastal Condition Report (NCCR I), published in 2001, reported that the nation's estuarine resources were in fair condition. The NCCR I used available data from 1990 to 1996 to characterize about 70% of the nation's estuarine resources. Agencies contributing these data included EPA, NOAA, DOI's Fish and Wildlife Service (FWS), and USDA. This second National Coastal Condition Report (NCCR II) is based on available data from 1997 to 2000. These data are representative of 100% of estuarine acreage in the conterminous 48 states and Puerto Rico, and they show that the nation's estuaries continue to be in fair condition. Agencies contributing data to this report include EPA, NOAA, FWS, and the United States Geological Survey (USGS). Several state and regional/local organizations also provided information on the current condition of the nation's coasts.

With each National Coastal Condition Report, the collaborating agencies strive to provide a more comprehensive picture of the nation's coastal resources. The NCCR II builds on the foundation provided by the NCCR I, and efforts are under way to assess even more areas using comparable and consistent methods. Although the NCCR II provides some condition data for Alaska, Hawaii, U.S. island commonwealths and territories, and the Great Lakes, these data are not comparable with data provided for other regions. However, current monitoring efforts in Alaska, Hawaii, and the island commonwealths and territories will allow comparisons in future National Coastal Condition Reports.

The NCCR II presents three main types of data: (1) coastal monitoring data, (2) offshore fisheries data, and (3) assessment and advisory data. The ratings of coastal condition in the report are based primarily on coastal monitoring data because these data are the most comprehensive and nationally consistent available data related to coastal condition. One source of comprehensive and nationally consistent coastal monitoring data is EPA's National Coastal

Assessment (NCA) program, which provides information on the condition of coastal estuaries for most regions of the United States. The NCCR II relies heavily on NCA estuarine data in assessing coastal condition and uses NCA and other data to evaluate five indicators of condition—water quality, coastal habitat loss, sediment quality, benthic community condition, and fish tissue contaminants—in each region of the United States (Northeast Coast, Southeast Coast, Gulf Coast, West Coast, Great Lakes, and Puerto Rico). The resulting ratings for each indicator are then used to calculate both overall regional ratings and an overall national rating of coastal condition. This national assessment applies to 28 coastal states (20 ocean states, 6 Great Lakes states, and 2 ocean/Great Lakes states) and Puerto Rico (Figure 1).

In addition to rating coastal condition based on coastal monitoring data, the NCCR II summarizes available information related to offshore fisheries and beach advisories and closures. This information, together with descriptions of individual monitoring programs, paints a picture of the overall condition of coastal resources in the United States.

Summary of the Findings

This report is based on the large amount of monitoring data collected between 1997 and 2000 on the condition of the estuarine and Great Lakes resources of the United States. Ecological assessment of these data shows that the nation's estuaries are in fair condition, with poor conditions in the Northeast Coast and Puerto Rico regions and fair conditions in the Southeast Coast, Gulf Coast, Great Lakes, and West Coast regions. No overall assessments were completed of Alaska, Hawaii, Guam, American Samoa, the Northern Mariana Islands, or the U.S. Virgin Islands, although surveys of Alaska and Hawaii have been completed, samples are being analyzed, and data will be available in 2004. New ecological monitoring programs will permit a comprehensive and consistent assessment of all of the nation's coastal resources by 2006.

Major Findings of the 1997–2000 Study Period

Overall condition of the nation's estuaries is fair. This rating is based on five indicators of ecological condition: water quality index (including dissolved oxygen, chlorophyll *a*, nitrogen, phosphorus, and water clarity), sediment quality index (including sediment toxicity, sediment contaminants, and sediment total organic carbon [TOC]), benthic index, coastal habitat index, and a fish tissue contaminants index.

Twenty-one percent of assessed resources are unimpaired (good condition), whereas 35% are impaired (poor condition) and 44% are threatened (fair condition) for aquatic life use or human use.

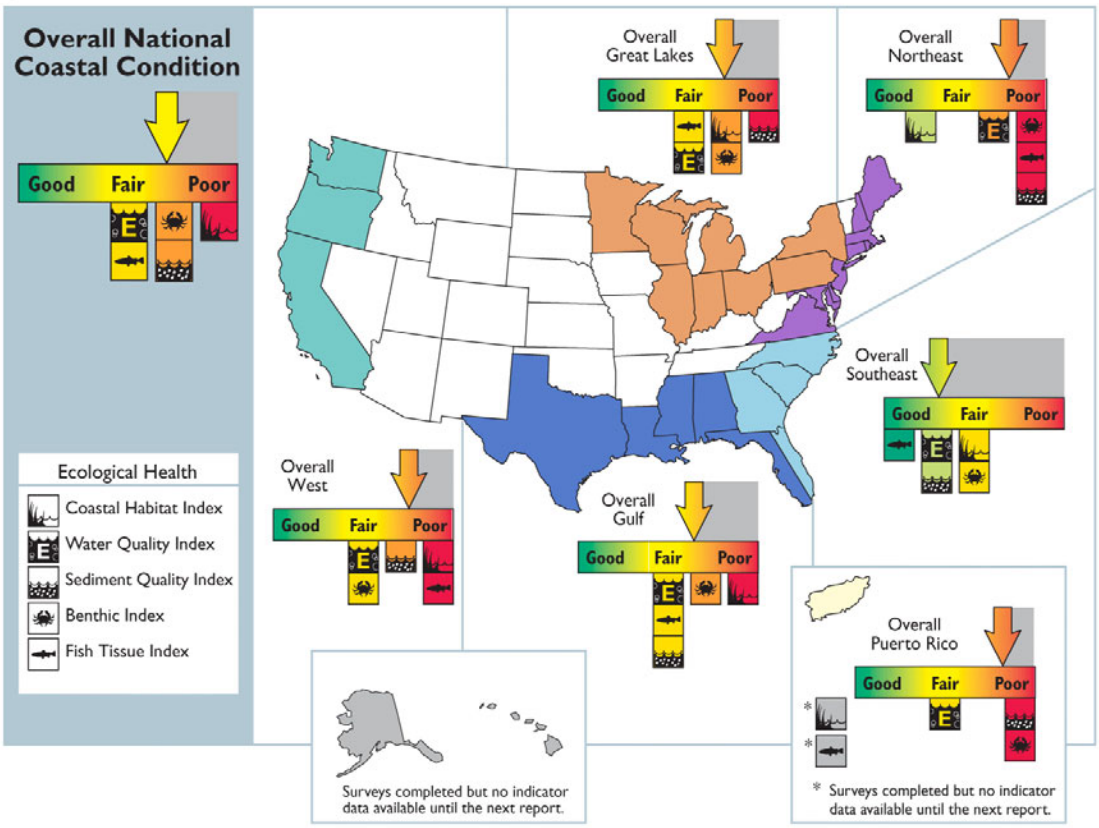

Figure 1.

Twenty-three percent of estuarine waters are impaired for swimming, based on the water clarity data presented in this report. Water clarity represents the aesthetic component of this human use. The suitability of estuarine waters for swimming is best measured using microbial measures, which are not included in this report.

Twenty-two percent of estuarine waters are impaired for fishing, based on the risk-based noncancer guidelines for moderate consumption. Suitability of waters for fishing is measured using the fish tissue contaminants index in this report.

Twenty-eight percent of estuarine waters are impaired for aquatic life use. Suitability of waters for aquatic life use is measured using the water quality, sediment quality, habitat loss, and benthic indices in this report.

The indicators that show the poorest condition throughout the United States are coastal habitat condition, sediment quality, and benthic condition. The indicators that generally show the best condition are the individual components of water quality—dissolved oxygen and dissolved inorganic nitrogen.

Describing Coastal Condition

Three types of data are presented in this report:

Coastal Monitoring Data—data from programs such as EPA's Environmental Monitoring and Assessment Program (EMAP) and NCA, NOAA's National Status and Trends (NS&T) program, and FWS's National Wetlands Inventory (NWI), as well as Great Lakes information from the State of the Lakes Ecosystem Conference (SOLEC). These data are used in this report to develop indicators of condition, which are then used to calculate regional and national ratings of coastal condition.

Offshore Fisheries Data—data from programs such as NOAA's Marine Monitoring and Assessment Program (MARMAP) and Southeast Area Monitoring and Assessment Program (SEAMAP). These data are used in this report to assess the condition of coastal fisheries in large marine ecosystems (LMEs).

Assessment and Advisory Data—data provided by states or other regulatory agencies that are compiled in nationally maintained databases. The agencies contributing data use different methodologies and criteria for assessment, so the data cannot be used to make broad-based comparisons among the different coastal areas. These data provide information about designated use support, which affects public perception of coastal condition as it relates to public health.

A summary of each indicator is presented below:

Water Quality Index—This index is rated fair throughout the United States, although a slightly larger proportion of waters in Northeast Coast estuaries are in poor condition (19%), resulting in a rating of fair to poor.

Sediment Quality Index—This index is rated fair to poor for the United States. Sediment quality is poor for the Northeast Coast, Great Lakes, and Puerto Rico. Sediment quality in the remainder of the country's estuarine waters is in fair condition. Many regions of the United States have significant sediment degradation, including contaminant concentrations of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, and metals that are above guidance levels. Most of these excesses occur in Northeast Coast and Puerto Rico estuaries. High concentrations of sediment TOC (often associated with the deposition of human, animal, and plant wastes) are observed

in 44% of Puerto Rico estuaries.

Benthic Index— Benthic condition is fair to poor in most of the United States. Poor condition is observed in Northeast Coast and Puerto Rico estuaries largely as a result of degraded sediment quality, but in some cases it is associated with poor water quality conditions, low dissolved oxygen, and elevated nutrient concentrations.

Coastal Habitat Index—This index is rated poor. Coastal wetland losses from 1780 to 2000 were greater than or equal to 1% per decade in each region. The index score was greater than 1.25 in coastal wetland areas of the West Coast and the Gulf of Mexico.

Fish Tissue Contaminants Index—The overall rating for fish tissue contaminants for the nation is fair. Fish tissue contaminant concentrations are above guidance levels in fish captured in Northeast Coast and West Coast estuaries for 4 of the 75 contaminants measured (total PCBs, total PAHs, total DDT and mercury). Projections of mercury concentrations in fillets based on whole-body concentrations showed mercury concentrations in fillets are likely to exceed guidance levels for about 42% of sites in the United States. Fish tissue contaminant concentrations were not available for estuaries in Puerto Rico, Florida, and Louisiana.

Offshore Fisheries

Currently, the only comprehensive, nationally consistent data on the condition of offshore coastal waters are fisheries resource data from NOAA surveys. In 2001, NOAA's Office of Sustainable Fisheries reported on the status of 595 marine fish and shellfish stocks out of 951 total stocks (NMFS, 2002). Eighty-one stocks were overfished (compared with 92 in 2000), and 67 of these (83%) were steadily rebuilding. Twenty more stocks had sustainable harvest rates in 2001 than did in 2000. Sixty-five stocks experienced catches exceeding allowable harvest levels. The National Marine Fisheries Service (NMFS) has approved rebuilding plans for the majority of overfished stocks. Of the 81 stocks that are overfished, 67 have an approved rebuilding plan and 9 have plans under development.

Assessments and Advisories

Assessment information from the Clean Water Act Section 305(b) is available for 36% of the nation's estuaries and 6% of the nation's shoreline waters. Available information suggests that 51% of assessed estuaries and 14% of assessed coastal shoreline in the United States (excluding Alaska) are impaired by some form of pollution or habitat degradation. This information is consistent with the national coastal monitoring data presented in this report. States and tribes rate water quality for Clean Water Act reporting by comparing available

water quality data to their water quality standards (water quality standards include narrative and numeric criteria that support specific designated uses, such as swimming and aquatic life use). Each state has different monitoring resources and uses a different methodology for assessment, so this information is not nationally consistent and is often incomplete. Aquatic life support, primary contact recreation (swimming), and fish consumption are the designated uses that were most frequently impaired. The leading stressors resulting in these impairments are metals, pesticides, oxygen-depleting substances (oxygen is consumed during the degradation of organic matter and the oxidation of some inorganic matter), toxic chemicals, PCBs, and dissolved solids.

The number of coastal and estuarine waters under fish consumption advisories represent an estimated 74% of the coastline miles of the United States, including 92% of East Coast, 100% of Gulf Coast, and 11% of West Coast coastline miles. An estimated 50% of the estuarine square miles are also under advisory, including 78% of East Coast estuaries, 23% of Gulf Coast estuaries, and 20% of West Coast estuaries. Every Great Lake is under at least one advisory, and advisories covered 100% of the Great Lakes shoreline.

EPA's review of coastal beaches (U.S. coastal areas, estuaries, and the Great Lakes) showed that of the 1,813 marine or Great Lakes beaches responding to the survey, 529 beaches, or 29%, had an advisory or closing in effect at least once during 2002 (Figure ES-6). Beach closures were issued for various reasons, including sewage contamination, elevated bacterial levels, and preemptive reasons. The major sources of contamination were storm water runoff, sewer line problems, sewer overflows, and in many cases, unknown causes.

Shortcomings of Available Data

This report focuses on coastal regions for which nationally consistent and comparable data are available. Such data are currently available only for the conterminous 48 states and Puerto Rico. Alaska has very little information to support the kind of analysis used in this report (i.e., spatial estimates of condition based on indicators measured consistently across broad regions). Nearly 75% of the area of all the bays, sounds, and estuaries in the United States is located in Alaska, and no national report on estuarine condition can be truly complete without information on the condition of living resources and use attainment of these waters. Similarly, little information is available for Hawaii, the Caribbean, or the Pacific territories to support estimates of conditions based on the indicators used in this report. Although these latter systems make up only a small portion of the nation's estuarine area, they do represent a set of estuarine subsystems (such as coral reefs and tropical bays) that are not located anywhere else in the United States with the exception of the Florida Keys and the Flower Gardens off the Louisiana/Texas coast. These unique systems should not be excluded from future national assessments, and initial condition surveys have

already been completed for monitoring programs in Hawaii and portions of Alaska.

This report tries to make the best use of available data in order to characterize and assess the condition of the nation's estuarine resources; however, the report cannot represent all individual estuarine systems of the United States or all of the appropriate spatial scales (national, regional, and local) necessary to assess the condition of estuaries. This assessment is based on a limited number of ecological indicators for which consistent data sets are available to support estimates of ecological condition on regional and national scales. Through a multiagency and multistate effort over the continuing decade, a truly consistent, comprehensive, and integrated national coastal monitoring program can be realized. Only through the cooperative interaction of the key federal agencies and coastal states will the next effort to gauge the health of the coastal ecosystems in the United States be successful.

Although most of the chapters in the report use ecological indicators to address the condition of coastal resources in each region, the last chapter addresses coastal condition in the context of how well estuaries are meeting the uses that humans expect of them. Only one estuary, Galveston Bay, was considered. In this case, it appears that human uses for commerce, fishing, and recreation are being met. The exception is that fish consumption advisories are required at the upper end of the bay near Houston.

Comparisons to the First National Coastal Condition Report

A primary goal of the National Coastal Condition Reports is to provide a benchmark of coastal condition in order to measure the success of coastal programs over time. To achieve this end, the conditions reported in each report need to be comparable. For the first two reports (NCCR I and NCCR II), there is insufficient information to examine the potential trends in estuarine condition that might be related to changes in environmental programs and policies. In the next report (anticipated in 2006), the information from 1990 through 2002 will be evaluated for potential trends.

Comparing data between the NCCR I and NCCR II is complicated because, in some cases, indicators were changed in order to improve the assessment. For example, in the first report, seven indicators were used, including multiple indicators for water quality, where a single water quality indicator is used in this report. In addition, reference conditions for some of the indicators were modified to reflect regional differences. In order to facilitate a comparison, the values reported in the NCCR I were recalculated using the approaches followed in this report, to the extent possible.

Barry Burgan
U.S. Environmental Protection Agency
Office of Water 4504T
Office of Wetlands Oceans and Watersheds
1200 Pennsylvania Avenue
Washington, DC
USA
Ph (202) 566-1242
Fax (202) 566-1336
burgan.barry@epa.gov

TRANSFORMING CORAL REEF CONSERVATION: USING RESILIENCE TO STAY ON THE FACE OF THE WAVE

Nina P. Hadley, The Nature Conservancy
Rod Salm, The Nature Conservancy
Elizabeth McLeod, The Nature Conservancy
Scott Smith, The Nature Conservancy

"It is not the strongest of the species that will survive, but the ones most adaptable to change."

~ Charles Darwin

Introduction

The Nature Conservancy has over 50 years of experience in effectively establishing, managing and financing protected areas for the conservation of terrestrial and marine biodiversity in over 28 countries. Globally, The Nature Conservancy is leading a highly collaborative program to transform the way coral reef related marine protected areas (MPAs) are selected, designed and managed. The goal of this program – called Transforming Coral Reef Conservation in the 21st Century – is to catalyze a worldwide effort to establish and protect resilient networks of MPAs within high biodiversity tropical marine ecoregions that are designed to survive, managed to last, and inter-connected. The program is founded on five core principles:

1. Establishing MPAs and integrating them into wider management frameworks as the most effective way to secure protection for coral reef biodiversity and associated tropical marine ecosystems.
2. Building resilience in the face of global change into MPA networks to ensure long-term survival of coral reef and related biodiversity.
3. Developing sustainable means for MPAs to meet their costs.
4. Strengthening local capacity to manage MPAs effectively for their continued existence and the long-term survival of the marine biodiversity.
5. Supportive policies and political backing to provide incentives for the conservation and sustainable use of tropical marine resources, address key drivers of biodiversity loss, and integrate conservation into development priorities

The Principles of Resilience

While the science behind resilience is still developing, there are simple practical steps that managers can take now to begin to incorporate it into MPA design and management. At the core of the Transforming Coral Reef Conservation (TCRC) program is a model of resilience that incorporates four elements: representation and replication, refugia, connectivity and effective management (Figure 1).

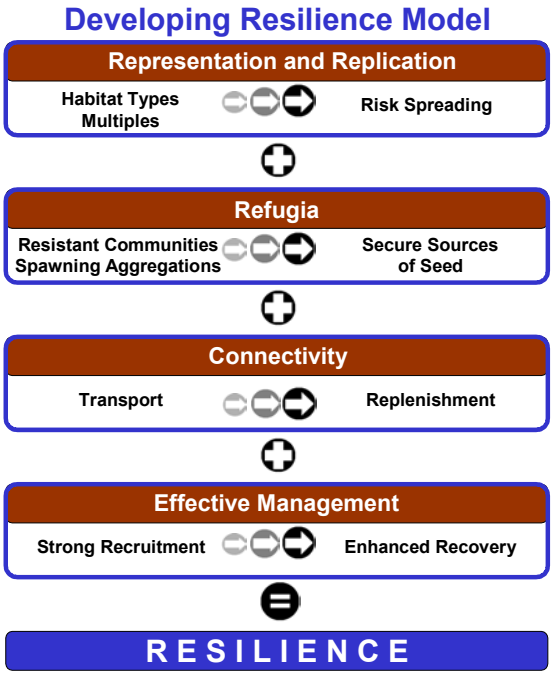

Figure 1

The highest priority is to protect a representative range of habitat types, including critical habitats of target species. Replication of these at multiple locations wherever possible to decrease the risk of total loss of any one type of reef is important.

It is also important to protect communities that are naturally positioned (in areas where cooling, shading, screening occur) to survive global threats, such as coral communities that resist bleaching due to a high stress tolerance. These refuges provide secure and essential sources of larvae to enhance the replenishment and recovery of damaged areas.

Understanding the complexities of connectivity is another important component of resilience. Connectivity enables managers to position MPAs that are linked through currents, larval dispersal patterns, and species movements, and to design MPA networks that are mutually replenishing.

Finally, managers need to increase their effectiveness by responding to direct, environmental threats such as pollution and sedimentation to keep the reef healthy. Healthier reefs are associated with more resilient corals and a greater probability of recruitment. Healthy reefs and, therefore, healthy corals will be more likely to bounce back after a catastrophic event and more likely to exhibit

resilience. Enhanced recovery of reefs provides many benefits for fisheries, tourism, and sustainable development.

Coral Bleaching

West and Salm (2003) have identified at least four factors that help the corals survive a bleaching event. One factor is cooling. In some places, the shape of the seabed and pattern of ocean currents interact to cause the upwelling of cold deep water, which mixes with the hot surface water. This mixing effect cools the heated surface water and helps coral communities in these areas to resist bleaching. Such areas of predictable mixing and cooling would be good places to find reefs that will survive bleaching and to invest in conservation action. Shading is a second important factor that can help corals resist bleaching. High islands that are oriented north-south can shade corals during one-half of the day. Additionally, undercut coastlines can provide shaded shelves that protect corals from intense sunlight, and even trees growing along slopes can provide protective shading. When corals bleach, they essentially lose their sunscreen and become vulnerable to the harmful effects of the intense sunlight. Intense sunlight will kill corals if they remain stressed and bleached for too long.

The third factor is screening by particles in the seawater. These particles act as shade netting that screens out harmful radiation to help corals resist bleaching. There are places near estuaries or in sheltered bays where coral communities have adapted to these conditions and thrive there. These areas, often overlooked for conservation, provide important refuges for resistant corals and would be valuable places to invest our conservation effort. The fourth factor that helps corals survive a bleaching event is stress tolerance developed through exposure to harsh conditions. The corals on reef-flats, where you might expect the sun to have the greatest effect, can and often do survive; while those deeper down the reef slope will bleach and die. These shallow corals are routinely exposed at low tides, where they dry out, get scorched by the sun, and flooded by rainwater – their very survival requires tolerance of wide-ranging conditions. These four factors (cooling, shading, screening, and stress tolerance) help corals either to resist bleaching altogether or to recover quickly from it.

Case Study: Palau

In an effort to better understand the scientific aspects of coral bleaching, the Conservancy recently teamed with the Australian Institute of Marine Science (AIMS) and The Cooperative Research Centre for the Great Barrier Reef World Heritage Area (CRC Reef) on a preliminary study of the impacts of coral bleaching off the Great Barrier Reef. The results of these joint analyses indicate that there is a strong relationship between coral bleaching and the location of large patches of cooler and hotter water. It was found that coral bleaching impacts were generally the most severe in the hottest areas and least severe in the coolest areas. However, this pattern was not universal: within some of the

hotter regional patches, corals were not as adversely impacted. This finding is consistent with the Conservancy's initial hypotheses, which surmised that small-scale water mixing, which can help circulate cooler water, can protect some corals within larger areas from extensive coral bleaching damage.

To translate these preliminary findings into on-the-ground results, The Nature Conservancy has again teamed with NOAA and AIMS to develop a computer model to predict which reefs are at higher or lower risk of bleaching. The model will be developed in Palau, one of the TCRC top priority MPA networks. The model will provide the Conservancy with a comprehensive understanding of the expected patterns of hot water for future bleaching events, which may occur during the next El Niño weather cycle. This information is invaluable in ensuring that future protected area design and management includes an understanding of the areas most likely to survive future ecological changes.

The results from this project will have enormous implications for management and prediction of coral bleaching. The most obvious use of these findings is that we can map the relative "bleaching risk" of reefs in Palau and provide valuable input to the design of the forthcoming national marine protected area network. Information on areas of high and low risk for bleaching will allow the Conservancy and our local partners to assist the Palau government in better developing a set of protected areas which are less susceptible to future bleaching events. We also anticipate adapting the model for use in other tropical marine biodiversity "hotspots" – such as the Mesoamerican Reef in Central America, the second largest reef system in the world.

The Conservancy has an on-the-ground presence in Palau, and has worked with government officials to pass a resolution to establish a system of marine protected areas nationwide to save the country's marine resources. The "Protected Areas Network Act" was signed into law on November 26, 2003. The purpose of the Act is to establish a nationwide network of marine and terrestrial protected areas that will allow the national government to assist states in the protection of significant areas of biodiversity, important habitats and other valuable resources that are essential to the future stability and health of Palau. It has the dual objectives of protecting Palau's unique biodiversity and supporting the states and communities to more effectively manage and protect their natural resources. The Ministry of Resources and Development has the responsibility for implementing and administering the Act.

The Nature Conservancy provided technical advice to, and contributed to, the drafting group that prepared the Protected Areas Network Act, and has made a special commitment to support the establishment of the nationwide network of protected areas in Palau. To this end the Conservancy and the Ministry of Resources and Development have entered into a mutually beneficial partnership, through a Memorandum of Understanding, to support the initiation and development of the network.

Fish Spawning Aggregations

Fish spawning aggregations—the places where teeming masses of fish gather to mate at the same time each year—are critical in the life cycle of the fishes that use this reproductive strategy as "sources of seed." To build resilience into MPA networks, protecting fish spawning aggregations is a high priority. Therefore, the animals breeding at fish spawning aggregation sites need to be protected from exploitation during the spawning periods (TNC 2004). For decades, aggregations have been observed and recorded by scientists and knowledge of them as "places to fish" is deeply embedded in the traditional knowledge of many local fishermen. Where aggregations have been discovered, they have often been overexploited. Most commercially important species forming transient spawning aggregations are locally threatened by fishing. Fishermen often target spawning aggregations because of the large concentration of fishes at a single site. Unsustainable fishing practices exacerbate this problem and have led to the disappearance of aggregations. One of the challenges of a spawning aggregation conservation program is to convince local fishers that protecting spawning aggregations will actually improve their fishing success in the long term by providing each species with the optimal conditions to reproduce. Additional threats, such as habitat destruction, pollution, and disturbance by tourism, also exist at many aggregation sites. Finding these aggregation sites and protecting them before they are eliminated is imperative to protect the societies that depend on reef resources and the ecological balance of a fully functional and healthy coral reef ecosystem.

Case Study: Belize

Intensive studies of the Nassau groupers in Belize have been going on since the mid-1980's which have involved grouper monitoring efforts and annual surveys. In 1998, The Nature Conservancy began its research on spawning aggregations at Gladden Spit, and has continued its on-going research both there and at Lighthouse Reef Atoll.

All of the major government and non-government organizations, including the Conservancy, working on spawning aggregation monitoring and conservation in Belize together have formed the National Spawning Aggregations Working Committee. The Belize Audubon Society now chairs this Committee. This informal group has worked to monitor and describe 13 multi-species spawning aggregation sites in Belize and has involved local aggregation fishers in the monitoring and research at these sites. Armed with three years of monitoring data, the group proposed sweeping national legislation to protect endangered Nassau groupers - by means of a closed season. The enacted legislation protects all of the viable spawning aggregation sites that are known to harbor multi-species aggregations.

The National Spawning Aggregations Working Committee raised the issue of conserving these spawning aggregations to national attention using a variety of techniques. Importantly, the Minister of Fisheries visited traditional fishing sites, talked with fishers directly, and came to understand the issues. Various members of the group conducted workshops, developed posters, radio and television spots, infomercials and short videos, and gradually raised the nation's consciousness on the subject. Fishers were involved in all major research and monitoring and were paid for their assistance as boat captains and as research assistants. The local fishing cooperatives, which act as the main fish buyers/exporters, support the idea that FSA protection enhances the future of sustainable fisheries and now actively participate in spawning aggregation protection.

The Nature Conservancy was asked to develop a series of maps that located reef promontory spawning aggregations. These maps were based on the analysis of georeferenced satellite imagery. Using GPS, 13 of the spawning aggregation sites were mapped into buffer zones of about 6 – 8 square miles. When presented with these maps in a public forum, the fishers agreed with the concept but suggested that the size of the aggregation closures be reduced. New maps were created and shared with fishers who agreed to the new boundaries.

As a final check before signing the legislation protecting spawning aggregations, the Minister of Fisheries, requested that patriarch fishers join him in a public forum to ensure that he was adequately representing their interests. Each and every fisher offered support. The Minister signed legislation in November 2002 that created a closed season for Nassau Grouper between December and March (G.O.B. 2003a), and 11 new fully protected marine reserves surrounding the spawning aggregation sites were established (G.O.B. 2003b).

Policy and Implementation

For this global vision to be put into action, a coordinated effort among coral reef stakeholders is essential. The Nature Conservancy and its partners are promoting this effort by forging alliances with local communities, other non-governmental organizations, government officials, the private sector and scientists around the world.

The IUCN World Parks Congress is an event that takes place every ten years providing a major global forum for setting the agenda for protected areas. The Conservancy played a key role in formulating the final recommendations of the Congress related to creating a global system of representative MPA networks by 2012. They provided input from the marine stream into the message from the Congress to the Convention on Biological Diversity, and provided the marine content of the Durban Accord and Action Plan. These Congress outputs reflect the key approaches embodied in the Conservancy's Transforming Coral Reef Conservation program. In particular, the concept of building resilience in the

face of global change into MPA networks is prominent in Congress products, and is making its way into the conservation mainstream at multiple levels from global policy to field application. Our inputs and products are highlighted in the report of the marine theme of the Congress, which among other things identifies building resilience into MPA networks as one of six key outcomes of the Congress. It also includes our suggestion to create a WCPA-Marine working group on further elaborating and applying this concept. The organizers of a 2005 conference on MPAs, which will review the progress of MPA-related recommendations and actions from the Congress, are considering a major focus on resilience.

R^2 - Reef Resilience Toolkit

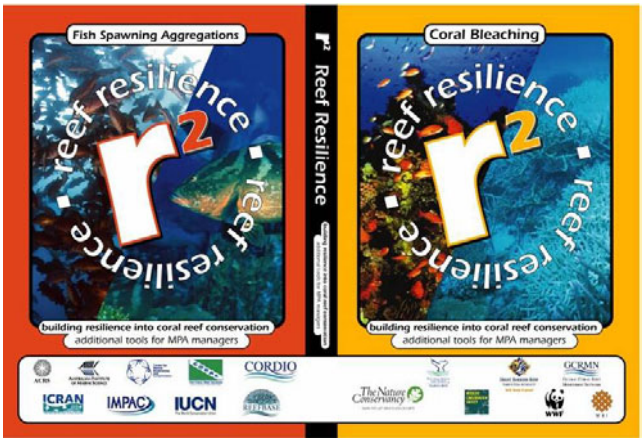

Figure 2. ©TNC

To reach the critical audience of MPA managers, the Conservancy has developed a "toolkit" of resources. Known as the Reef Resilience toolkit, or "R^2 toolkit," (Figure 2) it provides managers—many of whom are working in remote, isolated locations—with access to cutting-edge science and lessons learned at similar projects worldwide. Building upon the principle of effective management, the R^2 toolkit helps coral reef and MPA managers, trainers, and policymakers respond to the threats associated with global climate change by enhancing their planning and management strategies.

The multimedia CD-ROM toolkit outlines the steps necessary to select, protect and monitor coral reef communities. Comprised of two streams – Coral Bleaching and Fish Spawning Aggregations – the toolkit helps practitioners build resilience into their coral reef conservation programs so that valuable marine ecosystems can survive anticipated demographic, economic, and environmental changes expected during the next century. The Coral Bleaching Stream is designed to assist MPA managers examine factors that may help coral

communities either to resist or recover quickly from bleaching events; it also helps identify the locations of resistant communities as well as suggests specific actions that MPA managers can take to diminish the impacts of mass bleaching at different scales. The Fish Spawning Aggregation Stream helps marine conservation practitioners protect commercially and environmentally important spawning aggregations. Establishing refuges that harbor and safeguard important ecological processes is an essential component of reef and fisheries survival.

Conclusion

The Nature Conservancy, working closely with a wide range of partners both internationally and in the U.S., has created a vision for tropical marine conservation that enhances the prospect of recovery and survival for coral reefs in the face of growing local and global stresses, especially stresses associated with elevated sea surface temperatures and coral bleaching. Grounded in science, innovative in approach and collaborative in nature.

References

Government of Belize. 2003a. Statutory Instrument No. 162 of 2003. Fisheries (Nassau Grouper Protection) Regulations, 2003. 162:1-2.

Government of Belize. 2003b. Statutory Instrument No.161 of 2003. Fisheries (Spawning Aggregation Site Reserves) Order, 2003. 161:1-8.

The Nature Conservancy, 2004. R^2 – Reef Resilience Toolkit. Version 1.0.

West, J. and R. Salm, 2003. Resistance and Resilience to Coral Bleaching: Implications for Coral Reef Conservation and Management, Conservation Biology, Vol. 17, No. 4, pp 956-967.

Nina P. Hadley
Program Coordinator, Marine Initiative,
The Nature Conservancy
159 Waterman Street
Providence, RI 02906
Ph (401) 453-0005
Fax (401) 751-7596
email: nhadley@tnc.org

THE PORTFIELDS INITIATIVE: REVITALIZING BROWNFIELDS IN PORT COMMUNITIES

Kenneth Walker, NOAA Office of Ocean and Coastal Resource Management
Robert Neely, NOAA Office of Response and Restoration
David Holst, NOAA Office of Response and Restoration
Mary Baker, NOAA Office of Response and Restoration
Rosemarie McKeeby, NOAA Office of Ocean and Coastal Resource Management

In an effort to restore coastal environments and revitalize the economies of urban port communities, the National Oceanic and Atmospheric Administration (NOAA) is leading a federal interagency effort called "Portfields," which focuses on the redevelopment of brownfields in and around ports, harbors, and marine transportation hubs with an emphasis on development of environmentally sound port facilities. Overarching goals include waterfront revitalization, coastal habitat restoration, and the leveraging of public and private investment. Reuse of these sites can also provide jobs, improve the flow of commerce by enhancing port infrastructure, and increase the community's access to and pride in its waterfront.

The Portfields federal partners— NOAA, Environmental Protection Agency, Economic Development Administration, U.S. Maritime Administration, Army Corps of Engineers, Department of Labor, Department of Interior and Department of Housing and Urban Development — have selected three port communities to implement pilot projects: New Bedford, MA, Bellingham, WA, and Tampa, FL.

Through this effort, the partners seek to demonstrate improved delivery of financial and technical resources; improved coordination among federal, state and local partners; establishment of a process for redeveloping portfields properties as productive port facilities, while balancing environmental, social, and economic concerns; identification and application of tools, techniques, and information needs to improve decision making; and communication of lessons learned to other port communities. Where possible, the Portfields Initiative will build upon ongoing local comprehensive planning efforts in each of the pilot ports and will focus on priority projects identified through these planning efforts. This paper provides more detailed information on this effort and a snapshot of activities getting underway in the pilot ports.

Why Portfields?

Many brownfields are located in coastal communities, as industries historically were situated along the shore for access to the water for transportation, power and cooling. Of the 500,000 brownfields nationwide, an estimated 10-15% are located along waterways and coastal areas. Contamination from hazardous

substances is a common obstacle to development of port properties and port infrastructure. Brownfields also pose a threat to the marine environment and sensitive coastal resources. The cleanup and redevelopment of coastal brownfields presents opportunities to restore coastal resources, revitalize urban waterfronts, provide public access and enhance marine transportation systems. In addition, the clean up and reuse of abandoned or under-utilized properties in urban centers can reduce the pressure to develop "greenfields" at the urban fringe.

Important links exist between marine transportation, our nation's ports and harbors, and waterfront brownfield sites. Approximately 95% of U.S. foreign trade travels through our nation's ports and harbors, which contributes $742 billion to the GDP and employs 13 million people. Maritime trade is expected to double by 2020, exerting further pressure on already highly developed coastal areas. Redeveloping brownfields in port areas can facilitate improved marine transportation while providing environmental, economic, and social benefits. By redeveloping brownfields, communities can expand their port facilities, increase commercial port activity, and promote economic development opportunities.

How Portfields Began

Portfields originated from the 2002 Brownfields Federal Partnership Action Agenda. A brownfields federal partnership was created in 1996 and includes more than 20 agencies. Spurred on by the Bush Administration's commitment to brownfields and the Small Business Liability Relief and Brownfields Revitalization Act of 2002, the federal partners renewed their commitment to work together in a timely manner to prevent, assess, safely cleanup and reuse brownfields. The result was a new Brownfields Federal Partnership Action Agenda that was developed in October 2002. The Action Agenda contains lays out commitments from participating federal agencies. Through the Action Agenda, NOAA committed to leading the interagency Portfields effort. Each federal partner participating in Portfields brings its own specialized expertise and strong commitment to the overall goal of revitalizing port communities.

Portfields Phase I Report

In the first phase of Portfields, the federal partners commissioned a study to gain a better understanding of the issues and challenges port communities encounter with brownfields cleanup and redevelopment. The federal agencies interviewed eight ports that have successfully incorporated brownfields redevelopment into port activities. The participating agencies partnered with the International City/County Management Association (ICMA) to develop a Portfields Report from information gathered through these interviews. The Portfields report includes successful practices and strategies that can be transferred to other ports, and is available at http://www.brownfields.noaa.gov.

Portfields Pilots

New Bedford

The City of New Bedford, located in the lower Acushnet River watershed, is the most densely urbanized area on Buzzards Bay in southeastern Massachusetts. Home to the Port of New Bedford, a state designated port area (DPA) protects marine industrial uses in the lower harbor. The DPA includes portions of the harbor in New Bedford, located on the west bank, and in the Town of Fairhaven on the east bank. The Port of New Bedford, with authorized channel depths of 30 feet, offers deepwater access for maritime vessels. The harbor features a hurricane barrier with a 150-foot opening that is closed during hurricane conditions and coastal storms. As a result, the harbor is one of the safest havens on the eastern seaboard. The port has a history of seafaring traditions that continue today with one of the largest active fishing fleets on the east coast, freight ferry service, and cruise ship docking. The port is supported by the city's outstanding, multi-ethnic work force and international distribution services, which include an adjacent airport as well as rail and interstate highway connections. With over 950 recreational boat slips, New Bedford Harbor is also an important center for recreational boating on Buzzards Bay.

New Bedford Harbor is contaminated with metals and organic compounds, including polychlorinated biphenyls (PCBs). Because of the high concentrations of PCBs in the sediment, New Bedford Harbor was listed by the U.S. Environmental Protection Agency (EPA) as a Superfund site in 1982 and cleanup is underway. In addition to contaminated harbor sediments, numerous brownfield properties are located in proximity to the port, especially on the New Bedford side. Using the Portfields designation to maintain momentum, New Bedford and Fairhaven seek to implement additional components of the state-approved New Bedford/Fairhaven Harbor Plan for the DPA. Priority projects identified by the regional portfields steering committee include navigational dredging of sediments contaminated below Superfund levels; waterside brownfields remediation and reuse; pier and bulkhead enhancements; and the creation of public access points on the harbor. The committee also seeks to identify suitable sites for habitat restoration to offset impacts from port infrastructure development projects. The goal is to, at a minimum, compensate for lost functions and values from port projects. The hope is to improve the overall health of the harbor environment and the public's ability to use the resource while facilitating economic revitalization.

The Portfields steering committee and technical advisory group will apply the "state-enhanced remedy" provision of the New Bedford Harbor Superfund site Record of Decision as the procedural mechanism for streamlined processing of navigational dredging projects. This provision petitions for the inclusion of navigational dredging in New Bedford Harbor as an enhancement of the EPA remedy and would link, as appropriate, the dredging and disposal of sediments dredged from the harbor's navigational channels with statutory authorities (e.g.,

CERCLA) and the Superfund program. In the Record of Decision, EPA contends that the primary benefits of linking remedial and navigational dredging projects, while not sacrificing the normal regulatory review process for federal navigational projects, will include the following:

- Streamlined permitting process for on-site navigational disposal facilities;
- Coordinated rather than separate environmental monitoring programs (where feasible); and
- Increased overall coordination between the two dredging projects.

Tampa

The Port of Tampa is Florida's largest tonnage port, handling nearly half of all seaborne commerce that passes through the state. As one of the largest tonnage ports in the nation, the port handles 3,700 vessels and up to 50 million tons of cargo with an estimated value of $13 billion annually. It is also a major cruise port. Currently, more than 20,000 people work directly in four main port industries – cruise, shipping, transportation, and phosphate and chemical industries. The Tampa Port Authority supports the employment of 108,000 people. Port land uses include bulk and general cargo, ship repair facilities, cruise ship terminals, fisheries and non-traditional retail and entertainment uses.

The Port of Tampa has proposed a comprehensive strategy for brownfields redevelopment that includes economic, environmental and social goals. The port also plays an integral role in the protection and restoration of the environmental health of Tampa Bay. Through the Portfields designation, the Port of Tampa seeks the opportunity to work with federal agencies to enhance redevelopment and to improve the economic and social conditions in and around the port.

Brownfields redevelopment is identified as a goal within the Tampa Port Authority Master Plan. The port's brownfields redevelopment program began with the designation of its property as a State Brownfields Area in 2001. Additionally, the City of Tampa's Brownfield Target Area was expanded in 2002 to include all of the port's properties, which assures coordination of brownfield activities between the City of Tampa and the Tampa Port Authority. The port is also located within the City of Tampa Enterprise Community and Federal Enterprise Community, as well as along a designated Federally Significant Estuary within a Florida Outstanding Waterway. Clearly, brownfields redevelopment has a critical role in the economic and environmental health of the immediate Tampa Bay community.

The Port of Tampa's main goal is to expand port commerce while minimizing environmental impact. Preliminary environmental assessments have been conducted on several project sites in order to prioritize them for cleanup and redevelopment. Sites that have redevelopment potential or possible end users have received top priority. Brownfields redevelopment will support waterborne

commerce at the Port of Tampa by increasing capacity and expanding existing and new port businesses. Import and export businesses are at the forefront of the expansion plans, which will increase overall tonnage and cargo value realized by the port.

The Port of Tampa was chosen as a Portfields pilot for its commitment to port redevelopment, its innovative approach to waterfront planning and revitalization, its unique set of needs, its willingness to participate, and the overall value federal assistance can add to the redevelopment effort.

Bellingham

The Port of Bellingham is a municipal corporation serving Whatcom County, located between the major metropolitan areas of Seattle and Vancouver, BC. A 1995 study estimates that base employment tied to the port's waterfront is 2,491 jobs, and 3,853 if export-related and secondary impact employment is considered. The port's mission is to fulfill the essential transportation needs of the region while providing leadership in maintaining the County's overall economic vitality through the development of comprehensive facilities, programs, and services. The port pledges to work cooperatively with other entities within the framework of community standards to be a responsible trustee of publicly owned assets.

In Bellingham, the port hopes to restore the mouth of Squalicum Creek, which enters Bellingham Bay at the head of the navigation channel under a bridge that restricts fish passage. Restoring the creek mouth will support both salmon recovery and commercial use of the federal navigation channel. Preliminary planning (including alternatives analysis) has been completed and some sediment contamination has been discovered, which will be addressed through a comprehensive cleanup plan for the bay. Additional funding will be needed to reconstruct the Roeder Avenue Bridge and rail access. The port hopes to reach preliminary agreements for funding the project over the next year.

The Port of Bellingham has recently been engaged in coordinated efforts to plan economic revitalization and environmental stewardship within Bellingham Bay. The port's sustainable waterfront stewardship approach is focused on meeting future transportation needs, economic revitalization, and restoration and stewardship of marine habitat. The Port of Bellingham aims to apply its Portfields status to implement projects identified through its comprehensive planning efforts.

The Port of Bellingham was selected as a Portfields pilot due to its exciting vision for the community to redevelop its waterfront while balancing social, economic, and environmental goals. In addition, the Port is committed to public involvement, environmental stewardship, responsible business practices, and cooperative problem solving. Also, because of recent economic changes in the community, a number of brownfields or under-developed properties within the port area create opportunities for federal partnerships.

The port of Bellingham will implement high priority projects identified as part of the Bellingham Bay Pilot Project and as part of the ongoing Waterfront Futures Group process. These projects are designed to address historical contamination problems in Bellingham Bay and to support local economic development efforts. The agency work group for the Bellingham Bay Pilot Project has published a "Comprehensive Strategy for Bellingham Bay," and this cooperative partnership between the local community, federal and state agencies and tribes is beginning to show results which will have sustainable positive benefits in the marine environment, including source control, sediment cleanup, and protection of aquatic resources. The Waterfront Futures Group, which is a broad based community effort funded by the Port and the City of Bellingham, will provide a vision for the future of waterfront redevelopment along the shore of Bellingham Bay in 2004.

Conclusion

Regardless of location, ports share concerns related to management, the environment, development, transport, commerce, homeland security, and stakeholder coordination. The major goals that drive port revitalization are surprisingly similar nationwide. These include: increasing port commerce while protecting the environment and human health, economic development, job creation, environmental cleanup and restoration of land and water, and improved transportation systems. Brownfields redevelopment can be an important strategy to support the diverse port and community goals. Portfields is an opportunity for the federal government to partner with port communities, state programs and other stakeholders to build on the port's ongoing efforts to be both an engine of commerce and a good steward of the environment.

Kenneth Walker
NOAA's Ocean Service
Office of Ocean & Coastal Resource Management
1305 East West Hwy Room 10166
Silver Spring MD 20910
Ph (301) 713-3113 X157
Fax (301) 713-4367
Kenneth.Waker@noaa.gov

ASSESSING AND RESTORING LOON AND SEADUCK INJURIES FOLLOWING THE NORTH CAPE OIL SPILL

Molly Sperduto, USFWS,
Sean Powers, Department of Marine Sciences,
Michael Donlan, Industrial Economics,
Dave Evers, BioDiversity Research Institute,
Stewart Fefer, Gulf of Maine Program

Abstract

On January 19, 1996 the tank barge North Cape struck ground off Moonstone Beach in South Kingstown, Rhode Island, spilling over 800,000 gallons of No. 2 fuel oil. Nearly 400 dead birds were recovered. Using a multiplier to account for the proportion of dead birds not recovered, we estimated at least 2,292 birds were killed. We synthesized information on bird population dynamics to adjust for expected longevity and productivity, and to develop an appropriate restoration strategy. Seaducks, loons, and grebes accounted for 87% of the total injury. Loons and eiders were selected as targets for restoration because of regional concern over their population status and the magnitude of injury. Three restoration options were evaluated for loons: nest site protection; nest site enhancement; and public education/outreach. Nest site protection was preferred for both loons and eiders because nest site availability and/or quality currently limit(s) productivity. Based on a series of scaling calculations, protection of 25 nest sites from loss/degradation for a 100-year period was expected to balance the loss. Four years of monitoring indicate that productivity is not as high as estimated and either additional nests or management are needed to balance the loss. Our analysis provides a means of quantifying the level of breeding habitat protection required to restore injured populations of birds.

Molly Sperduto
USFWS
New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
Phone 603-223-2541
Fax 603-223-0104
Email: molly_sperduto@fws.gov