

# INTERCOAST

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## Coastal Management: In Search of Success

By William Matuszeski

There are now a great many coastal management efforts underway throughout the world. These undertakings have resulted in many studies, new institutions, and commitments to bring change. Especially where integrated coastal management has been tried across a range of issues, agencies and interests, there have been ongoing efforts to evaluate success. But, the ultimate measures of success must be the recovery and sustained

health of the coastal resources themselves. These kinds of results are fewer and more difficult to pin down.

This issue of *InterCoast* seeks out success stories and tries to explain what made them happen. It draws heavily upon experience in the United States. This is not because there are no success stories elsewhere. We all know of progress in coastal resource restoration and protection being made worldwide from the Great Barrier Reef to the

Baltic Sea. But, little has actually been written up for the professional audience on how these places have been saved. As your Guest Editor, I have only limited overseas experience and contacts. So I found it easiest to draw upon friends and colleagues here in the US to put their experiences to paper.

The result is a set of articles in this issue by remarkably talented practitioners—people who almost never have the time to sit down and write out what happened and why. I know  
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William Matuszeski

## Chesapeake Bay, USA: Lessons Learned from Managing a Watershed

By Ann Pesiri Swanson

The Chesapeake Bay is the largest and most productive estuary in the United States and among the most productive in the world. Efforts to restore the Chesapeake Bay are now more than two decades old, and there are many lessons we have learned. This paper is intended to highlight some of these lessons and to identify some of the successes experienced in the effort to manage the bay as a single ecosystem, including all of its waters and the land that defines its watershed.

The Chesapeake Bay restoration

effort is designed to work within the highly participatory framework of the American democratic culture. Multiple players are involved at every stage of the restoration process including various levels of government, private citizens, and businesses. The lessons outlined in this paper are put forth with transferability in mind. Some may be directly transferable to similar restoration efforts elsewhere in the world. Others may need to be modified in order to work within the ecological, cultural, or political framework of a given region or country.

### The Chesapeake Bay

The Chesapeake Bay has often been referred to as the “crown jewel” of the United States’ 850 estuaries. Located midway along the east coast of the United States, it extends 180 miles (290 km) from the tidal reaches at the mouth of the Susquehanna River in Maryland to Cape Charles, Virginia, where it meets the Atlantic Ocean. It cuts across virtually the entire north-south length of two states—Maryland and Virginia— helping to define their landscape, their cultures, and their economies.

As an estuarine system, the Chesapeake Bay is highly complex.  
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*InterCoast's* policy is to limit submissions to a short essay or summary. The editor routinely edits submissions heavily and removes references. Such changes are commonly made without further consultation with the author.



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## Matuszeski

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this because it was difficult to get many of them to do it for you. These are folks who are accustomed to being in the field—out there making things happen. I hope you will join me in thanking them for taking time out to tell their stories.

We start with Chesapeake Bay, the place I am most familiar with. I counted Ann Swanson among my closest and most capable colleagues during the decade I spent with the Bay Program. The Chesapeake is America's largest estuary, and worldwide is exceeded in size only by the Ob in northern Siberia. The Chesapeake Bay Program is the granddaddy of US coastal restoration efforts, and the issues it deals with are as vast as its enormous watershed and as complex as the interactions in its 700,000 acres (280,000 hectares) of shallows. Ann's article captures the key lessons from 25 years of intensive management efforts.

Donna Nickerson's piece explains how the US National Estuary Program (NEP) grew out of the Chesapeake Bay effort and expanded to eventually encompass one-third of the nation's estuaries. She goes on to provide a set of insights on how the NEP model and experience was applied to a bay in Thailand, with measurable positive results.

Next we turn to Tampa Bay Program in Florida. This is a NEP with a comprehensive restoration plan, and they have taken the lead on a range of issues, including the impact of deposition of air pollutants on the water and the living resources of the bay. We asked Holly Greening, the Program's Chief Scientist, to take a specific issue and demonstrate how goals were set and results achieved. She has provided us with a myriad of insights related to how they went

about restoring the underwater grassbeds in Tampa Bay.

An overseas success story comes from Singapore, where L.M. Chou outlines how a coordinated government effort cleaned up the Singapore River and the Kallang Basin. A great many difficult decisions had to be made and many people had to change their livelihoods and their lifestyles, but a clear action plan and broad support brought measurable results.

Back in the states, we look at two infamous examples of pollution where there were concerted efforts and major turnarounds. The Cuyahoga River in Cleveland is right up there with the Santa Barbara Oil Spill as a touchstone for the awakening of America's environmental consciousness. This was the river that was so polluted it caught fire and burned in 1969. Since then, it has seen a remarkable recovery. This past summer at the Coastal Zone '01 Conference in Cleveland, US, I sat in an outdoor restaurant on the river in downtown Cleveland, dining on Great Lakes seafood with friends and watching the yachts go by.

The other remarkable comeback has been Boston Harbor. As recently as 1988, the waters were so polluted that they were an issue in the presidential election campaign. Since then, there has been massive investment of public funds to rebuild the sewage treatment system of the metropolitan area. Rich Delaney's article explains how it all happened and the results so far. The lesson here is that coastal cleanups in urban areas have to deal with the basics of human sewage, and the solutions are not cheap.

Keeping finance in mind, we next learn about Puget Sound in Washington State, one of the first NEP to complete its conservation and management plan. We asked Nancy McKay to focus on how

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# OCEANS AND COASTS AT RIO+10

TOWARDS THE 2002 WORLD SUMMIT ON SUSTAINABLE DEVELOPMENT, JOHANNESBURG  
ASSESSING PROGRESS, ADDRESSING CONTINUING AND NEW CHALLENGES  
PARIS, FRANCE DECEMBER 3-7, 2001

## Background

It has been almost a decade since many important new agreements on oceans and coasts were adopted at the 1992 Earth Summit in Rio de Janeiro (United Nations Conference on Environment and Development (UNCED)), including Chapter 17 of Agenda 21, and the oceans-related aspects of the Convention on Biological Diversity and the Framework Convention on Climate Change. Since that time, too, the United Nations Convention on Law of the Sea has come into force, and several modifications to the convention—related to straddling stocks and to deep-seabed mining—have been adopted. There has been much investment in the management of coastal and marine areas by national and international donors, and the number of nations undertaking coastal and ocean management has increased significantly. International entities have done extensive work in providing guidance for sustainable development of coastal and marine resources, and national governments and communities are increasingly experimenting with models of management emphasizing sustainable development, integration, and the precautionary approach.

## Purpose

The Global Conference on Oceans and Coasts at Rio+10: Assessing Progress, Addressing Continuing and New Challenges, to be held at UNESCO headquarters in Paris on December 3 through 7, 2001, is intended to provide an overall assessment of progress achieved on oceans and coasts since the Earth Summit and to provide input to the discussions by governments which will take place in September 2002 when nations around the world will converge at the World Summit on Sustainable Development (Rio+10) in Johannesburg, South Africa, to assess progress made in the implementation of all aspects of the world agenda on environment and development agreed to at the 1992 Earth Summit.

## Conference Structure and Information

The conference is organized into 17 panels and 9 working groups. Conference participants will have the opportunity to participate in working groups centered on pressing current issues in ocean and coastal governance. Recommendations drafted by these groups, together with other conference outputs, will provide key input to the discussions by governments which will occur at the 2002 World Summit on Sustainable Development in Johannesburg, South Africa, on September 2 to 11, 2002.

We kindly invite representatives of ocean and coastal NGOs, IGOs, and governments relevant to the Rio+10 assessment of oceans and coasts to participate in the conference and/or working groups and present information on their views relevant to the oceans and coasts assessment to the conference secretariats for possible distribution at the conference (this information should be presented in summary form (no longer than 3 pages) by November 1, 2001).

## Conference Registration

Conference registration fee is \$250 USD (postmarked prior to November 1, 2001) and a late registration fee of \$400.00 USD after November 1, 2001 (until December 1, 2001) to cover Conference materials, receptions, and refreshments.

For conference information, including major conference topics and themes, participation and registration guidelines, and further organizational details please visit the conference website:

<http://www.udel.edu/CMS/csmpr/rio+10/>

Pre-registration is required. No registration will be taken at the Conference

## For Further Information

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# From the USA to Thailand: Transferring Lessons Learned Within and Across Borders

By Donna Nickerson-Tietze

Estuarine management has evolved in the US from the Chesapeake Bay Program “experiment” of 1976, to a firmly established national program that currently includes approximately one third of the some 100 estuaries in the US. These estuaries are a part of the National Estuary Program (NEP), which is the product of an adaptive learning process in US estuarine management that is in its second generation or ‘cycle’ of development.

The NEP was established in 1987 and is currently composed of some 28 individual estuaries or “NEPs” located throughout the US and Puerto Rico. The program seeks to manage human impacts on estuarine ecosystems through a collaborative planning process that results in the completion of a comprehensive conservation and management plan (CCMP) for the estuary. The US Environmental Protection Agency (EPA) funds CCMP development, which typically takes five years. During this time, the programs come up with

ways to finance implementation.

The program is voluntary—estuaries are nominated by the respective state governors. Once part of the program, participants are obligated under the US Water Quality Act of 1987 to implement the plan.

While each NEP is locally managed by a consensus-based decisionmaking structure that seeks to balance a representation of four constituencies (i.e., elected and appointed policymaking officials from all government levels; environmental managers from federal state and local agencies; local scientific and academic communities and private citizens and representatives from public and user interest groups including businesses, industries, and community/environmental organizations), the management structure of each NEP is slightly different. Local needs and values guide the organization of the committees and management structure. This is one of the compelling features about the NEP that makes its guiding principles and management approach ‘transferable’ not only nation-wide, to the diverse communities found throughout the US, but also as recent experience has shown, to a unique bay community outside the US.

To understand the NEP, it is important to appreciate its origins. It is actually a product of the successful Chesapeake Bay Program (CBP). In 1986, the US Congress was eager to expand the 10 years of experience gained from the CBP to other estuaries in the US. Therefore, the approach and methods of the NEP are based largely on the CBP principles of federal/state partnerships; consensus-based decisionmaking by the representative

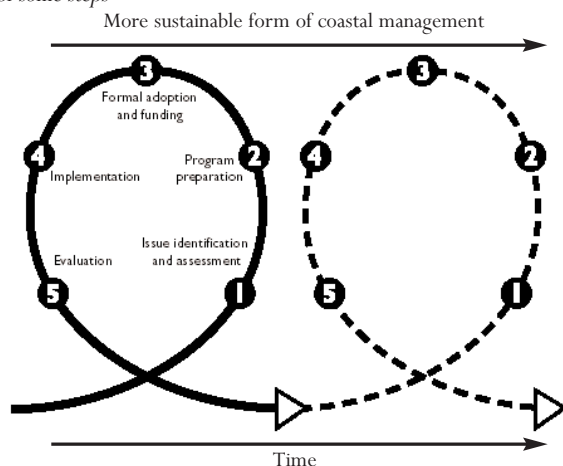
groups that have a stake in the management area; encouraging local communities to take responsibility for managing their own estuaries; and practicing ecosystem management, which seeks to maintain the integrity of the whole system including its chemical, physical, and biological properties, as well as its economic, recreational and aesthetic values. The CBP has also learned from its own early years and has evolved individually as a program.

As with the CBP, the EPA administers the NEP. However, the EPA has taken more of a ‘backseat role’ with the NEP. For example, the NEP’s program office staffs are employees of the lead state agency of each program and take their guidance directly from the NEP management committee. The EPA applied several lessons to the NEP that it had learned in administering the CBP since 1976. Applying these lessons to the NEP has eliminated the often-painful years of learning that slows and inhibits progress, and sometimes discourage participants from contributing the hard work that is needed to implement integrated coastal management (ICM). It has allowed each NEP to begin with a strong start and also continue learning with its close ties to the CBP.

In addition, there exists a close network between NEPs. EPA sponsors annual national meetings for NEP directors and their staff where they learn from each other’s programs by exchanging ideas, progress, problems, and solutions. The NEP directors have also independently established an association of NEPs, which formalizes their network and also allows them to deal directly with Congress on many issues including funding. The NEP directors have been as successful in working together as they have been in their own estuaries. One result has been the passage of

## The Steps of the Coastal Management Cycle

*The dynamic nature of coastal management requires feedback among the steps and may alter the sequence, or require repetition of some steps*



Senate bill S835, introduced in 1999. The primary purpose of this bill is “to encourage the restoration of estuary habitat through more efficient project financing and enhanced coordination of federal and non-federal restoration programs and for other purposes.” It was the vehicle for the passage of other estuary-related bills, including a bill to reauthorize the NEP. This bill extends the NEP five years into the future, increases the budget authorization for the NEP, allows federal funds to be used to help implement management plans, and increases the non-federal match requirement from 25 percent of federal funds, to 50 percent.

The new increase in local funds to match federal grant funds conforms to the NEP principle of relying largely on local sources of funding to sustain the program. This has been an important principle, and one that has been proven by many NEPs to be not only achievable, but a real key to a program’s sustainability and sense of local ownership. In fact, many NEPs have been successful in generating more funds for implementation than they had during the years when EPA funded their CCMP development. For example, from 1986 to 1991, the Buzzards Bay (Massachusetts, US) NEP had an average yearly budget of about US\$500,000 during CCMP development. Since the CCMP was completed, the Buzzards Bay NEP has brought in an annual average of US\$840,000 for CCMP implementation from 1992-1997. The EPA portion of the budget steadily decreased from 75 percent during CCMP development to approximately 25 percent during implementation. However, it is important to note that this transition was gradual and over a course of 10 years. The program needed the EPA’s financial support for the ini-

tial years of implementation. This and other similar lessons from mature NEPs indicate that the long-term goal of “financial independence” from the sponsoring organization is essential, but programs must have steady sources of funding in the meantime.

Almost 1.4 million km<sup>2</sup> of coastal bays and estuarine area is currently managed under the NEP. Common issues include:

- Nutrient overloading
- Pathogens
- Toxic chemicals
- Habitat loss and degradation
- Introduced species
- Alteration of natural flow regimes
- Declines in fish and wildlife populations

These estuaries are in various stages of development and implementation. Most have fulfilled the mandates of the program. Many have excelled in realizing the NEPs general principles. Some of the earlier programs are mature enough that they can now see environmental impacts resulting from the efforts. For example, Buzzards Bay has recently succeeded in reopening 4,000 acres of shellfish beds. Shellfish beds in Puget Sound (Washington, US) have also been reopened. Cleaning up Boston Harbor was a priority activity for early action by the Massachusetts Bay NEP. By 1996, Boston Harbor had become noticeably cleaner. The harbor clean-up has turned into one of the remarkable success stories of recent years. Thirty years ago, Tampa Bay (Florida, US) was so polluted that many felt it could not be restored to health. But water quality is now improving; soft corals and tunicates have returned to some of the most polluted sections of the bay. While water quality regulations began some 10 years before the Tampa Bay NEP was formed, the Tampa Bay community and regulators

credit the NEP with improving and strengthening existing legislation, as well as redirecting the individual efforts of the agencies and public to a single more efficient cooperative effort. Altogether, NEPs have forged an unprecedented partnership of federal, state, regional, and local interest on estuarine issues.

Successful results in the NEP have demonstrated the importance of transferring the lessons learned from older estuarine management programs to new and ongoing programs. For example, the CBP took many years to learn that the largest portion of nutrients contributing to over enrichment in the estuary was coming from sources located directly on the bay, not from the watershed. This would likely be the case for other estuaries. The NEPs had the benefit of this experience. They were encouraged to include as much of the watershed as possible from the outset in defining the boundaries for management. The experience of the CBP illustrated that an estuary program must be guided by the boundaries of the ecosystem in defining the boundaries for management, rather than the politically defined boundaries of district jurisdictions and states.

Other lessons learned from the CBP experience that were applied to the NEP include the following general principles of:

- Using science as an objective foundation to base management decisions
  - Keeping the scientific work directed towards the initial set of problems
  - Adapting the management structure to fit the needs of the community and how decisions are reached, what perceptions are prevalent, and who or what institutions are influential
  - Emphasizing implementation of solutions early where probable causes are generally known and agreed upon
- (continued page 36)

# Nutrient Management and Seagrass Restoration in Tampa Bay, Florida, USA

By Holly Greening

The Tampa Bay estuary is located on the eastern shore of the Gulf of Mexico in Florida, USA. At more than 1,000 km<sup>2</sup>, it is Florida's largest open water estuary. More than 2 million people live in the 5,700 km<sup>2</sup> watershed, with a 20 percent increase in population projected by 2010. Land use in the watershed is mixed, with about 40 percent undeveloped, 35 percent agricultural, 16 percent residential, and the remaining commercial and mining.

Major habitats in the Tampa Bay estuary include mangroves, salt marshes, and submerged aquatic vegetation. Each of these habitats has experienced significant areal reductions since the 1950s, due to physical disturbance (dredge and fill operations) and water quality degradation, particularly impacting the seagrasses due to loss of light availability. Five species of seagrass are commonly found in Tampa Bay, with *Thalassia testudinum* (turtlegrass) and *Syringodium filiforme* (manatee grass) dominating in the higher salinity areas and *Halodule wrightii* (shoalgrass) and *Ruppia maritima* (widgeon grass) usually found in lower salinities.

The importance of seagrass as a critical habitat and nursery area for fish and invertebrates, and as a food resource for manatees, sea turtles, and other estuarine organisms has been recognized by the Tampa Bay resource management community for several decades. In 1990, Tampa Bay was accepted into the US Environmental Protection Agency's (EPA) National Estuary Program. The Tampa Bay National Estuary Program (TBNEP), a partnership that includes three regulatory agencies and six local govern-

ments, has built on the resource-based approach initiated by earlier bay management efforts. Further, it has developed water quality models to quantify linkages between nitrogen loadings and bay water quality, and models that link water quality to seagrass restoration goals.

Recent recommendations from the National Academy of Science National Research Council (NRC) include those which regional watershed programs might consider in developing nutrient management strategies. The NRC recommendations are based on the process designed by the Tampa Bay Estuary Program partners to develop and implement a seagrass protection and restoration management program for Tampa Bay. Three critical steps of the Tampa Bay process are to:

1. Set specific, quantitative seagrass coverage goals for each bay segment
2. Determine seagrass water quality requirements and appropriate nitrogen loading targets
3. Define and implement nitrogen management strategies needed to achieve load targets

## Step 1. Set quantitative resource management goals

Establishment of clearly defined and measurable goals is crucial for a successful resource management effort. In 1992, TBNEP adopted an initial goal to increase current Tampa Bay seagrass cover to 95 percent of that present in 1950.

Based on digitized aerial photographic images, it was estimated that approximately 16,500 hectares (ha) of seagrass existed in Tampa Bay in 1950. At that time, seagrasses grew to depths of 1.5 m to 2 m in most areas of the bay. By 1992, approximately 10,400 ha of sea-

grass remained in Tampa Bay, a loss of more than 35 percent since the 1950 benchmark period. Some (about 160 ha) of the observed loss occurred as the result of direct habitat destruction associated with the construction of navigation channels and other dredging and filling projects within existing seagrass meadows, and is assumed to be non-restorable through water quality management actions.

In 1996, the TBNEP adopted a bay-wide minimum seagrass goal of 15,400 ha. This goal represented 95 percent of the estimated 1950 seagrass cover (minus the non-restorable areas), and includes the protection of the existing 10,400 ha plus the restoration of an additional 5,000 ha.

## Step 2. Determine seagrass water quality requirements and appropriate nitrogen loading rates

Once seagrass restoration and protection goals were established by the participants, the next steps established the environmental requirements necessary to meet agreed-upon goals and subsequent management actions necessary to meet those requirements.

### Determine environmental requirements needed to meet the seagrass restoration goal

Recent research indicates that the deep edges of *Thalassia testudinum* meadows, the primary seagrass species for which nitrogen loading targets are being set, correspond to the depth at which 20.5 percent of subsurface irradiance (the light that penetrates the water surface) reaches the bay bottom on an annual average basis. The long-term seagrass coverage goal can thus be re-stated as a water clarity and light penetration target. Therefore, in order to restore seagrass to near 1950 levels in a given bay segment, water clarity in that segment should be restored to the point that allows 20.5 percent of

subsurface irradiance to reach the same depths that were reached in 1950.

**Determine water clarity necessary to allow adequate light to penetrate to the 1950 seagrass deep edges**

Water clarity and light penetration in Tampa Bay are affected by a number of factors, such as phytoplankton biomass, non-phytoplankton turbidity, and water color.

Water color may be an important cause of light attenuation in some bay segments; however, including color in the regression model did not produce a significant improvement in the predictive ability of the regression model. Results of the modeling effort indicate that, on a bay-wide basis, variation in chlorophyll *a* concentration is the major factor affecting variation in average annual water clarity.

**Determine chlorophyll *a* concentration targets necessary to maintain water clarity needed to meet the seagrass light requirement**

An empirical regression model was used to estimate chlorophyll *a* concentrations necessary to maintain water clarity needed for seagrass growth for each major bay segment. The adopted segment-specific annual average chlorophyll *a* targets are easily measured and tracked through time, and are used as intermediate measures for assessing success in maintaining water quality requirements necessary to meet the long-term seagrass goal.

**Determine nutrient loadings necessary to achieve and maintain the chlorophyll *a* targets**

Water quality conditions in 1992-1994 appear to allow an annual average of more than 20.5 percent of subsurface irradiance to reach target depths (i.e., the depths to which seagrasses grew in 1950) in three of the four largest

bay segments. Thus, a management strategy based on “holding the line” at 1992-1994 nitrogen loading rates should be adequate to achieve the seagrass restoration goals in these segments. This “hold the line” approach, combined with careful monitoring of water quality and seagrass extent, was adopted by the TBNEP partnership in 1996 as its initial nitrogen load management strategy.

As an additional complicating factor, a successful adherence to the “hold the line” nitrogen loading strategy may be hindered by the projected population growth in the watershed. A 20 percent increase in population, and a 7 percent increase in annual nitrogen load, are anticipated by the year 2010.

Therefore, if the projected loading increase (a total of 17 US tons per year) is not prevented or precluded by watershed management actions, the “hold the line” load management strategy will not be achieved.

**Step 3. Define and implement nitrogen management strategies needed to achieve load management goals**

Local government and agency partners in the TBNEP signed an intergovernmental agreement (IA) in 1998 pledging to carry out specific actions needed to “hold the line” on nitrogen loadings. The IA includes the responsibility of each partner for meeting the nitrogen management goals, and a timetable for achieving them. How those goals are reached will be left up to the individual communities as defined by them in their action plans. The TBNEP was also renamed the Tampa Bay Estuary Program (TBEP) as part of the progression from the planning phase to implementation of the adopted Comprehensive Conservation and Management Plan.

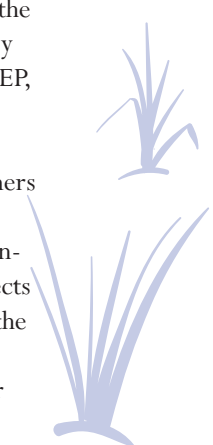
To maintain nitrogen loadings at 1992-1994 levels, local government action plans address that por-



tion of the nitrogen target which relates to non-agricultural stormwater runoff and municipal point sources within their jurisdictions, a total of 6 US tons of nitrogen per year through the year 2010.

To address the remaining 11 US tons of nitrogen of the 17 total per year each year through the year 2010 needed to “hold the line” (attributed to atmospheric deposition, industrial, and agricultural sources and springs), a Nitrogen Management Consortium of local electric utilities, industries, and agricultural interests, as well as the local governments and regulatory agency representatives in the TBEP, was established. The Nitrogen Management Action Plan developed by public and private partners in the consortium combines for each bay segment all local government, agency and industry projects that will contribute to meeting the five-year nitrogen management goal. To ensure that each partner was using similar nitrogen load reduction assumptions for similar projects, guidelines for calculating nitrogen load reduction credits were developed with the partners,

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# Restoration of the Singapore River and the Kallang Basin

By L.M. Chou

The Singapore River and the Kallang Basin (which drains five other rivers) form an important catchment covering one-fifth of Singapore's total land area. These waterways served important functions in the economic development of the country. The Singapore River was used mainly for the transfer of cargo between the myriad of warehouses lining its banks and the numerous ships anchored in the harbor. The river was heavily congested with the busy traffic of barges using the restricted space left unoccupied by moored barges. This intensified with the development of steamships, and the opening of the Suez Canal in the 1840s and the resulting increased volume of trade. With financial institutions and various commercial activities concentrated along its banks, it became a busy waterway supporting the growth of trade and the majority of the population living and working around it. Squatter colonies were established along the upper reaches. Backyard industries flourished along the river.

Not far from the Singapore River is the Kallang Basin and its connecting rivers, all of which were similarly impacted by increasing pollution overload from a larger variety of economic activities that included ship repair yards, sawmills, and pig and duck farms.

By mid 1970, it became clear that the pollution problem had to be solved. These important waterways degenerated into an open sewer and rubbish dump from the indiscriminate discharge of wastes. The waters were black and choked with filth and debris, and devoid of aquatic life. The offensive odor and unsightly mess were not compatible with their position as the commercial hub of the nation, and did not fit the image of Singapore as a clean and modern city. The systems also conveyed land-based pollution to the surrounding sea.

In such condition, the areas could not be further developed to provide a stronger contribution to the expanding economy. With changing emphasis in Singapore's economic directions, past river-based activities built on dated infrastructure lacked the modern facilities necessary to cope with sophisticated and varied demands of a rapidly growing economy. They occupied an area where space was a high premium and locked up the vast potential of the urban waterfront, denying it the investment opportunity that can be derived from other activities. In 1977, the prime minister initiated the cleaning of the Singapore River and the Kallang Basin. He stated that within ten years, Singaporeans should be able to fish in the Singapore River. Thus began a mammoth, comprehensive 10-year program costing US\$150 million and involving 11 government agencies.

## Program Strategy

The solution required cross-sectoral action and close collaboration and coordination between various public agencies. Conflicts emerged as each agency had its own action agenda and were unaccustomed to acting across sectoral borders. The

entire program was integrated with the nation's longer-term strategic development plan so that it was not an isolated exercise.

The ministry of the environment coordinated the action program. It recognized the complexity of the problem and the need to involve various government agencies. The program was finalized after an 8-month study of pollution sources, the problems involved and the measures required from the various government agencies. It addressed not only the immediate steps necessary to clean the rivers, but also the long-term approach in maintaining them pollution free.

The sources of pollution were identified as pig and duck farms, unsewered premises, street hawkers (street merchants), riverine activities, and vegetable wholesale activities. Pollution loading of the waterways through effluent discharge from the 600 pig farms and 500 duck farms was high. The 21,000 premises populated by squatters used mainly night-soil buckets or pit latrines. Some had overhanging toilets, which released untreated sewage directly into streams and rivers. Street hawkers were common in the 1970s, numbering 5000 within the Singapore River and Kallang Basin catchment alone. Most discharged wastes into roadside drains that connected to streams and rivers.

Industries alongside the rivers, like trading, cargo handling, boat building and repairing, were housed in old and congested buildings. These did not have any pollution-control facilities and discharged oil, human waste and garbage and other pollutants into the watercourses. Vegetable wholesale activities were carried out along streets or on vacant land without proper facilities. Spoiled vegetable and trash were discarded in drains and streams where they eventually rotted and polluted the

Restored  
Singapore River





ivers. Other point sources of pollution included indiscriminate discharge of waste and wastewater into drains by households, coffee shops, markets, backyard industries and motor-repair activities.

## Plan Formulation

The program involved four phases: 1. cleaning and dredging of the waterways, 2. phasing out of polluting activities, 3. removal and/or relocation of farms, hawkers, and improper workshops, and 4. development of suitable infrastructure, factories, housing, and food centers for those affected by the relocation.

The program was effective in providing the participating agencies with an overview of the entire range of polluting activities in the catchment, at a time when each was concentrating on its own agenda such as the sewage management, or refuse collection or drainage. The participating agencies had to be convinced that their involvement was necessary to achieve something better—an environment which is cleaner, new opportunities such as recreation which were impossible before, new developments, and enhanced land values. They had to be convinced that they will be leaving a legacy for future generations and that this clean water resource can in the long term be turned to during times of emergency.

Pollution problems were grouped into three categories. First, in areas where control facilities were provided, their efficient use had to be promoted. Education was necessary to change habits such as careless handling of night-soil and rubbish collection by service handlers to reduce spillage, and dumping of refuse by householders into drains. Second, in areas where facilities could be provided with redevelopment, plans had to be known well in advance and squat-

ters resettled. Third, in areas where it was impossible or economically not feasible to provide such facilities, action had to be taken to control, minimize, or remove the sources. The main objective of the action plan was to restore the Singapore River and the Kallang Basin to the extent that marine life can thrive.

Habits had to be changed. For more than 160 years, people used the rivers as an open sewer or dumping ground. The action to be taken also involved people's livelihood. Squatters had to be resettled, farmers relocated, and hawkers moved into centers provided with proper water supply and drainage. Getting people to accept change was the major challenge, and it is recognized that strong political commitment played a crucial role in facilitating the process. Before any relocation could be carried out, alternative areas had to be identified, and therefore, the long-term plans for these areas had to be determined taking into account the nation's overall development plan. The plan was not to cause an abrupt halt to businesses and industries, but to provide alternative sites with the necessary infrastructure to control and manage pollution.

The program established specific targets to be achieved within certain time frames. An eight year target was set for the improvement of water quality, the reduction of odor, the absence of rubbish, and the presence of fish for most of the time. Targets for re-development of some areas were set at a maximum of seven to eight years.

## Program Action

Regular coordination meetings kept all agencies informed of progress, problems, and needs. The meetings were effective in reaching solutions through the cooperation of a few agencies when a single



Restored Singapore River

agency experienced difficulty in solving a problem on its own. The task of resettlement of squatters and other landowners for example, required the full collaboration of the Urban Redevelopment Authority, Land Office, and the Housing Development Board. Coordination between agencies enabled schedules to be met.

Relocation and re-settlement presented difficult problems. There were questions of compensation, the basis of determining the rates, and identifying who were or were not entitled to compensation. Alternative housing had to be built before the squatters could be moved. Businesses also made problems by rejecting given alternative sites, but eventually, all were moved. Some old shop-houses and other buildings had to be demolished and reconstructed because it was impossible to sewer them due to site constraints.

By 1982, all pig and duck farming activities were phased out or relocated. Over 2,800 backyard and cottage industries were relocated to new industrial and housing estates provided with modern sanitation and solid waste removal facilities. A total of 21,000 unsewered premises were phased out. In 1983, the 800 barges moored at the Singapore River were relocated to another coastal area provided with proper mooring and other facilities. Relocation of the boatyards from the Kallang Basin was almost completed by 1985.

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# From Flame to Fame: The Restoration of the Cuyahoga River, an American Heritage River

By Janine Rybka, Kay Carlson, and Kelvin Rogers

The Cuyahoga River—the river that burned—gained a national reputation as one of the most polluted rivers in the country when a welding spark ignited surface oils and debris on June 22, 1969. This travesty sparked the growing environmental movement, leading to the passage of one of the United States' landmark environmental laws, the Clean Water Act of 1972. Thanks to the Clean Water Act, water quality conditions steadily improved in the 1970s and 1980s, but it was not until the 1990s that significant changes were documented. Today, most of the river meets water quality standards and is a symbol of renewal and renaissance, thanks to the success of regulations and a variety of collaborative projects between stakeholders, including the grassroots public.

Compared to many, the Cuyahoga River is not a long river. It flows for just 100 miles, draining an area of 813 square miles in portions of five Northeast Ohio counties—Geauga, Portage, Summit, Medina and Cuyahoga. The watershed comprises 2 percent of the land in Ohio and supports 17 percent of the state's population. Now, the Cuyahoga is heavily impacted by urbanization and industrialization. On its downstream journey, the river travels through rural and scenic areas. In fact, a 25-mile stretch of the river in the upper watershed is designated as a state scenic river. Needless to say, this once rural area is on the threshold

of development. The impacts of urbanization increase as the river winds its way down stream, including impoundments for drinking water, numerous dams and storm drains. In Cuyahoga Falls, a community where the river drops over a series of cascades, a 65-foot dam cuts the river in half. This 45-mile long downstream segment of the river, from Akron to Cleveland, is the area that has been most affected by the years of persistent pollution. Just north of the dam, the river flows through the 33,000-acre Cuyahoga Valley National Park, which provides a wonderful buffer between the urban and industrial centers of Akron and Cleveland. The Cuyahoga River flows through Cleveland and empties into Lake Erie. Oddly enough, this U-shaped river's headwaters are just 30 miles east of its mouth.

Like many rivers, the Cuyahoga River was utilized for centuries by Native Americans as the primary means of access between Lake Erie and the Ohio River. At one time, the Cuyahoga River formed the western boundary of the US. Settlers flocked to the new Connecticut Western Reserve to start farms and business. In 1825, the 308-mile Ohio and Erie Canal was constructed to help transport goods between the Great Lakes and the Gulf of Mexico. In a few short years, Ohio went from a wilderness to the third most populated state in the country. Soon afterwards, industries including Standard Oil, Quaker Oats, Republic Steel and Goodyear Tire and Rubber Company flourished along the river.

Since most of the population and industries were located in the lower half of the river, the upper half of the Cuyahoga River remained in fairly good condition.

The lower river, however, was a different story. Industries, sewage treatment plants, and other point-source dischargers dumped wastes in the river. Nowhere was the problem as great as in the lower 5 miles of the river, known as the Navigation Channel. Oil and debris that washed downstream contributed to numerous fires during the 20th century with the last one being on June 22, 1969. The attention given to the burning river catapulted the City of Cleveland into the "Pollution Hall of Shame" and helped spur environmental legislation, including the Clean Water Act, the Great Lakes Water Quality Agreement and the creation of national and state Environmental Protection Agencies (EPA).

Environmental regulations that focused on large point source dischargers dramatically improved the conditions of the river. Gone are the days of oil sheens and dead fish in a river that the Ohio EPA said was so polluted "that there were times when pollution-tolerant sludge worms couldn't live in its waters." Yet, pollution problems, particularly nonpoint-source problems, remain. For this reason, the EPA classified the lower 45 miles of the Cuyahoga River as one of 43 Great Lakes Areas of Concern, warranting development of a Remedial Action Plan (RAP).

## Overview of Remedial Action Plans (RAP)

The RAP program was established subsequent to an agreement between the United States and Canada. The goal was to clean up and protect the Great Lakes by reducing contaminants from the major tributaries. RAPs were to take a holistic, ecosystem watershed approach to identifying prob-

Cuyahoga River on fire



lems and implementing solutions.

The concept of RAPs originated from a 1985 recommendation of the Great Lakes Water Quality Board of the International Joint Commission (IJC). The board found that despite implementation of regulatory pollution control programs, a number of “beneficial uses,” such as unrestricted human consumption of fish, successful reproduction of indicator wildlife species, and adequate fish and wildlife habitat, were not being restored. Thus, the board recommended that comprehensive and systematic remedial action plans be developed and implemented to restore all “beneficial uses” in the local areas of concern.

A 1987 amendment to the Great Lakes Water Quality Agreement formalized the RAP program and defined the areas of concerns as specific geographic areas where beneficial uses or the area’s ability to support aquatic life were impaired. Impairment of beneficial use means a change in the chemical, physical, or biological integrity of the Great Lakes ecosystem sufficient to cause any of 14 use impairments.

The Cuyahoga RAP process began in 1988 when the Ohio Environmental Protection Agency formed the Cuyahoga River RAP Coordinating Committee, consisting of 33 representatives from local, regional, state and federal agencies, private corporations, and citizen and environmental organizations. The mission of the Cuyahoga RAP is to plan and promote the restoration and preservation of beneficial uses of the lower 45 miles of the Cuyahoga River and a ten-mile stretch of near-shore Lake Erie through remediation of existing conditions and prevention of further pollution and degradation.

The RAP is truly a community-based effort. The people behind the

RAP are a dedicated group of volunteer community leaders and a small staff working together to take the plan beyond words and paper into research and action. Cuyahoga Coordinating Committee (CCC) members are involved in the planning and implementation of the plan. They meet to discuss issues and formalize the agenda to address specific impairment issues. Six key issues around the beneficial use impairments have been identified: human health; fish and aquatic organisms; wildlife; socioeconomic uses; recreation; and public awareness. Work groups that focus on the six issues reach beyond the CCC members to involve additional stakeholders to further identify and implement actions that benefit the river.

Unlike most of the other RAPs, the Cuyahoga River Community Planning Organization, a nonprofit, 501(c) (3) charitable organization formed in 1989, supports the activities of the Cuyahoga River RAP. A small staff conducts the planning and coordination of the CCC’s activities, manages contracts for technical research, organizes community involvement activities, and provides various public education programs. Staff also has the responsibility of raising funds through grant writing, special events, and membership drives.

## Accomplishments Through Community Involvement

It is important to note that the improvements to the river have been the result of remarkable collaborative efforts. The Cuyahoga River RAP has provided the forum for getting stakeholders to the table, which helped to form a research agenda, work program, and public involvement strategy aimed at educating the public and increasing public participation.

A 1992 Community Preference

Poll of Cuyahoga and Summit County found that residents believed the water quality of Lake Erie and the Cuyahoga River was better, but there was still more that needed to be done. Many residents believed industry was responsible for most of the pollution, but indicated that all segments of society needed to be responsible for protecting and cleaning up the environment. In fact, respondents indicated that they would do more to help the environment, if they had



Storm Drain Painting

information about how to do so.

The poll results led to initiatives designed to increase awareness of environmental issues and protection, including the Cuyahoga River RAP’s Stream Stewardship Program. Collaborative efforts with a variety of agencies and organizations, both governmental and neighborhood-based, have led to the development of projects such as water-based curriculum guides for schools; a video about the proper maintenance of septic systems; a regionally recognized storm drain stenciling program; stream restoration projects; and education programs, including workshops, events, and tours for citizens and community leaders.

In 1995, the Cuyahoga River RAP initiated a Stream Stewardship  
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# Lessons Learned in Boston Harbor, USA

By Richard Delaney

During the 1980s, alarming reports of massive pollution, highly publicized legal challenges and even presidential political campaign accusations, helped earn Boston Harbor, Massachusetts, USA, a worldwide reputation as one of the most polluted harbors in the US. Today, the restoration of Boston Harbor has emerged as one of the most significant success stories in the coastal US.

Like many urban harbors, Boston Harbor is a shallow estuarine system. It encompasses 45 square miles of embayments, coves, tidal flats, and 32 islands. It receives freshwater flows from the rivers of four adjoining watersheds, comprising 755 square miles and empties into Cape Cod Bay. It was a center of colonial maritime commerce, and until recently, an unwilling recipient of metropolitan Boston's municipal sewage waste since 1820.

By 1980, two primary sewage treatment facilities located on either side of the entrance to the harbor were discharging 480 cubic feet per second (cfs) of partially sewage effluent and tons of residual sludge. Consequently, an extremely productive estuary with significant stocks of lobster, flounder, over 4,700 acres of shellfish beds and five miles of fine sandy public swimming beaches were closed to

the public with tremendous economic losses and reduced social benefits.

This article reviews some of the key institutional, legal, scientific, social and political decisions and events that have led to the successful restoration of the natural resources of Boston Harbor in an unexpectedly short period of 15 years.

## Creation of Adequate Institutional Capacity

One of the most difficult political decisions, and one that became pivotal to many subsequent actions, was the creation of a new, independent institution which had sufficient financial autonomy and technical capacity to implement a remedial action plan.

The agency charged with the responsibility for the sewer system since 1919, the Metropolitan District Commission (MDC), had become virtually ineffectual due to chronic under-funding, inadequately trained staff, excessive volumes of sewage beyond design capacity, and treatment facilities that had little or no maintenance or upgrading for years. Even when the operational aspects were running smoothly, the treatment strategy included only primary treatment of the sewage with the chlorinated effluent and sludge discharged into the outer harbor on outgoing tides.

The new entity, the Massachusetts Water Resources Authority (MWRA), established by the Massachusetts Legislature, was given numerous authorities specifically intended to address the failings of its predecessor. Not only does MWRA have the authority to raise funds by issuing tax-exempt municipal bonds, which are to be paid off through the collection of user fees, but it can also set rates and determine its own personnel

hiring and pay systems outside state civil service requirements. The MWRA is organized much like a public corporation, with a board of directors and an executive director responsible for day-to-day operations. The result has been a \$3.8 billion public infrastructure project that has actually achieved that elusive goal of being completed "under budget and on time."

## Ongoing Judicial Oversight

The role of the judiciary system was another key positive contribution. In late 1982, the city of Quincy, Massachusetts, filed a civil suit against MDC in state court seeking relief from the chronic pollution of Boston Harbor and adjacent Quincy Bay. In June 1983, the Conservation Law Foundation brought federal suit against MDC and US Environmental Protection Agency (EPA), charging that EPA had failed to force MDC compliance with the US Clean Water Act (CWA).

The Quincy suit played a critical role as a "focusing event" that not only led to political recognition of the problem; it also served to galvanize regional environmental groups and public attention. The court appointed a special master, and a schedule for compliance with CWA requirements was developed in conjunction with all responsible parties.

Subsequently, the federal judge convened monthly sessions where all parties would report the details of their efforts to meet the benchmarks of the compliance schedule. At critical points, when the process slowed or stalled, the threat of a court-imposed moratorium on new sewer hookups across the system quickly got everyone's attention and served as another catalyst for progress.

Boston Waterfront



## Maintaining a Comprehensive Framework and Perspective

Understanding the dynamics of Boston Harbor within the larger ecosystems of Massachusetts Bay and the land-side watersheds was another important factor in several of the key management decisions.

The existence of a Massachusetts Coastal Zone Management (CZM) Program and the designation of Boston Harbor/Massachusetts Bay as a national estuary, both provided a more comprehensive framework for this understanding and for decisions.

Driven primarily by the mandates of the CWA—that focused largely on point sources of discharges—the initial scientific studies and policy decisions of the MWRA dealt primarily with a limited range of pollution. As the environmental assessments were undertaken, it became evident that a truly comprehensive abatement strategy must address a wider range of sources and types of pollutants.

The Massachusetts Bays Program (MBP) established a forum for both scientific studies and the development of a comprehensive management plan for the waters of Boston Harbor, as well as Cape Cod and Massachusetts Bays. The forum also presented an opportunity for better collaboration among the numerous federal, state, and local agencies and for substantive input from the scientific community in direct response to priority problems raised by the managers and citizens.

The Massachusetts CZM program and policies provided the broadest management framework for all activities impacting Boston Harbor and the coast, and in some cases it provided the authority to implement the broader aspects.

## Meaningful Participation from an Informed Public

With extensive media coverage (over 5,000 articles), numerous formal and *ad hoc* citizen committees and an ambitious outreach campaign by the MWRA and other agencies, the clean up of Boston Harbor was a very transparent and public endeavor with meaningful input from all sectors.

Early in the process, a special commission with broad public representation, appointed by the governor and staffed by the Massachusetts CZM staff, first laid out the management recommendations that became the basis for the Boston Harbor strategy. They included recommendations that favored secondary treatment, composting of sludge, a deep-water outfall pipe, and the creation of an institution with sufficient capacity to implement the project (MWRA). Prior to this report, both the state and federal government agencies had suffered through several years of scientific uncertainty, political maneuvering, and what would ultimately be financially costly delays.

The delays occurred during a period when the federal government's financial contributions to the cost of sewer treatment facilities were being essentially phased out, thereby shifting the financial burden to the users. These citizen ratepayers have been the real "unsung heroes" by remaining committed to the restoration even as their rates escalated from US\$259 (in 1989) to US\$525 (in 1992 the national average) to US\$850 (2000) annually for a family of four. The rate escalation shock had very real potential for ratepayer revolt.

In addition, an extensive public education campaign increased citizen awareness. School education

programs and public information campaigns encouraged the reduced use of toxic materials being disposed via residential sewer lines. A technical assistance program for the 5,000 businesses using the system demonstrated the financial and environmental benefits achievable by substantially reducing the use of toxic materials. As further motivation, the MWRA was vested with authority to levy very costly fines against repeated offenders.

Throughout the process, harbor oriented nongovernmental advocacy groups, such as Save the Harbor and the Boston Harbor Association, helped maintain the public's attention and interest in the project.

## The Role of Science and the University

Many management decisions were driven by the CWA of 1972, which required publicly owned treatment works to provide secondary treatment by 1977 (defined as the removal of 85 percent of both total suspended solids and biological oxygen demand). This presented complex technical and scientific issues such as the basis for a possible exemption from this requirement, the appropriate location of outfall pipes and the design of comprehensive long-term monitoring program. These added uncertainty, controversy, and often time delays in the early stages of the project.

Extensive participation by university faculty scientist and policy experts, especially the University of Massachusetts Boston, strategically located on the harbor, helped frame the issues and develop and assess remedial options. University scientists played prominent roles on scientific and policy advisory committees, and public information meetings and conferences where hosted on campus.

The final benchmark for success was the project's ability to treat

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# Funding Implementation: Puget Sound Management Plan, USA

By Nancy McKay

Puget Sound is the United States' second largest estuary. Located in the northwest corner of Washington State, USA, its shorelines stretch for 2,300 miles and there are 16,000 square miles of land and water in the basin. Water depths reach over 900 feet, and in many locations the daily tidal range is over 12 feet. More than 10,000 rivers and streams flow into its waters. While much of the sound is healthy, rapid growth and development in the region are stressing the system. A steady loss of habitat, alarming declines in some fish and wildlife populations, and closures of shellfish beds are signs that the sound is threatened.

## The Puget Sound Management Plan

Managing and protecting the sound's water quality and biological resources is a challenge. What makes the task most daunting is the sheer number of government bodies that have some jurisdiction affecting the sound. There are 108 cities, 12 counties, 12 conservation districts, 28 port districts, 22 tribal governments, 14 state agencies and nine federal agencies. In addition, there are hundreds of special purpose districts for water, sewer, groundwater protection, diking, drainage, and irrigation.

During the 1960s and 1970s, there was increasing concern that the health of Puget Sound was deteriorating. This came in spite of many efforts to protect the sound at every level of government. By 1985, there was general agreement that better coordination among programs would improve their effectiveness and efficiency—and ultimately improve the health of Puget Sound. That year, the Washington State Legislature creat-

ed the Puget Sound Water Quality Authority to develop and oversee implementation of a management plan for the Puget Sound basin.

The Authority developed the first Puget Sound Water Quality Management Plan in 1987. Updates were prepared in 1989, 1991, 1994, and 1996. During this time, the management plan evolved along with the issues. Some plan actions called for in the plan were completed, some were revised and new programs and actions were added.

Responding to similar concerns at the national level, US Congress established the National Estuary Program as Section 320 of the US Clean Water Act in 1987. The US Environmental Protection Agency approved the Puget Sound management plan as the federal Comprehensive Conservation and Management Plan for the basin in 1991.

In July 1996, the authorizing legislation for the Puget Sound Water Quality Authority expired. That year the Washington State Legislature enacted the Puget Sound Water Quality Protection Act. Under this law the Puget Sound Water Quality Action Team and Puget Sound Council assumed the Authority's responsibilities, and the program became a part of the Washington governor's office. The state legislature provided about US\$3 million each year to support 23 employees who staff the work of the action team and council. The action team and council adopted further amendments to the Puget Sound management plan in 2000.

The Puget Sound Water Quality Management Plan is comprehensive, addressing problems ranging from contamination of shellfish growing areas to wetlands and habitat protection, sediment con-

tamination, stormwater, monitoring and research. Each program has a goal and a strategy to prevent future harm while addressing past problems.

## Implementing the Plan

Implementation of the Puget Sound management plan began in 1987. During the 1987-1989 the Washington state legislature first budgeted funds for the Puget Sound Water Quality Authority, other state agencies, and two universities to implement actions called for in the plan. Since 1987, the legislature has provided nearly \$200 million to implement the plan. In 1996, the legislature required the newly-created action team to develop two-year work plans to implement the longer-term management plan. Since then, state appropriations have been stipulated within state agency and university budgets for specific actions identified in the annual work plans. For example, funding is stipulated in the state Department of Ecology's budget to support technical assistance to local governments on stormwater management, monitoring of specific parameters to assess the health of the sound, and other actions. As another example, funding is stipulated in the budget of the state Conservation Commission to support the work of the 12 conservation districts in the sound.

## Sources of State Funding

State sources of funds have included the state general fund, the water quality permit fee account, state capital account, various fee programs, the motor vehicle fund, the water quality account (supported by cigarette tax revenues), the aquatic lands enhancement account, oil spill administration account, and the toxics control account.

In 1997, at the urging of the action team, the state legislature passed a bill which allows counties to use utilities to fund a number of water quality programs, including operation and maintenance programs for on-site sewage systems. Each year, more local governments create utilities to fund stormwater programs. In the early 1990s, the legislature enacted a law, proposed by the Puget Sound Water Quality Authority, that requires counties to create districts when commercial shellfish beds are downgraded. Under the law, counties are allowed to adopt fees to better protect shellfish beds.

### **Grant Funds**

The action team has been successful in making implementation of the Puget Sound management plan a priority for the use of State Revolving Loan Funds and federal Clean Water Act Section 319 funds. Another important source of funding is the state Water Quality Account. In 1986, the state legislature increased a tax on cigarettes, creating the Water Quality Account. The fund has supported a grant and loan program, administered by the state Department of Ecology, which has provided about US\$90 million each year to support local water quality projects throughout the state. Tribes, cities, counties and other local entities in the Puget Sound basin have used these funds to carry out many projects to implement the Puget Sound management plan.

### **The Action Team's Pie Program**

In 1987, the Puget Sound Water Quality Authority created the Public Involvement and Education Program (PIE) to support local education and involvement projects. Since 1987, the program has provided US\$5.2 million for more than 300 projects, and US\$2.5 million more has been leveraged through matching funds. Two mil-

lion people have been directly involved in projects and countless others reached indirectly. The average amount of a contract is US\$17,000. PIE contractors have included school districts, environmental groups, local and tribal governments, and business and trade associations. Projects have included restoration and enhancement activities; technical assistance; development of best management practices; beach and water quality monitoring; field workshops and site visits; volunteer and teacher training; prototypes of environmental products; day camps and family outings; interpretive signs and displays; experiential learning (theater, plays, storytelling); public meetings and events; telephone hotlines; science-based reports and studies; and promotional and educational materials.


### **Federal Funding**

The US Environmental Protection Agency (EPA) and other federal agencies have also supported plan implementation. EPA has provided US\$6.5 million since 1987 to support research projects and conferences; the Puget Sound Ambient Monitoring Program created under the Puget Sound management plan; workshops and materials on low-impact development, on-site sewage systems, stormwater management, shellfish protection, citizens' monitoring, protecting nearshore habitat and other topics; the work of the Georgia Basin (Canada)/Puget Sound International Task Force which is co-chaired by action team staff; and implementation of actions called for in the Puget Sound management plan. The U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration are among other federal agencies that have provided funding for plan implementation.

### **Other Funding**

It is difficult to estimate how

much money local and tribal governments, businesses, nongovernmental organizations, and individuals have spent to implement the Puget Sound management plan, but the figure would total millions of dollars. Since 1985, over 70 percent of the cities and counties in the basin have created stormwater programs, 11 of 12 counties have created or upgraded operation and maintenance programs for on-site sewage systems, 29 local governments have upgraded their sewage systems from primary to secondary treatment, and more than 50 local governments are implementing watershed action plans developed under the Puget Sound management plan. In addition, Superfund sites and some contaminated sediment sites have been cleaned up. Local governments and nongovernmental organizations have acquired many acres of habitat and wetlands and carried out numerous restoration projects. Nongovernmental organizations, youth groups and schools have organized monitoring and clean up programs for streams, wetlands, and beaches. Many businesses have cleaned-up contaminated sites and upgraded facilities, practices and equipment to better protect water quality. Farmers have installed new equipment and fenced streams. Homeowners have repaired or replaced their on-site sewage systems. All this has taken place with the intent of cleaning up Puget Sound.

*Nancy McKay, Chair, Puget Sound Water Quality Action Team. For further information about the Puget Sound Water Quality Action Team and its work, visit the action team's website: [www.wa.gov/puget\\_sound](http://www.wa.gov/puget_sound) *



# San Francisco Bay, USA: Long-Term Management Strategy for Dredged Material

By Keelin Kuipers and Steve Goldbeck

San Francisco Bay (the bay) is a major shipping center, with Oakland Harbor serving as one of the world's largest container/shipping ports. Annually, 632 million tons of cargo pass through Oakland Harbor. Historically, material dredged to establish and maintain the navigation channels necessary to support the shipping industry in the bay has been disposed of at in-bay sites.

While the bay is a major center for maritime commerce, it is also home to sensitive ecological resources. There are about 500 species of fish and wildlife associated with the bay's aquatic habitats, including 20 threatened and endangered species. Approximately 90 percent of the bay's original tidal marshes are lost, resulting in greatly reduced habitat for fish and wildlife. Only 16,000 acres of the original 190,000 acres of historic tidal marsh remains. Much of this habitat has been lost due to filling and diking of the bay.

The San Francisco Bay Conservation and Development Commission (BCDC) is a regional agency responsible for regulating development in and along the shoreline of the bay. The goal of the BCDC is to address the effects of bay fill and to provide opportunities for increased public access. Since its establishment in 1965, BCDC's efforts have increased the size of the bay by 1,843 acres through the reopening of diked areas to tidal action and other restoration efforts. BCDC has also opened up 860 acres of new public access along more than 78 miles of bay shoreline.

## Long-Term Management Strategy

In 1990, the BCDC and several other federal and state partner agencies cooperatively began to develop a Long-Term Management Strategy (LTMS) to address problems associated with dredging and the disposal of dredged material. These partner agencies include the US Army Corps of Engineers (USCOE), US Environmental Protection Agency (EPA), San Francisco Bay Regional Water Quality Control Board, and California State Water Resources Control Board. Issues associated with dredged material disposal include limited in-bay disposal site capacity, potential environmental impacts of dredging and in-bay disposal, and differing agency policies regarding dredging and disposal. Under the 50-year planning period for the LTMS, the projected dredged material disposal needs are estimated conservatively at about 300 million cubic yards, or approximately six million cubic yards annually.

Large-scale dredging efforts for the navigation and maritime industries have taken place in the bay for more than one hundred years. Currently, the USCOE maintains 17 deep- and shallow-draft channels in the bay. Given the high level of dredging activity that has continuously occurred in the bay, disposal capacity has become a major issue. Historically, the majority (80 percent of the approximately six million cubic yards dredged annually) of sediments dredged in the bay have been disposed at three federally designated open-water sites in

the bay, located near Alcatraz Island, in San Pablo Bay, and in the Carquinez Strait. Alcatraz Island has been the most heavily used site. Dredged material disposed of here was expected to disperse, thereby avoiding potential hazards to navigation. However, an 80-foot high mound of dredged material whose top was less than thirty feet below the bay surface was discovered at the site in 1982. Ocean sites and beneficial reuse opportunities have generally been limited due to the unavailability of alternative sites, high disposal and reuse costs, and regulatory challenges to establishing alternatives to in-bay disposal, among other issues.

While the limitations of in-bay disposal sites were emerging, concerns were also being raised regarding the effects of dredging and the disposal of dredged material on the aquatic environment. These concerns included potential impacts to fisheries and other aquatic organisms and ecological resources, including species listed as either threatened or endangered under the federal and state Endangered Species Acts.

At the same time, the state and federal regulatory agencies responsible for the review and approval of dredging projects began considering changes to their requirements on a relatively *ad hoc* basis. In addition, review of dredging projects took place on an agency-by-agency basis without much coordination. This further reduced the predictability of getting dredging projects approved and eroded confidence that environmental concerns would be adequately addressed.

Eventually, these increasing concerns about disposal capacity, environmental effects of dredging and disposal of dredged material, and project delays due to multiple agency review became known as "mudlock" and highlighted the need



for a regional strategy that provided a diverse array of disposal options. This need led to the development of the LTMS.

In 1992, BCDC amended the Dredging Findings and Policies contained in the San Francisco Bay Plan (Bay Plan) to recognize the importance of dredging to the economic and social welfare of the bay. Also needed was:

- To address the limited capacity of existing in-bay sites and potential adverse impacts on natural resources

- To specify that material should be disposed of in the bay only if other alternatives are not feasible

- To encourage the beneficial reuse of dredged material for wetlands restoration and other purposes

This amendment of the Bay Plan was done on an interim basis pending completion of the LTMS process. The LTMS was adopted by partner state and federal agencies in 1999. It is based on a conservative approach that the annual average of total disposal volume will be about six million cubic yards. The selected long-term strategy for the region involves taking approximately 40 percent of this annual volume to beneficial reuse sites and 40 percent to the federally designated deep-ocean site, while limiting disposal at the in-bay sites to 20

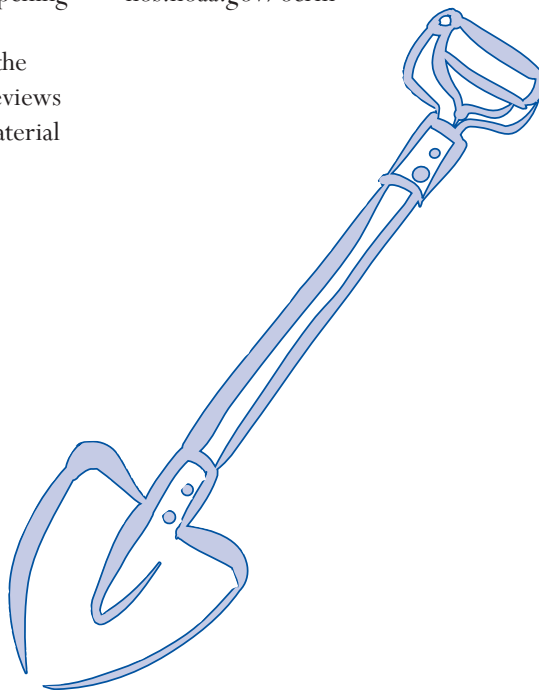
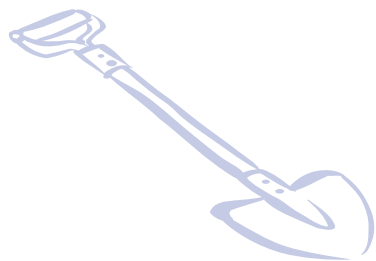
percent. The goal is to limit in-bay disposal to approximately one million cubic yards per year. The Draft LTMS Management Plan presents guidance for implementing this strategy. In December 2000, BCDC adopted revised policies and regulations to be able to implement the LTMS Management Plan as a partner agency.

One of the key options for beneficial reuse described in the LTMS Management Plan is the use of dredged material for wetland restoration and creation. The restoration of wetlands at Hamilton Army Airfield is one such project using dredged material from the bay. BCDC is working in partnership with the State Coastal Conservancy, City of Novato and USCOE to restore more than 700 acres of tidal and seasonal wetlands, as part of reuse of the closed Hamilton Army Airfield. The Hamilton Field Wetland Restoration Project will provide important fish and wildlife habitat, public access, and flood protection. The project will provide for beneficial reuse of more than 10 million cubic yards of dredged material from San Francisco Bay maintenance dredging and new deepening projects.

The LTMS also addresses the need to coordinate permit reviews by establishing a Dredged Material

Management Office (DMMO). The DMMO is made up of the permitting agencies, including BCDC, the State Lands Commission, the San Francisco Bay Regional Water Quality Control Board, the USCOE, and the EPA, and serves as a single point of contact for dredging permit applicants. The DMMO reviews all navigational dredging and disposal projects in the Bay Area and provides for coordinated and consistent regulatory review of these projects. The goal of these coordination efforts is to reduce redundancy and delays in the permitting process and ensure environmental protection. For this effort, BCDC, the State Lands Commission, and the San Francisco Bay Regional Water Quality Control Board received a National Oceanographic and Atmospheric Administration Excellence Award for Coastal Zone Management in 1999.

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# Cross Sectoral Initiatives in Democracy and Environment: Chetumal Bay, Mexico

By Pamela Rubinoff, Rafael Romero, and Octavio Chavez

The environment/democracy linkage has recently been initiated in Mexico's US Agency for International Development (USAID) program. This provides an opportunity to evaluate a new way of doing business, where sectoral issues such as tourism, fishing, or reef management are embedded into a larger context of democratic principles of transparency, accountability, and participation. The goal is to support effective governance and contribute towards "sustainable development."

USAID-supported efforts in Southern Quintana Roo, Mexico, have been implemented by the University of Rhode Island, Coastal Resources Center (CRC) and local partners to provide both tangible examples of participatory management and to build capacity for promoting integrated coastal management (ICM) as a tool for sustainable use and conservation of coastal resources. In 1998, Chetumal was chosen as a place to build the

capacity of local institutions in various aspects of ICM. Here biodiversity was high, pressures from tourism were increasing, zoning plans were being developed, and additional marine protected areas were being designated, including the state Manatee Sanctuary in Chetumal Bay. No doubt this was additionally catalyzed by the 1998 declaration of the Meso American Reef Initiative and the subsequent program design by the Global Environment Facility aimed at conserving the world's second longest barrier reef, extending from Mexico's Yucatan Peninsula to the Bay Islands in Honduras. The USAID project supported the establishment of the *Red MIRC*, an ICM network of nongovernmental organizations (NGOs) and institutions. The network was to exchange experience, knowledge, understanding, and information on coastal issues between a broad group of stakeholders. In parallel, these organizations helped form the Belize-Mexico Alliance for Management of Common Coastal Resources (BEMAMCCOR), a binational effort to advance ICM in shared waters such as Chetumal Bay and the Meso American Reef complex. At the institution level, the University of Quintana Roo initiated efforts to create the MIRC Center to focus on research, extension, outreach, and academic programs associated with ICM. To date, partners and colleagues have implemented community extension, outreach, environmental education, and community-based tourism initiatives to stimulate interest and advance participatory democracy for coastal management in the region.

Understanding the need to inte-

grate across issues, stakeholders, and levels of government, the 2001 objective for the USAID/CRC project was to "consolidate information, define issues, build stakeholder and decisionmaker support and capacity sufficient to identify priority actions and contribute to an integrated management initiative in Chetumal Bay." One of the key goals was to have a well-attended meeting (later called the Chetumal Bay Summit) of key stakeholders to discuss the state-of-the-bay and to develop a consensus-driven action agenda. In addition to catalyzing ICM in Chetumal Bay, this would support the continued effort of the university to establish itself as a facilitator and to strengthen its capability and stature as an ICM center.

While the direct partners have been the NGO community and the university, there is the need to target ICM activities that include government actors. This coincides with one of the USAID/Mexico Democracy Program's goal and has been implemented by the International City/Country Managers Association (ICMA). This project contributes to institutional strengthening, particularly in areas where municipalities are major actors in resource management. The municipality of Chetumal in Quintana Roo was chosen by the ICMA to test their strategy for replicating their Resource Cities Program (RCP), which had been effective in Guadalajara. The RCP is a unique mechanism that provides technical assistance focusing on general municipal management, urban services management, and citizen participation. The RCP links cities in the US with municipalities in Mexico in an effort to facilitate



Sign encouraging water conservation for the Future

know-how and practical experiences to municipalities in Mexico. At the same time, US cities benefit from these relationships.

In July 2000, a pilot project was designed to link Chetumal with a counterpart in the US through the ICMA. Sarasota, Florida, was chosen as the US community. The intent was for the Sarasota program's staff to assist the administrators in Chetumal to improve the operation of their water quality management systems, including potable, wastewater and storm drainage systems—all affecting the water quality in Chetumal Bay.

Sarasota, Florida was chosen for a variety of reasons. While Sarasota is much more developed and wealthier than Chetumal, parts of its local environment are more degraded. This can provide examples of good and bad development strategies, as well as the management techniques used to promote community participation, political commitment, impact mitigation, and habitat restoration.

Sarasota Bay and its watershed has been an established National Estuary Program of the US Environmental Protection Agency since 1989. The program has made significant advances in techniques that address the bay's conservation and management. Some of these techniques can be adapted for use in Chetumal, which experiences similar problems. In both places there is the need to preserve manatees, wetlands, and seagrass.

In September 2000, five people from Sarasota visited Chetumal—four water quality specialists and the director of the bay program. The team identified the issues and priorities in Chetumal and used these to develop a follow-up assistance program. In December 2000, Chetumal's mayor and director of urban development and ecology visited Sarasota to participate in both political and technical forums

regarding water and bay management. In April 2001, three technical staff from the water commission in Chetumal visited Sarasota to examine management techniques and physical infrastructure. In August 2001, a member of the Sarasota County team participated in the Chetumal Bay Summit.

The final trip to Sarasota will include the director of Chetumal's manatee sanctuary, a university staff member from the ICM center, and a community business leader, who will learn about the economic benefits of a well-managed bay. This trip will evaluate advances in bay and urban water management issues and identify the next steps towards enhanced local governance of Chetumal Bay. By the end of the project, 16 people with discrete roles and experience will have participated in events within the six exchange activities between Sarasota and Chetumal.

While there are still two visits ahead, there are several successes that can be shared to date:

- The Chetumal Bay Summit was convened in August 2001, with over 50 presentations and work sessions devoted to ecology, water quality, legal frameworks, socioeconomic issues, and bi-national agreements. Two key outcomes included input to a status-and-trends report and a permanent working group to forward scientific research and management efforts.

- The advanced technical capacity of the Chetumal Water Commission was verified. Many of their techniques for water treatment were state-of-the-art; however, it was revealed that the human component was missing in effective program implementation, such as fee structure and collection. It became very evident that water management was not only a technical issue, but rather a social, cultural, and political issue. Recent



Local experts discuss key issues associated with the bay's ecology

changes in Chetumal have resulted from the Water Commission's stronger stance on fee collection and their ability to recuperate costs for further improvements.

- Officials acknowledged that one key problem is the lack of community understanding on the links between septic systems and contamination of the bay, and sewer hookups. The water commission has since begun to work with NGOs to initiate a public education campaign.

- The university has been recognized as a facilitator for open discussions. The actors understand that the common goal is to identify actions needed to avoid further degradation of the bay. The ICM network and the NGOs have focused their efforts on community outreach and environmental education. In parallel, the state has established a Manatee Sanctuary Committee, where municipality, NGOs, university, and other stakeholders are involved as "advisors" in its management.

- This exchange between Chetumal and Sarasota has shown the university, NGOs, and government participants in Chetumal that management is a long-term process that goes beyond the term limits of any one public official. Additionally, it has demonstrated that governance mechanisms can be adapted and implemented to become an effective tool for regional management.

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# Invasion of “Killer” Mediterranean Weed to California, USA

By Christina S. Johnson

In June 2000, a group of divers went for what they thought would be a routine swim through a gently undulating eelgrass bed in the Agua Hedionda Lagoon in northern San Diego County, California, USA. Working on a restoration/mitigation project that was paid for by the nearby power plant, they swam transects across the eelgrass bed, measured its length, width, and noted new eelgrass shoots. Everything appeared normal, until one of the divers discovered a large patch of unusually green, beautiful feathery seaweed. The strange seaweed would later be identified as the first confirmed North American sighting of “the killer algae” blighting Mediterranean waters of southern Europe.

Subsequent genetic tests showed that the seaweed specimens were not only the same species, but also clones of the Mediterranean strain. The seaweed, technically a green alga, is known scientifically as *Caulerpa taxifolia*. It is a popular decorative aquarium plant. It was called “the killer algae” by the French media because people irrationally feared the aquarium plant was poisoning seafood. In fact, the alga does contain predator-

repelling toxins, but it is not considered a threat to human health. In the Philippines, where the *Caulerpa* strain grows naturally, people eat the seaweed and enjoy the slight stinging sensation caused by its chemical defense system.

The nickname “killer,” however, is appropriate to a certain extent. Its ability to grow rapidly, to grow over boulders, seawalls, in mud, sand, or on rocks has the effect of severely reducing populations of native seaweeds and grasses. Because fish, invertebrates, and seabirds need native habitats to survive, *Caulerpa* outbreaks can dull the biological richness of marine ecosystems very quickly. In June 2000, when the infestation was detected in the Agua Hedionda Lagoon, it was estimated that the biomass of the *Caulerpa* had already exceeded that of all native grasses in the lagoon.

In America, as in Europe, wildlife agencies are focused on trying to prevent the seaweed from spreading beyond control, into the open ocean, for instance, where containment efforts would be futile.

## Why is the Algae such a Problem?

First, fishermen detest the seaweed because it clogs nets and makes them heavy to haul up. Secondly, divers, and tourists prefer an aesthetically pleasing underwater landscape, teeming with fish, shells, and plant life. *Caulerpa* meadows have been compared to wet, overgrown Astroturf. Thirdly, in California, the seaweed threatens protected habitats, such as the eelgrass—essential habitat for lobsters, flatfish, and bass. Many animals would suffer with loss of the native kelps and marine grasses.

In California, there is cautious

optimism that *Caulerpa* can be controlled because of the limited range of the initial infestations, and because of the prompt reaction by government agencies to handle the situation.

The California Regional Water Quality Control Board in San Diego is pursuing several avenues that make its control effort unique. This included conducting an extensive outreach program, and pursuing legislation.

As of March 2001, there were only two known infected areas in the country: the lagoon in San Diego County and Huntington Harbor, which was reported in July 2000, soon after the first discovery. Both infestations are being treated, with funds from a multi-agency organization Southern California Caulerpa Action Team (SCCAT). The California Regional Water Quality Control Board is leading the eradication program, in conjunction with agencies such as the Department of Fish & Game, California Department of Food & Agriculture, the National Marine Fisheries Service, the U.S. Fish & Wildlife Service and the California Sea Grant College Program.

Merkel & Associates, the same biological consulting firm that discovered the *Caulerpa*, has been hired to eradicate the algae. This has been done by putting tarps over the *Caulerpa* patches, sealing the tarps at the bottom, and then chlorinating the patches. The tarps, thick sheets of black plastic, starve the plants of sunlight. Once the tarps are in place, there is monitoring for re-growth outside the tarps. New sprigs, of which there have been many, are then treated. As of March 2001, about one-fifth of the Agua Hedionda Lagoon bottom was covered with tarps.

*Caulerpa taxifolia*



In Huntington Harbor, the same strategy has been employed: tarps, chlorine, and monitoring.

Huntington Harbor, however, has been slightly more difficult to purge. Not only the harbor, but also two adjacent ponds are infested. The ponds have not been covered and chlorinated because, for the last two months, heavy rains closed waters to diving. Once the bacterial levels have returned to normal, tarps can be put into place. In addition, the ponds have been outfitted with filtering devices that remove small pieces of seaweed from out-flowing waters. Even small pieces of the seaweed can grow into whole new colonies. This biological quirk and others makes eradicating *Caulerpa* very challenging.

Many of the attributes that make *Caulerpa* a good product for the aquarium trade also make it very difficult to kill. Surveys of the aquarium retailers in Southern California are being conducted to determine the number of species of *Caulerpa* being sold in the area and the percentage of stores that sell *Caulerpa* species. *Caulerpa* is probably not the only decorative seaweed that has the potential to menace the native marine ecosystems in California. There are also concerns about the sale of “live” rocks, which contain a variety of exotic marine organisms.

Consider some of *Caulerpa*'s amazing traits:

- It can survive transportation and thrive in home saltwater tanks.
- It can grow as much as 3 inches a day.
- Although native to the tropics, in places such as Indonesia and the Caribbean, it can also survive in cold waters. It is believed to be tolerant to waters as cold as 50 degrees, which means it theoretically could establish itself throughout California and Baja California, Mexico.

■ It prefers shallow water, but has also been pulled up in fishing nets in waters 300-feet deep.

The plant's ability to reproduce asexually, however, may be the most amazing trait. The seaweed—even though it has root-like hairs, stem-like stems, and fronds—is actually a single-celled plant with multiple nuclei. *Caulerpa* could be the biggest single-celled organism on the planet; it can reach lengths of 9 feet.

Because of its unusual single-celled structure, any fragment of the plant that contains a nuclei and a chloroplast—the structure that allows for photosynthesis—is capable of growing into a new plant. Susan Williams (University of California at Davis) is concerned the alga's pseudo-roots may be capable of surviving chlorination. *Caulerpa* has underground tissue (the algal equivalent of roots) that extends 15 cm into sediments. She said the chlorine might not be able to seep that far into the ground.

Williams says, “I am further concerned because in Aqua Hedionda, *Caulerpa* is now growing next to the treatment tents. Although it is assumed that this new growth is remaining fragments made during the eradication treatments in the summer, I wonder if the rhizoids had not grown out from under the tents. In my experience with this seaweed, this is entirely within its capacity and even likely to happen.”

Williams has been funded by California Sea Grant to identify areas that may be especially vulnerable to invasive seaweed infestations. People are assuming the high-risk areas are quiet bays. It is possible that environmental factors, such as water pollution and nutrient levels, might influence *Caulerpa*'s ability to invade. She says, “Based on scientific studies in the Mediterranean and on my research, sea grass beds that are degraded are less resistant to

*Caulerpa* invasion.”

In upcoming months, the Department of Fish & Game will begin surveying several high-risk areas, visually and with side-scan sonar. Large stands of the seaweed grow in circular patterns that can be discerned easily in acoustic images.

The spread of the seaweed in the Mediterranean is a good indicator of the potential dangers. In the mid-80s, only one square meter of *Caulerpa* claimed the seafloor as its home. By 1989, it had usurped more than 2 acres. Despite costly eradication schemes, by 1997 more than 11,000 acres were smothered in a dense blanket of swaying feathery green fronds. To slow the spread, harbors were forced to close their docks to boats; fishing grounds were closed to commercial and sport fishers.

Even with preventative measures, in the last five years, the seaweed has spread to North Africa, Australia, and California. Genetic tests have shown that *Caulerpa* specimens in America and the Mediterranean are clones of specimens cultured and displayed at the Stuttgart Museum in Germany in the early 1980s.

The United States has learned from the experiences of others. Under the Federal Noxious Weed Act of 1999, it is a federal offense to import *Caulerpa taxifolia* or transport it across state lines. Pending state legislation would prohibit “the sale, possession, transportation, or giving away without consideration the salt water algae of the genus *Caulerpa*.”

At present, public outreach is considered the most crucial component of a successful eradication plan, since it is home aquarists that are likely spreading the seaweed. The public must learn that releasing the contents of their home aquariums into lagoons and harbors

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# The Role of Certification for the Marine Aquarium Trade

By Paul Holthus

According to a 1998 global overview of the state of coral reefs, a half a billion people—8 percent of the total world population—live within 100 km of a coral reef. This population and the growing use of the oceans are potentially threatening 58 percent of the world's reefs. Hot spots of reef fish biodiversity under threat from human activities include the Philippines, Indonesia, Tanzania, the Comoros, and the Caribbean.

The most widespread human impact on coral reefs undoubtedly comes from land-based sources of pollution, such as sediment and nutrients that are discharged into reef waters. However, cyanide use and other unsustainable practices

associated with some marine aquarium industry operators often grab the headlines. The public, government officials, and policymakers often never hear that the marine aquarium trade, at times, plays only a very minor role in the degradation of coral reefs in relation to other human activities and can actually play a positive role in creating incentives for their sustainable use and conservation.

## How the Aquarium Industry Supports Reef Conservation

Collecting and exporting marine aquarium organisms in developing countries creates jobs and income in rural, low-income coastal areas that have limited resources and economic options for a sustainable local industry. About 7,000 aquarium fish collectors, many whom support families, are estimated to operate in the Philippines. In Sri Lanka as many as 50,000 people are directly involved in the export of reef animals, according to UNESCO.

Marine ornamentals are, in fact, one of the highest value-added product from coral reefs. Live coral for the aquarium industry is worth an estimated US\$7,000 per metric ton, while harvested coral for lime production yields only about US\$60 per metric ton. The figures for reef fish are more striking. Reef fish harvested for food from one island country were valued at US\$6,000 per metric ton. Aquarium fish from the same country realized a return of more than US\$496,000 per metric ton.

Because the aquarium trade provides important socioeconomic benefits to rural, coastal communities in developing countries, collectors of marine ornamentals have an

incentive to ensure the reefs are healthy and productive. They often become active reef stewards, guarding these valuable resources against destructive uses and sometimes creating informal management systems or *de facto* conservation areas. For example, in a collecting site in Bagac, Bataan, in the Philippines, collectors declare a no-collecting season during the months of November and December or December to January, depending on when they notice fish are fragile or most species are spawning. Collectors from this site also do not allow collectors from their neighboring province to gather fish in this area.

Collection areas are often far from the reach of government resource management or law enforcement personnel, highlighting the importance of such community-based efforts. Many government agencies admit that they will never have the staff or funds to adequately manage or police most coral reefs.

For many villagers, the economic alternative to the aquarium industry is engagement in activities that may be more destructive to coral reefs or relocation to urban areas. This exacerbated the nation's social problems.

Coastal communities in developing countries are not the only ones to benefit from an environmentally-sound aquarium industry. In developed countries, public and private aquariums generate information about reef organisms and ecology and contribute to the love of nature, in general, and coral reefs in particular. There is undeniably something both appealing and comforting in an aquarium, as evidenced by the continued growth of aquarium keeping and new public aquariums. In fact, researchers have found that aquarium viewing reduces blood pressure and anxiety—undoubtedly contributing

### WHAT MAC CERTIFICATION MEANS TO:

#### Exporters and Importers

- Suppliers provide only what is ordered
- Optimal animal health is maintained during transport
- Organism mortality is reported at all points in the chain of custody
- Access to reports and data on general and species market trends, specific collection figures and trends, and status of shipped organisms in the market chain

#### Government

- Increased capacity to guide development of the marine aquarium sector
- Additional pressure and surveillance to ensure destructive methods are not used
- Monitoring of the fishery and ecosystem
- Government monitoring, control and surveillance are reinforced by certification requirements
- Access to a global industry data management system for automated statistical data input and management, resource mapping and planning, and industry trends

#### Collectors

- Training in sustainable harvesting and handling practices
- Collection of only suitable species and only those that are ordered
- Opportunity for collection areas to be managed under an ecosystem management plan
- Incentives to ensure the reef and its aquarium animal populations are healthy
- Access to a market that values high-quality, environmentally sound products

to the popularity of aquariums in doctor and dentist waiting rooms.

Aquariums also create an opportunity for not only aquarists, but also the public to experience nature and to appreciate the need to conserve it. A 1999 study conducted at the National Aquarium in Baltimore, Maryland, US, by the American Zoo and Aquarium Association found that a visit to the aquarium increased a person's awareness about conservation when pre- and post-visit results were compared.

Another conservation benefit to aquariums is increased knowledge about coral reefs. Scientific observation and experiments with reef animals and their interaction in nature is difficult, time consuming, costly, and complicated. But rigorous, regular observation of reef animals and systems are exactly what so many aquarists do best. Consequently, many aquarium keepers have made significant contributions to reef science. They have advanced our understanding of fish behavior, reproduction, feeding, and growth; the propagation and growth of corals, soft corals and other invertebrates; and the balance of nutrients, light, and water motion needed to maintain a reef ecosystem.

## Enhancing Reef Conservation in the Future

We know that the collection and export of marine aquarium organisms can be based on quality and sustainability and achieve a balance between reef health and the numerous socioeconomic benefits described above. Working with stakeholders around the world, the Marine Aquarium Council (MAC) is establishing a certification system that identifies those in the industry who adhere to environmentally sustainable practices and allows the consumer to selectively purchase

marine ornamentals that have passed "from reef to retail" through these operations. A collection area management plan to conserve the ecosystem and a ban on destructive fishing methods, such as cyanide, are among the many measures required for MAC Certification. The ability of consumer demand to modify industry behavior is already being effected in other natural resource industries, such as forestry and seafood production. The prospect for success in the marine aquarium industry is promising. During a recent survey of 200 US pet stores involved in the marine aquarium trade, the majority of the retailers felt that MAC Certification would improve the quality (health and longevity) of reef organisms available to their customers.

MAC Certification will additionally enhance coral reef conservation by greatly improving our understanding of coral reef ecosystems and sustainable use of them. MAC informational requirements will improve data on harvest levels and catch per unit effort, which are essential to improve sustainable use and conservation of coral reef ecosystems. MAC certification has requirements, mechanisms, and processes to collect and analyze information on the state of marine aquarium resources, the ecosystem, and the kinds and level of human use and impact. This information has not previously been required or available and will provide the basis to determine more objectively how close or far from sustainability marine ornamental industry operations are. MAC standards provide the means to integrate this information into the requirements for industry operations, creating the possibility to continually improve the sustainability of the marine aquarium trade through adaptive management.

Additionally, MAC has created

several international partnerships to support certification. In 2000, it teamed up with the United Nations Environmental Program's World Conservation Monitoring Center to create the Global Marine Aquarium Database. The world's database on the international trade in marine aquarium organisms has grown steadily and now includes data from Australia, Cook Islands, Fiji, Indonesia, Maldives, Marshall Islands, Netherlands, Palau, Philippines, Saudi Arabia, Sri Lanka, the United Kingdom, and the United States. MAC is also working with Reef Check, a member of the Global Coral Reef Monitoring Network, to develop international scientific methods for monitoring marine ornamental collection areas.



Participants of the MAC certification feasibility study learn to prepare containers to segregate marine ornamentals after capture.

## Additional Benefits to Coastal Communities

Many aspects of ensuring the environmentally sound and sustainable use of natural resources by an industry and market are linked to broadly defined social equity issues. For example, MAC's requirement for a collection area management plan ensures that stakeholders concerned about social equity have an opportunity to participate in the certification process.

MAC certification also requires transparency and traceability, e.g., documented collection numbers, (continued page 35)



COASTAL RESOURCES CENTER  
University of Rhode Island

# SUMMER INSTITUTE IN COASTAL MANAGEMENT



COASTAL RESOURCES CENTER  
University of Rhode Island

MAY 27 TO JUNE 21, 2002

The University of Rhode Island's Coastal Resources Center's (CRC) Summer Institute in Coastal Management program provides participants with practical skills to design, implement, and learn from integrated coastal management (ICM) programs and experiences from around the world. This includes learning to formulate effective strategies for the management of coastal ecosystems and to apply integrated, interdisciplinary approaches to solving coastal problems. While the program looks at coastal management challenges globally, its emphasis is on those challenges as they relate to developing nations.

## PROGRAM CONTENT

The Summer Institute emphasizes issues of concern to coastal planners and managers, including:

- Implications of ecological and socioeconomic trends
- Coastal development activities such as mariculture, tourism, shorefront construction, and their impacts
- Common coastal problems such as loss of habitats, coastal hazards, erosion, degradation of water quality, use conflicts, overfishing
- Linking local-level program initiatives with national-level policy development
- An array of regulatory and non-regulatory implementation techniques
- Techniques to build broad public support for programs
- Raising funds, writing proposals, and budgeting

Participants are paired with program advisors who work with them during the four weeks to ensure the program experience is as positive and as well-matched to the individual as possible and to provide opportunities for additional professional discussion and exchange to complement the classroom experience.

## PARTICIPANTS

This program is for professionals interested in integrated coastal management, including:

- Professionals in natural resources, fisheries, and environmental agencies
- National, regional, district, and municipal-level planners
- University lecturers and researchers
- Staff from nongovernmental environmental and community development organizations
- Professionals currently on leave from their jobs and studying at the graduate level in the United States

Participants typically have a wide variety of educational backgrounds in the natural and social sciences. Previous

participants range in age from their early twenties to early sixties. Most have advanced degrees in addition to substantial professional experience.

## INSTITUTE FACULTY

Program instructors are drawn from the group of coastal management practitioners at the CRC. CRC associates from field programs in the United States, Latin America, Africa, Asia, and the Western Pacific also act as program trainers. In addition, faculty from other URI departments, participate in specialized sessions. The program also includes guest speakers from other universities, national organizations, state coastal management agencies, local town governments, and the private sector.

## PROGRAM FEE

Program Fee: US \$5,000

The program fee covers all costs of the training program including tuition, meals, housing, field trips, reading materials, and special events. The fee also covers the cost of limited health and accident insurance for the duration of the program (please ask for details). Fees do not cover the cost of travel to and from Rhode Island. Participants should bring additional funds for personal expenses.

Checks or bank drafts should be payable to University of Rhode Island in U.S. dollars and drawn on a U.S. or affiliate bank.

## Application Procedure

Applications can be submitted:

By Internet: [http://www.crc.uri.edu/train/SI2002\\_app.html](http://www.crc.uri.edu/train/SI2002_app.html)

By Mail or Fax: Contact Kim Kaine. E-mail: [kkaine@gso.uri.edu](mailto:kkaine@gso.uri.edu)

Answers to frequently asked questions can be found at:

[http://www.crc.uri.edu/train/sicm\\_faq.html](http://www.crc.uri.edu/train/sicm_faq.html)

Participation will be limited to 25 individuals.

With financial assistance from U.S. Agency for International Development's Global Water Team, The David and Lucile Packard Foundation, The Intergovernmental Oceanographic Commission (UNESCO)




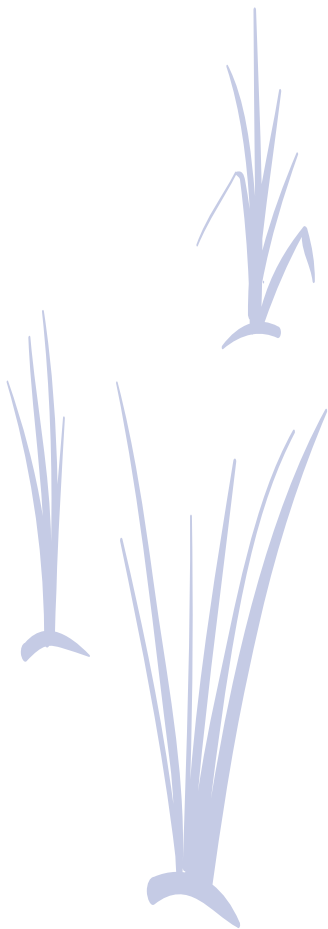
## Johnson

(continued from page 21)

is dangerous. In addition, early detection is crucial. Training recreational divers to identify new patches of *Caulerpa* will contribute to the effort to contain the seaweed's spread.

The SCCAT team is asking community members to be part of the team. Those who think they may have found a new outbreak are asked to report it immediately to SCCAT in hopes of preventing a return of 'the killer seaweed.'

For further information, contact Marsha L. Gear, California Sea Grant College Program, Scripps Institution of Oceanography, 9500 Gilman Drive, Dept. 0232, La Jolla, California 92093-0232 USA. Tel: 858-534-0581. Fax: 858-453-2948. E-mail: [mgear@ucsd.edu](mailto:mgear@ucsd.edu) 



# The Means are as Important as the Ends: Indicators of the Success

By Peter J.S Jones

How do you develop indicators of the success of estuary management partnerships (EMPs) when these initiatives are at an early stage of development and have yet to implement their management strategies? This was the critical question addressed by a project commissioned by English Nature as part of its review of the Estuaries Initiative, originally launched in 1992, and under which 23 EMPs in Britain have been established. English Nature recognized that there was a critical need to identify the benefits derived from these initiatives so:

- The institutional momentum behind EMPs is maintained and increased.
- The commitment of stakeholders to EMPs is maintained and increased.
- Further investment may be captured to support the implementation of EMP strategies.

However, three challenges had to be addressed in the process of developing meaningful indicators:


- The EMP strategies have barely begun to be implemented
- Individual EMPs are diverse and unique in their locally-oriented strategies
- Specific benefits and successes are difficult to demonstrate and attribute to the EMP

Therefore, the project focused on EMP process indicators, rather than looking at indicators of the benefits of specific outcomes. A draft set of indicators was sent to all EMP project officers in England, as well as some of the national government agencies. They were asked to score these indicators according to whether they

considered them to be meaningful, useful, and measurable. The ranked criteria were then discussed at a workshop attended by some of those who had given feedback on the draft indicators. This led to the development of a final set of indicators under four categories: stakeholder participation, funding leverage, steering group participation, and involvement in other strategic policy initiatives.

As well as potentially forming the basis for future evaluations and, hopefully, demonstrations of EMP successes, it was agreed by the participants that the indicators could also be used at a wider level to promote the development and demonstration of 'good practice,' and as a framework to report back on EMP initiatives. Of course, ultimately it should also be possible to develop indicators of the actual achievements or outputs of these initiatives. However, there will always be a need to also focus on the policy processes by which such outcomes have been achieved, as these more intangible 'means' can be as important as the ends, especially if such initiatives are to be sustainable from socio-cultural, institutional and economic perspectives.

For further information, contact Peter Jones, Environment and Society Research Unit, Dept of Geography, University College London, London, WC1E 7DP, UK. A paper on this project will be submitted to the journal, "Coastal Management."

For the detailed summary of this project, or to buy the entire report. E-mail: [P.J.Jones@ucl.ac.uk](mailto:P.J.Jones@ucl.ac.uk) 

## **Chou**

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Food centers provided with proper sewerage systems, washing and disposal facilities enabled all 5,000 street hawkers to be re-sited by 1986. A new roofed vegetable wholesale market, complete with sewerage system and solid waste removal facilities, was constructed to house all vegetable wholesalers away from the catchment area.

After the sources of pollution were removed or controlled, the riverbeds were dredged and over a century's accumulated rubbish was physically removed. Over 270 tons of rubbish were removed from the riverbanks and more than a half million cubic meters of mud contaminated with organic waste was excavated from the Kallang Basin alone.

Physical improvements were then made to the rivers and basin to transform them into riverside parks. These included lighted, paved, walkways and bridge underpasses; landscaping; and recreational facilities. In the Kallang Basin, the dredged river bed and sections of the banks were covered with sand (equivalent to 500 Olympic-size swimming pools) to create beaches giving it a new fresh look that was thought impossible only a few years before. The waterways improved tremendously and were now cleaner and free from stench.

Biological surveys indicated the return of aquatic life with faunal diversity in Singapore River increasing rapidly from 18 families in 1986 to 47 in 1992, and in the Kallang Basin from 28 in 1987 to 41 in 1995.

Water quality measurements showed improvements within the first three years of the clean-up program. Biochemical Oxygen Demand in the Singapore River dropped from 21 to 5 parts-per-million (ppm) between 1978 and 1981, while in the Kallang River, from 335 to 79 during the same

period. Suspended solids decreased from 108 (in 1978) to 45 ppm (in 1981) in the Singapore River and from 1025 to 314 ppm in the Kallang River. Dissolved oxygen levels improved from 0 ppm before the cleaning to 5.6 ppm in the lower reaches of the Singapore River, and 5.9 ppm in the Kallang Basin by 1988.

## **Long-Term Maintenance**

After phasing out pollution sources, follow-up action had to be maintained. Attention focused on diffuse and non-point pollution sources such as littering and sillage water discharge. Engineering design improvements were made to rubbish chutes and bin collection centers in housing estates to prevent the discharge of solid waste and wastewater into open drains.

Public education was increased to overcome anti-social habits. The mass media was mobilized in the appeal for public cooperation and provided extensive coverage to a series of activities with broad public appeal held in 1987 to mark the revival of the rivers. The importance of clean rivers and their benefits to Singaporeans, and how each could play a part in keeping urban river catchments clean was the central message. A long-term education program was initiated for school children with the collaboration of the Ministry of Education. The aim was to teach them the importance of clean rivers, and how they can be involved.

## **New Opportunities**

As the major waterways were restored to an unpolluted state, their potential for other forms of development and activities became possible. New concepts could be incorporated in the long-term development guide plans of these rivers. The Singapore River was to be developed into a River of History and Entertainment while

the Kallang Basin into a Basin of Fun and Recreation. These guide plans provided an integrated development approach meant to optimize use of the urban waterfronts and water bodies, and thus, offered greater opportunities for waterfront housing, recreation, business, and cultural activities.

The architectural heritage alongside the Singapore River is to be retained as far as possible.

Warehouses along its banks were given a major facelift. Instead of being demolished, they were renovated and upgraded with modern facilities without compromising the original architecture. Two main entertainment areas have been created—Boat Quay and Clark Quay—each targeting different age groups. The former with its row of elegant and unusual restaurants, pubs, and bars attract the young. Riverside dining along Boat Quay also contributed to the romance and charm of the place. Clark Quay, on the other hand, was developed into an all-family entertainment center with various themes and activities. Other land parcels further upriver are being released for development into residential and commercial properties. The contrast between new buildings, which have to be creative and well-designed, and the intricate traditional architecture will form the district's charm. The river has become the focus of carnivals and cultural activities and, together with entertainment and dining facilities, has been attracting both locals and tourists. It is closed to water traffic and only a few boat operators have been given permits to provide a water taxi service.

The Kallang Basin with its new sandy beaches and parks transformed it into a location for water sports such as water skiing, canoeing, and dragon-boat racing. It is a larger water body with more extensive banks than the Singapore

River. Plans include waterfront promenades, open parks, recreational facilities, commercial and residential developments. The promenade is designed to form a continuous link all round the basin.

The clean-up program supported the nation's long-term development plan. If action was not taken, the pollution problem would have been seriously compounded by now, and become a greater obstacle

to overall progress. The clean-up also meant that the sea received considerably less pollution loading.

The program was important in demonstrating the effectiveness of integrated area management and gave planners valuable experiences which could be applied to the nation's other rivers. It is considered an excellent investment, as it gave clean waterways with aquatic life in exchange for a polluted

health-risk eyesore. The entire program left a legacy for future generations and has given the people a refreshing sense of achievement.

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## Women's Contribution to Conservation

World Wildlife Fund (WWF) has recognized the efforts of two outstanding women for their role in conservation at an awards ceremony on June 26, 2001 in Washington, DC, US. Meidi Kasmidi from North Sulawesi, Indonesia, and Mauricia Gonzalez Garcia from Chiapas, Mexico, were selected to receive these awards for work in their native countries.

This is the first year that WWF has presented the Women and Conservation Awards. These awards acknowledge exceptional achievement in two categories—a woman's contribution to conservation, and an individual or organization's contribution to enhancing women's participation in conservation. Each winner received a cash award of US\$5,000.

"These women have made incredible contributions to conservation in their native countries. They are role models and effective stewards of the environment," said Kathryn Fuller, president of WWF.

Meidi Kasmidi, in the early 1990s, worked to establish the Bunaken Marine Park, now a World Heritage site, and helped to develop innovative and sustainable community-based village enterprises within the park. She worked closely with a range of women's groups

and gained widespread respect for her capacity to bring the concepts of marine conservation to fishers and other resource-dependent communities living outside the park. Kasmidi also founded Kelola, a leading nongovernmental environmental organization in North Sulawesi responsible for a broad range of advocacy and community empowerment programs. Through her work with the Indonesian coastal resources management program, Proyek Pesisir, Kasmidi assists other communities in initiating community-based marine sanctuary programs similar to Bunaken, and is working with government and nongovernmental organizations to upgrade school curriculums dealing with marine conservation.

"Meidi's being honored by World Wildlife Fund is well-deserved and will be an inspiration to not just her female colleagues, but to everyone involved in our international coastal programs," said Lynne Hale, field program director for the Coastal Resources Center, University of Rhode Island, US."

Mauricia Gonzalez Garcia, as a founder of the nongovernmental organization, Linea Biosfera, in Chiapas, Mexico, has focused on training a network of community promoters in 10 different communities in the areas of agroecology,

human rights, and health. Gonzalez has been instrumental in influencing communities in northeastern Chiapas to participate in a network of organizations from Mexico, Honduras, and Nicaragua that share lessons and methods for sustainable energy alternatives and incorporating gender issues. Recently, the governor-elect of Chiapas asked Gonzalez to lead the development of a biodiversity conservation strategy as part of a statewide development plan.

WWF established the Women and Conservation Initiative to recognize and expand the critical roles women play in using and managing natural resources. This includes growing food crops and cultivating home gardens, collecting water and fuelwood for household needs, and using forest products to make foods, medicines, and goods for sale, as well as participating in forest and protected area management. In addition to the awards, the initiative offers gender training, technical assistance, and development of tools to assist field staff in increasing women's participation in conservation strategies.

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Within its boundaries exist a range of aquatic environments, from freshwater to nearly full-strength seawater, allowing a broad spectrum of organisms to flourish. It has complicated physical circulation patterns that vary with changes of season, tide, and weather. Outside of its boundaries, adjacent or sometimes remote ecosystems influence the Chesapeake Bay, contributing to its remarkable complexity.

With a width of between four and 30 miles (6 to 50 km), the water surface of the tidal Chesapeake covers 2,500 square miles (6,475 km<sup>2</sup>). The Chesapeake's 64,000 square mile (165,760 km<sup>2</sup>) watershed encompasses part or all of six states—New York, Pennsylvania, Maryland, Delaware, West Virginia, and Virginia. It includes a number of geologic formations, from the flat coastal plains to the forested mountains of the mid-Atlantic region, with the fertile, largely agricultural piedmont in between. It receives most of its freshwater from about 50 major tributaries and thousands of streams, creeks, and ditches. Eight of these 50 rivers contribute about 90 percent of the freshwater contained in the main stem of the bay.

However, even describing the bay in the context of a watershed does not fully describe the land's influence on its waters. Chesapeake Bay, compared to other bodies of water, has a huge drainage basin for the amount of water it contains, a ratio of 2,743 km<sup>2</sup> of land for every 1 km<sup>3</sup> of water. The principle reason is the Chesapeake's extreme shallowness—its average depth is only 22 feet (7 m).

This shallowness contributes to its amazing productivity. It is the home for more than 2,700 species of plants and animals, from tiny creatures wallowing in the marsh mud to giant bald eagles, which have made an awe-inspiring comeback around the Chesapeake region. Some 250 types of fish, crabs, clams, and oysters live in the bay—many in extraordinary numbers. Together, they have a commercial value of more than one billion dollars annually. Half of the national catch of the Atlantic blue crab is harvested from bay waters. Based on a catch of 80 million pounds (36 million kg) in a good year, it equates to between 150 and 240 million individual crabs. Of the nation's soft-shell crab catch, 90 percent is taken from the Chesapeake.

Still, for all this productivity, the bay is not without its woes. The Chesapeake acts as a giant catch basin for everything that drains from its massive watershed. Today, much of the bay's watershed lies in some of the fastest developing regions of the country and is at the southern end of the urban megalopolis, spanning Washington, DC, to New York and the northeastern United States. Two of the country's five major North Atlantic ports—Baltimore and Hampton Roads—are on the Chesapeake, and more than 10,000 ocean vessels ply its waters each year.

Close to 15 million people live in the watershed that drains into

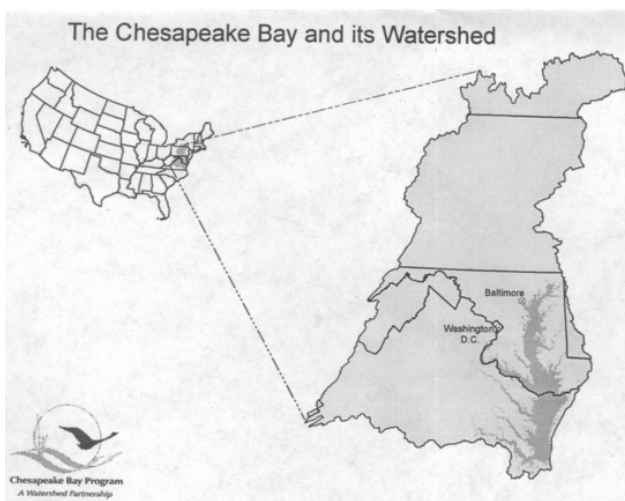
the Chesapeake. Thousands of municipalities, industries of every sort, and farms use water from the bay and its tributaries to do everything from irrigate crops to cool nuclear reactors. They also use it as a place to dispose of treated waste.

It is estimated that 1.5 million gallons (5.7 million liters) of treated sewage flows into the bay each day from more than 5,000 sources. This does not include the soil, fertilizer, and pesticides running off the farms. By their very nature, pesticides are toxic, while heavy amounts of the nitrogen and phosphorus in fertilizer set off an aquatic chain reaction that ultimately chokes out underwater grasses, the spawning ground for a variety of aquatic life.

At this point, it would be impossible to restore the Chesapeake Bay without addressing these man-induced influences. They permeate the ecosystem and help to define it. They have also inalterably changed it. The current restoration effort attempts to seek a balance whereby the human population can prosper while the native fish and wildlife are provided with the ample habitat, clean water, and harvest restrictions sufficient to sustain their populations.

## Chesapeake Bay Program: A Restoration Partnership

By the mid-1970s, the impact of the population—of unrestrained harvests and decades of degradation—had sharply impaired the Chesapeake's health and productivity. Under the leadership of several high-level elected officials from the region, the United States Congress in 1976 was persuaded to direct the federal Environmental Protection Agency (EPA) to launch a major study of the bay's decline. The research was to consider the entire bay system.



The 1976 Chesapeake Bay study marked a turning point for estuarine management nationwide. It demonstrated, for the first time, that ecosystem research and the resultant management programs can apply to geographically large areas that are ecologically, culturally, and politically diverse. It also confirmed that the bay's waters were inextricably linked to the land use practices of its watershed.

The findings and recommendations from the US\$27 million Chesapeake Bay research program were released late in 1982. The report laid the foundation for the first Chesapeake Bay Agreement signed in 1983. In that compact, the governments of Pennsylvania, Maryland, Virginia, the Chesapeake Bay Commission (the tri-state legislative agency), the District of Columbia, and the EPA agreed to develop and implement coordinated plans "to improve and protect water quality and living resources of the Chesapeake Bay estuarine system." While non-specific in its goals, the 1983 Agreement launched a regional effort to manage the bay as a whole—as an ecosystem.

That basic declaration of intent was expanded to a series of 31 commitments in a second Chesapeake Bay Agreement signed in December 1987. These commitments spelled out steps to improve the management of fish and wildlife, restore water quality, plan for development, increase public awareness and access, and continue to improve intergovernmental cooperation. The states and federal government were to carry out the agreement, each in their own way, by passing new legislation, creating new initiatives, extending (and better enforcing) existing programs, and backing their commitment with money.

At the core of this unprecedented regional compact was the firm

declaration that the "productivity, diversity and abundance" of the estuary's living resources were "the best ultimate measures of the Chesapeake Bay's condition." This agreement firmly established the connection among the component parts of the estuary and forced the integration of its management.

With the Chesapeake Bay Agreement as its basic charter, the Chesapeake Bay Program grew to become a unique regional institution, guiding and coordinating bay-related activities of hundreds of federal, state, local, and interstate government agencies, and working with dozens of nongovernmental business, civic, and environmental organizations as well.

Since 1987, the Chesapeake Bay Agreement has been revised just twice. First, in 1992, with a series of amendments. The basis for these amendments was an analysis called for in the 1987 Agreement. The analysis determined that nutrient reductions in any given river would not have an equal impact on the water quality of the bay. This finding triggered a fundamental adjustment in the direction of the bay clean-up effort. While continuing to work toward the 40-percent nutrient reduction goal set for the bay in the 1987 Agreement, the states also agreed to develop specific strategies to meet nitrogen and phosphorus reduction targets set for each major tributary.

Then, in 2000, the Agreement was entirely updated with a new, and even more far reaching, Chesapeake 2000 agreement. Subtitled "A Watershed Partnership," it couples hard-hitting, specific, and often deadline-driven goals with the clear cry for the participation of all—public and private sector alike. Without that partnership, the bay can simply not be saved.

Chesapeake 2000 takes an aggressive stance by calling for the

reduction of sediments as well as nutrients; ambitious recovery goals for oysters and subaquatic vegetation, a sustainable crab catch; a measurable decrease in the rate of conversion of farms and forests to developed lands coupled with the permanent preservation of 20 percent of the watershed's land; and more effective community-based stewardship of the bay's rivers and subwatersheds. Driving all of these actions is a powerful incentive; the removal of the Chesapeake Bay from the federal list of impaired waters by the year 2010.

Success in reaching the goals requires a substantial investment of time and money of every citizen in the watershed. It means providing incentives to promote proper environmental management practices. It means preventing nitrogen influx by upgrading waste containment and treatment. It means using less fertilizer on farm fields and building ponds, pits, and other protections against nutrient runoff. It means developing our landscape in more environmentally-sensitive patterns. It means levying heavy fines against scofflaws who continue to pollute. Basically, it means we need to change how we do things in the Chesapeake Bay region.

## **The Restoration Campaign is 25 Years Old**

A quarter century has passed since EPA began its research on the Chesapeake Bay and the multi-jurisdictional management effort was launched. Much has been accomplished, yet many more challenges lie ahead. What follows is a summary of the 12 key lessons learned by the leaders of the bay clean-up effort. They are presented in the belief that some or all of these lessons may be transferable to the restoration efforts of other large-scale environmental management efforts. (continued page 30)

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### 1. Begin with comprehensive scientific studies that combine theory, detailed knowledge, monitoring, and modeling

The EPA Bay Program study presented the public and political leadership of the region with a solid, scientific foundation for decisionmaking. The information was comprehensive and multi-disciplinary. It identified clear linkages between land, water, and living resources. Since the release of the EPA report in 1983, highly sophisticated monitoring, modeling, and targeted research have continued to play a central role in the formulation of policy in the region. Admittedly, policy decisions are not always based on science. However, if made available in an easily-understandable format, the chances are greatly improved that science will be integrated into the policy decisionmaking process. Ongoing monitoring helps policymakers to measure their progress while modeling offers a useful tool to test the monitoring findings into the future.

**Transferability:** Coastal management programs must be based on the best available science and technology. This normally is found at research laboratories that are components of universities within the region. Our experience is that facilitated and meaningful exchange of information between the academic research and management communities is highly desirable. As we move toward whole-ecosystem programs at the cutting edge of science and policy, it is absolutely essential.

### 2. Involve the highest levels of leadership possible

There is strength in strong leadership and accountability. High-level and diverse political leader-

ship is key. The chairperson of the Chesapeake Bay Commission, the governors of three states, the mayor of our nation's capital, and the administrator of the US EPA provide prominent leadership as members of the "Chesapeake Executive Council." The council meets annually to adopt new policies and revitalize the public commitment to the clean-up. Since the elected terms of these leaders vary, the program is never without continuity as elected officials take and leave office. The infrastructure of the program—the agreements, the staffs of the agencies involved, and the universities of the region—provide long-term stability.

**Transferability:** Jurisdictions vary, and coastal ecosystems embrace many of them both within and between nations. High-ranking political figures in each jurisdiction should be visibly involved in a coastal management program. Only these officials have the authority to endorse and implement policies developed by the program infrastructure.

### 3. Embrace clear, strong, specific, comprehensive, and measurable goals

A set of highly specific goals, many with deadlines, have been adopted that are unmatched nationwide. These goals cover a comprehensive array of issues including water quality, living resources, growth management, public information and education, research and monitoring, and public access. They include such specific goals as a tenfold increase in oysters by 2010 and striking the bay from the federal list of "impaired waters." Reducing nutrients, sediments, chemical contaminants, air pollution and boat discharge are at the heart of the matter, as is pollution reduction in priority urban waters—among the toughest to

restore. Water clarity that will meet the light requirements for sea grass is a central focus as is ensuring sufficient dissolved oxygen in the water to meet the living resources' life requirements.

There are nearly one hundred commitments to be met in Chesapeake 2000. Many are quantifiable which make progress measurable and keep leaders accountable. These goals last beyond the terms of the elected leaders and will provide for continuity in the face of political change.

**Transferability:** The specific goals of the Chesapeake Bay Agreement may not necessarily be the best models for other coastal systems. However, regardless of the restoration challenge, the process of setting mutually agreed upon goals is important. The commitments should be realistic, but they should also challenge the programs to implement significant change. In addition, they should form the basis for periodic re-evaluation of progress (lesson 11).

### 4. Encourage the participation of a broad spectrum of participants

Ecosystems like the Chesapeake's are extraordinarily complex. A framework to manage it has had to involve a complex array of players representing all levels of government, the private sector, scientists, and citizens. Three governors, 40 members of Congress, hundreds of state legislators and local elected officials, 13 federal agencies, four interstate agencies, more than 700 citizen groups, and hundreds of businesses all play a role in our restoration effort. Together, these players bring immense political leadership and financial support to the program.

The bay program has established more than 50 subcommittees and workgroups to ensure that all of

these interests are represented and that the goals of the program are ultimately achieved. Government employees work side-by-side with representatives of industry, local government, business, and the public at large. Strong communication strategies, frequent meetings, and an inclusive process have become the signature of the Chesapeake Bay program.

**Transferability:** Strong communication links can enable many to participate at minimal expense. No matter how desirable broad-based involvement may be, a coastal program should not outgrow the ability of its participants to communicate. Advances in electronic mail capabilities and access to the Internet now make this a lesson many more can learn.

### 5. Provide incentives and methods for institutional cooperation

In the bay region, the principle incentives are both money and public pressure. The active, financial involvement of EPA and other federal agencies has leveraged hundreds of millions of state and local dollars. Cost share and technical assistance programs have been established to address a range of management issues and have allowed for much of the restoration effort to be voluntary in nature. Regulatory programs that ensure protection of key resources have complemented these incentives. An informed and active public has continued to provide positive pressures on elected officials to adopt strong policies and to maintain the federal and state funding for bay clean-up initiatives.

**Transferability:** Over two-thirds of the world's population live close to a coastal sea or great lake. Behavioral change, such as the implementation of a phosphate detergent ban in the Chesapeake region, can have a huge multiplier

effect. Effective coastal management cannot reside solely with governmental agencies and non-governmental organizations. In addition to formal announcements and newsletters, nations can take advantage of their education infrastructure to teach ecological principles and environmental stewardship to the next generation of citizens.

### 6. Inform and involve the public

The citizenry of the bay region is remarkably knowledgeable. While there is a naturally high public sentiment toward saving the bay, some of the credit should go to the bay leaders' extensive educational and technical assistance efforts. Survey after survey reveals overwhelming public support for the restoration efforts and a growing understanding of concepts such as "watersheds" and "ecosystems." Citizens are concerned and speak their minds about what they are willing to do to restore the Chesapeake Bay. As in all situations, there is a wide diversity of opinion, but in the end most are supportive, at least at the base-line level. The management of the bay involves complex political decisions. Special interests add pressure to these decisions. But in the end, an informed and vocal public has proven to be the policymakers' greatest ally.

**Transferability:** A balanced approach can be a consequence of strong involvement at the level of the local jurisdiction. This is the basis of the new Tributary Strategies for the Chesapeake Bay. In some cases, it may be possible to take advantage of strong local activities by integrating them into a larger coastal management program. In others, as for the Chesapeake, the larger program came first and is now forming the context for local program development.

### 7. Develop a balanced set of management tools

In a program that spans the gamut from land use policy to fisheries management to recreational boating to airborne toxics, a diversity of implementation tools has proven critical. We have found that when managing an ecosystem, no one approach works best in all ecological, political, and economic situations. The bay program involves 20 agencies of the federal government, three states, the nation's capitol, more than one thousand empowered local governments of markedly different orientations, and citizens and scientists too numerous to count. As a result, management tools range from legislative mandates to voluntary efforts. Strong laws and regulations ensure effective pollution control and resource stewardship in the region while broad public education and technical assistance programs provide incentives. For the restoration of the bay to work, the approaches have had to vary greatly within the watershed.

**Transferability:** No coastal management program will be successful if it exceeds available financial resources. When choices must be made, combating known sources of pollution must be the immediate goal. Most programs begin with point sources—improving wastewater treatment or regulating toxic discharges. However, the phosphate detergent ban taught us that changing peoples' behavior has great amplification potential. Progress in pollution control will engender support of more difficult and costly activities such as habitat restoration and wetland mitigation.

### 8. Choose pollution prevention before restoration or mitigation

Despite significant public and private investments in control technologies and management

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practices to reduce pollution from discharge pipes and land runoff, the Chesapeake Bay continues to have nutrient and toxic problems. Once the pollution has entered the waterway or the habitat has been destroyed, it becomes technologically complex and expensive to restore. In the bay region, the prevention of pollution at its source has repeatedly proven to be the preferred approach. A ban on phosphate-containing laundry soaps instituted in the 1980s throughout the bay watershed, for example, has resulted in nearly a 40 percent reduction in phosphorus entering the Chesapeake Bay from point sources. This represents one of the largest single reductions of nutrients achieved since the bay program's inception. Importantly, it was achieved at no cost to government and little, if any, cost to the consumer. The bay waters are cleaner and clothes continue to be bright and stain-free.

**Transferability:** Without question, the degradation and pollution of our environment has reached global scale. Regardless of the location, the full restoration of an ecosystem, once it is degraded, has proven complex, costly, and usually impossible. We must do more, and develop ways to stop or to at least reduce pollution at its source. Businesses, universities, governments, and citizens must join forces to identify new methods of preventing pollution. Once they are identified, they must be shared regionally and globally.

### 9. Test scientific theories and management approaches on a small scale

For the past two decades, a number of scientific theories and pollution control technologies were comprehensively studied in smaller watersheds within the bay ecosystem. The effectiveness of var-

ious point and nonpoint source controls and approaches to public involvement were evaluated. In the bay region, testing research methodologies and pollution control strategies on a smaller scale, using demonstration or pilot projects, has led to increased success when these techniques have been applied more broadly. These demonstration projects have helped to develop public confidence, attract supportive dollars, and build the confidence of political leaders.

**Transferability:** In many cases, small-scale project testing can be melded with local jurisdiction program development. This provides for the development of partnerships and encourages more participants to become vested in the demonstration project.

### 10. Focus on integration of government agencies

Despite the existence of theory, practice, and tools that support the implementation of watershed-wide management, there remain practical obstacles to implementing the concept. In the United States, the state natural resources agencies are often separate from the planning, budget, or water management departments. This dissection of responsibility often leads to difficulties in integrating management efforts that cross agency lines. As our knowledge of the inter-relationships and connectedness of land, water, and living resources grows, we periodically attempt to restructure our government agencies to better integrate the component parts.

Achieving proper integration has proved problematic. It challenges the boundaries of traditional resource management. It requires the cooperation of diverse players whose educational, philosophical, and professional orientations are often worlds apart. It involves the

constant communication and collaboration of multiple agencies at numerous levels of government. It often crosses traditional areas of management, for example, forcing fisheries scientists to work with land planners, sewage treatment plant operators to coordinate with farmers, and so on.

**Transferability:** Our lesson in integration is equivalent to "harmonization" being practiced by many coastal programs, including those of the North Sea, Baltic Sea, and Inland Sea of Japan. Harmonization across agencies depends on the nature of governmental structure. In addition, if we could broaden this lesson, we strongly recommend that a coastal program provide for the integration of management, science, and citizen stewardship as a critical first step.

### 11. Conduct regular reassessments of goals and progress

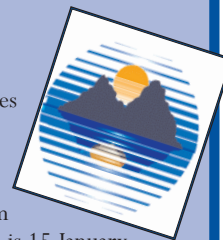
A cornerstone of the Chesapeake Bay Program has been a constant commitment to reassess our goals, monitor the trends, and measure our progress. The health and vitality of the living resources serve as an important indicator of our success. In addition, routine water quality monitoring and futuristic modeling helps us to track progress in achieving our goals and plot the course for the future. Periodically, these efforts reveal new information that, in turn, leads to improved ways of controlling pollution, managing fisheries, and restoring habitat. Sometimes this means a shifting of the course—a change in how we do things. Politically, these changes are never easy. We may have already informed the public that a problem was the result of a certain pesticide, only to later discover that it is caused by a nutrient instead. We have found that, regardless of the commitments that have been made in the past or the



## Coastal Zone Asia-Pacific: Improving the State of the Coastal Areas

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This international conference is the first of its kind for the Asia-Pacific region that aims to promote innovative approaches and best practices to improve the state of the coastal areas. Researchers, communities, coastal managers, policymakers and others interested in sharing the practical solutions to address problems in these coastal areas are invited to attend. Those with examples of success and failures in the management of the coastal areas are encouraged to submit paper, poster, and video presentations in the following themes: integrated management policies, community/resource interactions, ecosystem management, resource economics, sustainable coastal activities, and coastal area planning. Deadline for abstract submission is 15 January, 2002. Registration fee is US\$ 150 (or US\$85 for students), including lunches, reception, banquet and conference materials and publications.

Visit the website for registration, abstract submission and more information: [www.vims.edu/czap](http://www.vims.edu/czap), or contact: Ratana Chuenpagdee, Conference Coordinator, Virginia Institute of Marine Science, P.O. Box 1346, Gloucester Point, Virginia, 23062, USA. Tel. 804-684-7335. Fax. 804-684-7843. E-mail: [ratana@vims.edu](mailto:ratana@vims.edu)

information that has been released, it is always better to be straightforward with the findings. The public has generally demonstrated an ability to alter course if new knowledge dictates a revised approach. This dynamic approach to management has contributed to the integrity of the program.

**Transferability:** Periodic assessments should be undertaken in the context of program goals, and they should engage the participation of the full range of stakeholders. It is equally important to maintain program flexibility that allows for, as a result of advances in research, changes in goals or the establishment of new ones.

### 12. Demonstrate and communicate results

The bay program was officially launched in 1983. Since that time, its efforts have held the line on nitrogen and have achieved a 20 percent reduction in phosphorus in the Chesapeake Bay. The outlook remains optimistic. We are, at the very least, stabilizing our pollution loads, and are beginning to see significant improvements in many of our rivers. We have seen demonstrable gains in the way we manage land, provide fish passage, restore sea grasses, manage fisheries across state lines, and ban the use of toxic chemicals known to have an impact on our ecosystem.

Measuring progress and publicizing results has proven key to sustaining leadership commitment and public support. Honesty, even when the findings are disheartening, is critical. The frequent and open sharing of information—whether good or bad—has been essential to maintaining the trust and commitment of the stakeholders involved.

**Transferability:** While it is easy to view any environmental clean-up project pessimistically, in the Chesapeake, we have made progress. Some of that progress is witnessed by declining nutrient loads in spite of a growing population in the watershed. Some is in the restoration of commercially-important resources like the striped bass. In addition, some is in the increased environmental awareness on the part of our citizenry that many visitors to our region quickly observe. Many coastal programs were instituted in response to a crisis: toxics in marine mammals, red tides, oil spills, crashes in a fishery, to name a few. Continuing citizen stewardship depends on making progress in the absence of crisis.


### Conclusion

Over the last 25 years, the bay program has gone through its own evolution. What began as a water quality-oriented program designed

to address the decline of the bay's living resources has grown to involve integrated management of land, air, water, and living resources including man. Management mechanisms employed by the program factor in ecological, socioeconomic, and cultural considerations as well.

This evolution from water to watershed has required all of us to constantly reassess how we manage the program. As our concepts and knowledge evolve, so must our governance. We must constantly look for new and creative approaches to managing our resources, integrating and financing our programs, structuring our agencies, and soliciting our citizens' support.

The twelve lessons described above collectively constitute a framework for ecosystem management. While it is highly unlikely that the Chesapeake Bay model can be wholly transferred to another system, one central lesson stands out. In order to truly succeed, management strategies must be as comprehensive, interactive, and responsive as the ecosystem they are created to restore.

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## Rybka, Carlson, and Rogers

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Program that focused on two sub-watersheds—Big Creek and Yellow Creek. Concentrated efforts were mounted in each. The programs consisted of public meetings, which helped to rally public support and helped to identify needs in the smaller watersheds. Activities were developed and implemented in the watersheds, including stream clean ups, storm drain stenciling, biological stream monitoring, habitat improvement projects and water festivals. Citizens were encouraged to get involved and help sustain the activities in their own backyards.

Land use issues continue to be one of the biggest challenges in stream restoration. Urban sprawl, filling of wetlands and destruction of riparian habitat continue to impact water quality. These issues are being addressed through a variety of restoration activities. Several demonstration projects have been constructed that show the potential of bioengineering techniques for stream restoration. These projects demonstrated a variety of successful remedies for soil erosion and flooding problems. An array of the river stakeholders, including the US EPA, Ohio EPA, Soil and Water Conservation Districts are working to promote riparian setbacks, and obtain and encourage stream restoration projects. Work is also being done to establish conserva-

Children cleaning up trash



tion easements along the river and its tributaries. Sources of water quality impairment have been identified and other types of projects include the City of Akron's separate sewer overflow elimination program and plans to address combined sewer overflows.

A variety of research studies have been funded to promote understanding of water quality impairments and aid in the development and refinement of educational programs. Studies include navigation channel re-aeration feasibility, fish advisories, creel surveys, community preference polls, fish tissue, phytoplankton and larval fish studies, US Geological Survey bacterial studies and bio-engineering projects.

Noticeable environmental improvements have already been recorded in the Cuyahoga River. A 1998 larval fish study documented usage of the river as a navigation channel for Lake Erie fish migration. Follow-up studies in 1999 confirmed these results and documented the presence of steelhead trout adults.

## An American Heritage River

In 1996, Congress designated the lower 50 miles of the Cuyahoga River as the Ohio & Erie Canal National Heritage Corridor. The same section was also designated a National Scenic Byway in 2000. With the help of all the river stakeholders, including citizens, a massive effort was launched to promote the Cuyahoga River as a candidate for American Heritage River status.

The Cuyahoga was named one of the fourteen American Heritage Rivers in 1998 because of its unique historical, cultural, and environmental history. The vision of the Cuyahoga American Heritage River is to "retire the image of the Cuyahoga River as the

symbol for polluted waterways and restore its place in the community as our most important resource. The community vision for the Cuyahoga River is a renewal and renaissance of the river by integrating it back into the everyday life of the community. The Cuyahoga and its tributaries will be fishable, swimmable, and accessible. Its watershed will be known by its residents for its uniqueness, history, and importance to their quality of life." A River Navigator has been employed to further help in restoration and revitalization efforts along the entire 100 miles of the river.

Clearly, the Cuyahoga River has gone from flame to fame. Much work has been done since the last fire. Citizens in the Cuyahoga watershed are becoming increasingly aware of the phenomenal resource in their backyards. Many are working to protect and restore the river. Now the time has come to formulate a long-term vision for the region that capitalizes on the river and Lake Erie's assets, which will increase the quality of life and economic benefits for watershed citizens.

## Cuyahoga River Stakeholders

The renaissance of the Cuyahoga River would not be possible without the help of stakeholders who have worked so diligently on an action agenda aimed at restoring the river to its full potential. Stakeholders, many of whom provide support, both financially and in-kind on a variety of projects, include many national, state and local governmental agencies, neighborhood organizations, conservation groups, local municipalities, elected officials, businesses, schools, churches, scouts and other youth groups and the general public. Local foundations have provided much needed financial support

and so has the public.

The Cuyahoga River's remarkable recovery is helping to shape the future of the Northeast Ohio region. Green space initiatives and restoration projects are on the top of the local planners, action agendas. New parks along the river, the return of trophy fish and more recreational activities are encourag-

ing to the public. Everyone is beginning to realize how a healthy Cuyahoga River and Lake Erie contribute to a great quality of life and increased economic benefits for the region. Needless to say, continued support is needed to keep the momentum going on the numerous of restoration projects that have already been identified, but with

the successes so far, the river will be a hot spot for all the right reasons!

*For further information, contact Janine Rybka, Cuyahoga River RAP, 1299 Superior Avenue, Cleveland, Ohio 44114 USA. Tel: 216-241-2414, ext. 610. Fax: 216-621-3024. E-mail: jrybka@mpo.noaca.org*

## Delaney

(continued from page 13) and discharge the effluent without further damage to the receiving waters in Cape Cod Bay. To provide ongoing assurances to the public and regulators, comprehensive monitoring and contingency plans were designed and are being implemented by Battelle Memorial Laboratory, an independent research company. The results of the monitoring are available to the public daily via a website: for Boston Harbro: <http://www.mwra.state.ma.us/harbor/html/wkly-intr.htm>, for Massachusetts Bay: <http://www.mwra.state.ma.us/harbor/html/mbmon.htm>

<http://www.mwra.state.ma.us/harbor/html/wkly-intr.htm>, for Massachusetts Bay: <http://www.mwra.state.ma.us/harbor/html/mbmon.htm>

## Summary

While embarrassingly slow in initially responding to massive pollution of Boston Harbor, the responsible institutions have now not only done so, but also have used the Boston Harbor situation as a catalyst to successfully expand and incorporate a range of other issues and actions. Perhaps most

surprising to all, has been the rapidity with which the natural systems have recovered allowing once again swimming and fishing and a healthy environment for seals, birds, and marine life in Boston Harbor.

*For further information, contact Richard Delaney, University of Massachusetts, 100 Morrissey Blvd., Boston, Massachusetts 02125-3393 USA. Tel: 617-287-5570. Fax: 617-287-5575. E-mail: [rich.delaney@umb.edu](mailto:rich.delaney@umb.edu)*

## Holthus

(continued from page 23) species, locations and effort. This will help level the playing field as sellers and buyers can negotiate the fair price of a product based on full information, reducing the possibility of unfair transactions for those lacking this knowledge.

MAC certification indirectly addresses other social concerns through additional certification measures. Dive safety issues are addressed by requiring proper training of personnel using scuba or other gear and regular servicing of equipment. Collectors—many of whom have only a grade-school

education—will have the opportunity to learn about decompression sickness, which some now believe is the result of an encounter with a “sea ghost.”

During an ongoing feasibility study in the Philippines, 250 collectors in 18 collection areas were recently trained to the MAC standards through a partnership with the International Marineline Alliance. Test cases on the MAC standards will be conducted throughout the chain of custody in fall 2001, and the MAC certification system will be operational soon after.

*For more information, contact the Marine Aquarium Council at [info@aquariumcouncil.org](mailto:info@aquariumcouncil.org) or Fax: 808-550-8317*

### Identifying species suitable for capture



## ABOUT THE MARINE AQUARIUM COUNCIL (MAC)

- MAC is an international non-profit organization established in 1998 to bring the aquarium industry, hobbyists, conservation organizations, government agencies and public aquariums together to address the sustainable use of coral reef ecosystems by the marine aquarium industry.
- MAC's mission is to conserve coral reefs and other marine systems by utilizing the marketplace to reward good conservation practices.
- MAC creates industry standards, accredits third parties to certify those in the marine ornamental trade who adhere to these standards and educates industry operators, hobbyists and the general public about coral reef issues.
- It is anticipated that the first MAC-certified marine ornamental will be available to consumers in late 2001.

## Nickerson-Tietze

(continued from page 5)

■ Seeking sustainable funding for the program from both local sources as well as from state and national program budgets

## Bringing These Lessons to Estuaries Outside the US

In 1995, the Food and Agriculture Organization of the United Nations (FAO) Bay of Bengal Programme used these lessons learned from the NEP experience in designing the approach together with the Department of Fisheries, Thailand, for the Community-based Fisheries Management Project (CBFM) in Phang-nga Bay. It is one of the most biologically productive bays of the Andaman Sea, along the western coast of Thailand. However, it was not immune to what was happening to much of the world's coast, and by the mid 1980s, the bay's marine fishery resources had shown considerable decline. Declines were largely due to the common problems facing tropical estuaries: degradation of water quality, loss of mangrove and seagrass habitat, and use conflicts between resource users.


The joint project of the Department of Fisheries, Thailand and FAO marked a test case for community-based management in Thailand. The concept had not been implemented before, although discussions had been held among academics and government on its possibilities for improving fisheries management. However, Thai culture and values favored a community-based management approach. Thai coastal fishers, like American fishers, are independent and do not like being told what to do, but will be eager to do something if they believe in it. In addition, much of the decisionmaking within families and communities in Thailand is

through a kind of consensus. Community-based management could build on the independence and sense of duty and pride that is prevalent in Thai culture.

The choice for CBFM fit well for Phang-nga Bay. The project has thrived from the initial management structure established in 11 villages to currently more than 35 villages throughout the bay. One of the major reasons behind the strength of the project is the continuing emphasis on the "NEP principle" of using science as an objective foundation on which to base management decisions. With the focus on understanding the issues as they impact the estuarine ecosystem, it places all the participants in a more objective and equal position in making a decision on the issues. This has helped in resolving conflicts between the different fisheries uses and in bridging the gap between the government, communities, scientists, and the public. The project brought representatives from all perspectives of the bay's management together for the first time, and they continue to meet regularly to manage the bay. Representatives include the scientific community, universities, government, the private sector, non-governmental organizations, and most importantly, the coastal fishing communities who have perhaps the closest knowledge of the bay's coastal resources. Interestingly enough, through this focus of understanding the bay's ecosystem, the CBFM participants found that they had more areas of agreement than disagreement. By working together in the project, the scientists have been able to learn from the fishers, and have been able to use this improved understanding of the bay in the continued studies of its problems, which in turn is being used by the project. As in the NEP approach, the scientific findings are continuously brought back to the

communities for their feedback and understanding. The reason to keep the scientific findings accessible and presented in clear 'public prose' is to allow everyone to participate in the decisionmaking, and therefore, can use it to help make decisions together.

Two years into the project, a handful of participants from the CBFM project were able to attend the Sarasota Bay Training Workshop on estuarine management held in Sarasota, Florida, US, on April 14-27, 1996, organized by the Coastal Resources Center, University of Rhode Island, US, and the EPA Office of Water, Coastal Management Branch. The CBFM participants followed the training with a practical experience in two NEPs; the Barataria-Terrebonne Estuarine Complex (Louisiana, US) and the Puget Sound NEP. The experience proved an excellent exchange. One result was the expanded effort by the CBFM to address more of the habitat components of fisheries management. As a result, the villages set up several fisheries reserves in the bay. But more importantly, the project gained a broader understanding of integrated management, and an increased confidence in knowing that the approach they have been using and adapting in their own project is a result of many years of learning. CBFM participants are also self-evaluating their project periodically to identify where they need to make changes, if necessary. In this quiet bay in the Andaman Sea, the first cycle of estuarine management in Thailand is off to a strong start.

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# COASTAL RESOURCES MANAGEMENT

## *Coastal Resources Center, University of Rhode Island*

### PUBLICATIONS AVAILABLE

For a complete list, and for shipping and handling information if applicable, please contact the Coastal Resources Center, University of Rhode Island, South Ferry Road, Narragansett, Rhode Island 02882 USA. Tel: 401 874-6224. Fax: 401 789-4670. E-mail: [communications@crc.uri.edu](mailto:communications@crc.uri.edu). Website: <http://crc.uri.edu>

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## Greening

(continued from page 7)

and were used by each of the partners in the development of their action plans.

The types of nutrient reduction projects included in the nitrogen management plan range from traditional nutrient reduction projects such as stormwater upgrades, industrial retrofits, and agricultural best management practices to actions not primarily associated with nutrient reduction, such as land acquisition and habitat restoration projects. A total of 105 projects submitted by local governments, agencies, and industries are included in the plan; 95 percent of these projects address nonpoint sources and account for 71 percent of the expected total nitrogen reduction. Half (50 percent) of the total load reduction will be achieved through public sector projects, and 50 percent by industry.

A total of 134 tons per year reduction in nitrogen loading to Tampa Bay is expected from the completed projects, which exceeds the 1995-1999 reduction goal of 84 tons per year by 60 percent. An updated estimate of nitrogen loadings to the bay from all sources was initiated by TBEP in summer 2001, after which the effectiveness of the proposed projects in maintaining loads to the bay will be evaluated.

## Specific Projects and Expected Nitrogen Loading Reductions

**Stormwater facilities and upgrades:** Stormwater improvements or new facilities include both public and private examples. Stormwater retrofits using alum injection to urban lakes reduced total nitrogen (TN) loading by an estimated 6.4 tons per year. Stormwater improvements eliminated an estimated 2 tons of TN loading per year. Industrial

stormwater improvements at phosphate fertilizer factories and transport terminals reduced almost 20 tons TN loading per year by the year 2000.

**Land acquisition and protection:** Land acquisition and maintenance of natural or low intensity land uses precludes higher density uses and higher rates of TN loading. Land acquisition precluded more than 15 tons TN loading per year by the end of 1999. Approved overlay districts requiring additional nutrient control in management areas precluded an estimated 10 tons per year TN loading.

**Wastewater reuse:** Waste water reuse programs resulted in a 6.4 ton per year reduction on TN loading. Conversion of septic systems to sewer reduced TN loading by 1.7 tons per year.

**Emissions reduction:** Estimated emissions reduction from coal-fired electric generating plants between 1995-1997 resulted in reductions of NO<sub>x</sub> emissions of 11,700-20,000 tons. To estimate the reduction of nitrogen deposition which reaches the bay (either by direct deposition to the bay's surface, or by deposition and transport through the watershed), a 400:1 ratio (NO<sub>x</sub> emissions units to nitrogen units entering the bay) is assumed. Expected reductions from atmospheric deposition thus ranged from 29 to 50 tons per year by 1999. To date, emissions reductions have not been included in the estimated total TN reduction to the bay, pending agreement on estimation methods.

**Habitat restoration:** Although typically conducted for reasons other than nutrient reduction, habitat restoration to natural land uses reduces the amount of TN loading per acre in runoff. Habitat restoration projects have been completed or are underway in all segments of Tampa Bay's watershed. Estimated TN load reduction

from completed habitat restoration projects totaled an estimated 7 tons per year.

### Agricultural Practices:

Water use restrictions have promoted the use of microjet or drip irrigation on row crops (including winter vegetables and strawberries) and in citrus groves. Micro-irrigation has resulted in potential water savings of approximately 40 percent or more over conventional systems and an estimated 25 percent decrease in fertilizer applied. Nitrogen reduction estimates from these actions total 6.4 TN tons per year.

**Education/public involvement:** For those projects for which nitrogen load reductions have not been calculated or measured, but some reductions are expected, the Consortium Action Plan assumes a 10 percent reduction estimate until more definitive information is available. These programs have reduced TN loading by an estimated 2 tons per year.

**Industrial upgrades:** A phosphate fertilizer mining and manufacturing plant has terminated the use of ammonia in flou-plant (an element of the fertilizer manufacturing process), resulting in a reduction of 21 tons per year of nitrogen loading. Other fertilizer manufacturing companies have upgraded their product conveyor systems, resulting in a TN reduction of more than an estimated 10 tons per year due to control of fertilizer product loss. The termination of discharge by an orange juice manufacturing plant into a tributary of Tampa Bay has resulted in a reduction of more than 11 tons per year TN loading.

The approach advocated by the TBEP stresses cooperative solutions and flexible strategies to meet nitrogen management goals. This approach does not prescribe the specific types of projects that must be included in the action plan; con-


sortium partners have been encouraged to pursue the most cost-effective options to achieve the agreed-upon goals for nitrogen management. The TBEP will review and revise nitrogen management goals every five years, or more often if significant new information becomes available.

## Summary

The Tampa Bay management community has agreed that protection and restoration of Tampa Bay living resources is of primary importance. Through the TBEP process, partners have adopted

nitrogen loading targets for Tampa Bay based on the water quality requirements of *Thalassia testudinum* and other native seagrass species. A long-term goal has been adopted to achieve 15,400 ha of seagrass in Tampa Bay, or 95 percent of that observed in 1950. To reach the long-term seagrass restoration goal, a 7 percent increase in nitrogen loading associated with a projected 20 percent increase in the watershed's human population over the next 20 years must be offset. Government and agency partners in the TBEP and

private industries and interests participating in the Nitrogen Management Consortium have identified and implemented specific nitrogen load reduction projects to ensure that water quality conditions necessary to meet long-term living resource restoration goals for Tampa Bay are achieved.

For further information, contact Holly Greening, Tampa Bay Estuary Program, 100 8th Ave. S.E., St. Petersburg, Florida 33701 USA, Tel: 727-893-2765. E-mail: [hgreening@tbep.org](mailto:hgreening@tbep.org) 

**Rubinoff, Romero, and Chavez**  
(continued from page 19)

## Sustainability of this Impact

While long-term programmatic linkages have not been confirmed, it is anticipated that the expertise and collaboration initiated by the pilot project will help to prioritize and direct future efforts in bay management. This will ensure that ecological, governance, and socioeconomic issues are addressed in future management initiatives.


It is also hoped that a mechanism can be identified to stimulate

advances in local governance and participatory democracy, thereby increasing the success and sustainability of integrated management in Chetumal Bay as has happened in Sarasota Bay.

For further information on the Democracy-Environment Initiatives, please refer to the Biodiversity Support Program's EDGE program at [www.bsp-online.org](http://www.bsp-online.org). For more information on the programs supported by the International City/County Management Association, please contact Octavio E. Chavez. E-mail:

[ochavez@icma.org](mailto:ochavez@icma.org) or website [www.icma.org](http://www.icma.org).

For further information on USAID/Mexico's coastal program, please contact Pam Rubinoff, Coastal Resources Center, Narragansett, Rhode Island 02882 USA. Tel: 401-874-6135. E-mail: [rubi@gso.uri.edu](mailto:rubi@gso.uri.edu) or website [www.crc.uri.edu](http://www.crc.uri.edu).

Results of the Chetumal Bay summit can be viewed at [www.mirc.uqroo.mx](http://www.mirc.uqroo.mx) or by contacting Rafael Romero. E-mail: [rafomer@correo.uqroo.mx](mailto:rafomer@correo.uqroo.mx) 



# INTERCOAST, FALL 2001, ISSUE #40

## COASTAL MANAGEMENT: IN SEARCH OF SUCCESS



website: [www.crc.uri.edu](http://www.crc.uri.edu)



**Matuszeski** (continued from page 2)  
long-term financing of the sound's program has been secured and what roadblocks were encountered. This is an important issue because it is often easier to obtain planning money than it is to come up with the implementation funds. Those in Puget Sound faced this issue early and developed a range of funding sources, many of which show innovative thinking.

We finish with San Francisco Bay, where once again we look at one issue in the multitude of concerns addressed by the comprehensive management effort. It is an issue faced by more and more ports worldwide—how to deal with the material that must be dredged each year to keep the shipping channels open. In many regions this has become a contentious and confrontational problem, with economic interests pitted against environmental concerns. Keelin Kuipers and Steve Goldbeck show how in San

Francisco Bay the divergent forces came together and found mutually beneficial solutions.

In all these success stories we see common elements:

- Clear goals were set.
- Science was used to drive action, not to hold things up until more studies were done.
- Consensus was struggled for and reached among all interested parties, including the public.

For most failures or languishing efforts in coastal management, you can point to one or more of these elements that weren't taken seriously enough. The goals were too broad or too vague—they didn't deal with "how much by when;" or the science became a goal in itself, hamstringing the effort to move forward; or important people or interests were left out, often "for convenience."

What these success stories show is

that when you take the time to do it right, you can get real results.

*Bill Matuszeski recently retired after a decade as the Director of EPA's Chesapeake Bay Program, a partnership of Federal agencies, states, the District of Columbia, and a Commission of state legislative interests. Prior to that, he served in a series of Federal environmental positions, including Director of State Programs for Coastal Zone Management, and Executive Director of the National Marine Fisheries Service. He has also assisted in integrated coastal management efforts in Latin America, including Ecuador, Costa Rica and Brazil.*

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