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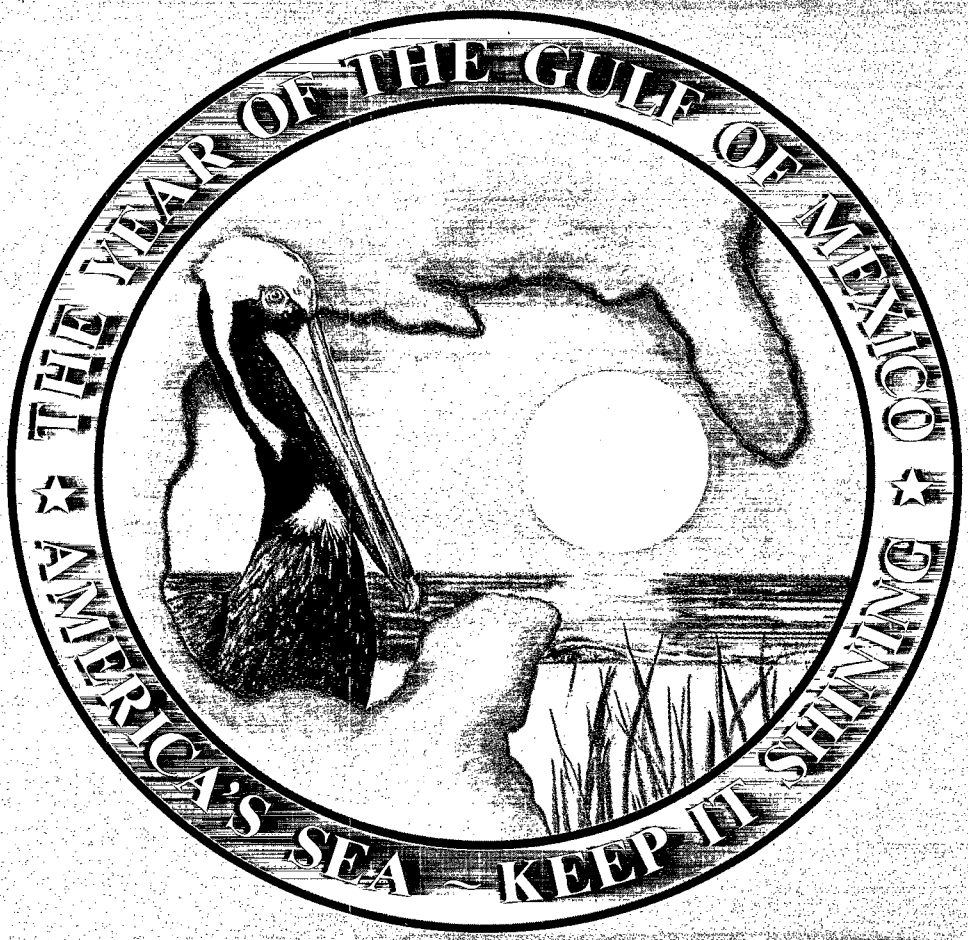
CELEBRATE

"America's Sea - Keep It Shining!"

The Gulf of Mexico Symposium

Issues and Opportunities



December 10-12, 1992 ▪ Innisbrook ▪ Tarpon Springs, Florida

"America's Sea - Keep It Shining!"

The Gulf of Mexico Symposium

December 10-12, 1992 ▪ Innisbrook ▪ Tarpon Springs, Florida

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Organizations that sponsored this symposium are listed on the title page. The support of these groups was invaluable and sincerely appreciated. The individuals who volunteered to register participants, assist exhibitors, operate projectors, record sessions, and, even, perform in the "Marine Gang" are not otherwise mentioned; they know that this symposium would have been impossible without their help. The sponsors thank the staff responsible for planning and conducting various sessions, the speakers and poster presenters for their time and energy in sharing information about their work, and the staff of Innisbrook for their excellent logistical support and unfailing courtesy. Most importantly, the sponsors thank the attendees for giving their time and infectious spirit without which the tasks we have pledged could not be accomplished.

Preface

LaJuana Wilcher, Assistant Administrator for Water, U.S. Environmental Protection Agency, likened to "frontiersmen" the more than 1600 attendees of the second biennial Gulf of Mexico Symposium. Their frontier was defined as "where a person confronts a fact." The confronted fact was that of "conquered and diminished resources where, you, the foot soldiers of this frontier, face the daunting task of restoring the balance of nature for the good of the Gulf and all its symbiotic creatures." Administrator Wilcher called this symposium "a watershed event where people who care are breaching cultural, generational, economic, and academic parapets toward a better world for us all."

The Partnership for Action, described as the "Magna Carta of the Gulf of Mexico" formally acknowledged the relationship amoung the partners which comprise the Gulf of Mexico Program. Citizens, industry, and government are poised for a broad frontal attack on the problems threatening the Gulf with guidance provided by the Partnership for Action.

The symposium proceedings describe the ideas, plans, and progress of 150 speakers; 43 technical posters presenting activities of the public, academics, and members of professional environmental communities representing industry; and local, State, and Federal government agencies concerned with the Gulf of Mexico. The scope of these activities is as broad as the Gulf and as varied as the life along its shores.

The Gulf of Mexico Symposium is a biennial, public report card on the environmental quality of the Gulf. It is intended to foster a greater understanding and exchange of information on the many complex issues facing the Gulf today and to generate and solicit enthusiastic support for solutions. Its sponsors are interested in preserving the unique legacy of "America's Sea."

Introduction

The second biennial Gulf of Mexico Symposium convened at Innisbrook, Tarpon Springs, Florida, at 9:00 a.m., Thursday, December 10, 1992, under the banner **America's Sea - Keep it Shining**. Barbara Sheen Todd, co-chairman of the Symposium Planning Committee, noted in her welcoming remarks that, although the Gulf of Mexico Program was largely funded by various government and private entities, its success would be due to the efforts of cooperating citizens and citizens' groups. Therefore, it was fitting that this symposium focused on environmental education issues and student activities that reflect the opportunities available for impacting existing environmental problems. Ms. Todd noted that the Gulf of Mexico Program is characterized by the breadth of its umbrella of interests and that "every attendee is a messenger to citizens about the importance of the Gulf of Mexico."

Jon Cannon, Director of the Gulf of Mexico Program, used his opening comments to introduce attendees to "A Partnership for Action," a 15-minute videotape produced by the Program. The videotape defines the Gulf as a holistic ecosystem in which partnership is essential and coordinated action is required. Copies of the videotape are available through the Program Office. Mr. Cannon stressed that, while examples of successes such as the Boaters Pledge, oyster reseeding, septic tanks, and seagrass plantings are important, much work remains to be done to cope with the loss of wetlands, the decline in sustainability of wildlife and fish production, and the all too prevalent public perception of the Gulf as a limitless resource that can provide for society's needs while suffering numerous abuses, such as nutrient overenrichment, massive erosion and habitat loss, and trash dumping. Mr. Cannon also noted that the Gulf of Mexico partnership would be signed later in the day at a ceremony in which authorized representatives of each local, state and federal agency, and a citizen's representative would formally pledge their cooperation and joint resources to meeting the challenges facing the Gulf and to protecting the Gulf from future degradation. Mr. Cannon likened the partnership to an "environmental Magna Carta."

At 10:30 a.m., a ceremony in Carnelian Hall marked the formal opening of the Symposium. After making brief, informal remarks, Martha Prothro, Deputy Assistant Administrator, Office of Water, U.S. Environmental Protection Agency, and Barbara Sheen Todd, Symposium Co-Chairman and Chairman of the Gulf Program's Citizens' Advisory Committee, jointly cut the ribbon and admitted attendees into the exhibit hall. Ninety-one exhibitions and forty-three poster presentations were held in this location.

Deputy Administrator F. Henry Habicht II, U.S. EPA, was the featured speaker at the luncheon preceding the *Partnership for Action* Signing Ceremony. Mr. Habicht recognized the contribution of the volunteers in the success of the symposium and noted that the same spirit drove those volunteers who endeavored to keep America's Sea shining. He described the Gulf Program as a "window on the future of environmental protection." The Gulf Program is a window because it is a working example of how government can obtain and maintain the perspective of people and thus focus resources for the maximum development of sustainable programs. The Gulf Program is a window because it is a transformation of the way we, as a government and a people, deal with complex, multi-faceted problems. The Gulf Program is a window because, for the first time, it brings the resources of diverse, often opposing, legislative, academic, industrial, and private environmental interests together to define, prioritize, and solve problems for the greater good. The Gulf Program's unique approach should restrict the Law of Unintended Consequences which always seems to be in effect when one group, no matter how good its intentions, offers a one dimensional solution to problems existing in a multi-dimensional realm.

The signing of the *Partnership for Action* confirms the relationship and provides the mechanism by which the Gulf of Mexico Program may become codified by Congressional action. Mr. Habicht noted that several bills to make the Gulf Program permanent will be introduced in the 103rd Session of Congress.

The *Partnership for Action* allows the Gulf Program to expand to include other nations rimming the Gulf and make the Program truly responsive to the integrated ecosystem that is the Gulf of Mexico.

After the presentation of the colors, the Pledge of Allegiance, and the national anthem, played by the Seminole High School Band, Ms. Prothro officiated during the signing of the *Partnership For Action.*

Dr. Sylvia Earle, Consultant to the NOAA Chief Scientist, proved to be the highlight of December 11th's luncheon. Dr. Earle reiterated the "holistic ecosystem" theme of the symposium by showing that the Gulf of Mexico is part of the world ocean - an interrelated system that both controls, and is controlled by, its environment. In comparing the Gulf of Mexico and the Persian Gulf, Dr. Earle noted that about 200 million years ago the Gulf of Mexico was a very shallow region to which great volumes of sea water were added a little at a time. Subsequently evaporated, the sea water left great layers of salt that created magnificent domes and concentrated the mineral wealth of the region. The American industrial revolution of the 20th century was powered by this mineral concentration. Similarly, the Persian Gulf has been developing layers of salt during the past 100 million years, and even today, portions of the area are characterized by tidal flats which are flooded and, then, evaporated, leaving behind layers of salt and wind-blown dust.

The Gulf of Mexico is relatively deep (12,000 ft. in the Sigsbee Abyssal Plain) while the Persian Gulf is rarely deeper than 300 ft. and averages less than 100 ft. The Gulf of Mexico continental shelf - where most aquatic animals and plants live - covers an area greater than 170,000 mi^2; the Persian Gulf - which is all at continental shelf depths - is about 72,000 mi^2. Both areas are "chock-a-block full of critters," particularly in shallow-water seagrass beds where both epifauna and infauna are vital components of the ecosystem.

Because the ocean is a dynamic system that is constantly mixing - vertically, horizontally, and temporally - it is easy to get the impression that its very size protects it. Two years after six to eight million barrels of Kuwaiti oil blackened the marshes of the Persian Gulf, the fish are, by and large, safe to eat, although oil is 18 in. below the surface. Timing is critical. In the Gulf of Mexico, during the August coral spawning season, polyps rise to the surface after a full moon and are spread to distant sites for repopulation. If an oil spill a fraction of the size of the Kuwaiti spill occurred in the Gulf of Mexico during the coral spawning season, protected coral reefs, such as the Flower Gardens, could be obliterated.

The ocean is dynamic but must be given time to heal. Environmental rules and regulations are intended to provide that time; environmental rules are not needed where common sense is available. What we do - or fail to do - bespoils the planet, but what we do - as evidenced by the people at this symposium - gives cause to hope.

At the Dec. 12th luncheon, Dr. William Seaman, of the Florida Sea Grant Program, presented awards to the five Sea Grant Science Project Winners. Voted best of the best were:

Hadley Sikes - Carbon Concentration by *Emiliania huxleyi,*

Robyn M. Hasselle - Tiny Toxic Tyrants Clean up Man-Made Mishaps: A Study of *Pseudomonas aeruginosa,*

Paul R. Constant - Nutrients' Effect on *Codium* Algae,

Katherine Schaudt - Predicting Seasonal Hurricanes in the North Atlantic,

Ryan Matherne - The Effects of Cobalt-60 on the Germination Rates of *Spartina alterniflora.*

Dr. Douglas Lipka, Co-Chairman of the Symposium, presided over the Wrap-Up Session later in the afternoon. The audience applauded the Symposium Committee on its success in increasing student participation relative to the 1990 Symposium. The Symposium Committee was challenged to increase minority participation by the same amount at the 1994 Symposium. After accepting that challenge and a resolution of appreciation from the Gulf of Mexico Program's Citizen Advisory Council, the Gulf of Mexico Symposium was adjourned.

GULF OF MEXICO PROGRAM
A Partnership for Action

Protecting, Restoring, and Enhancing the Gulf of Mexico and Adjacent Lands

VISION: Our vision is of a Gulf of Mexico flourishing in all its natural richness and variety -- beaches glistening in the sunlight, thriving coastal vegetation, and abundant fish, shellfish and waterfowl. The Gulf ecosystem is of incalculable value in itself, but our vision also embraces the many human uses of the Gulf which are part of the cultural fabric of the region and which are critical to the economic well being of both the region and the nation.

The incomparable beauty and resources of the Gulf of Mexico are threatened. The Gulf receives waste from much of the nation. Coastal marshes and seagrasses are being lost. This source of the nation's sustainable harvest of seafood is at risk. Many miles of the Gulf's beaches are washing away or are needessly fouled.

Our challenge is to meet this threat by harmonizing the diverse interests focused on the Gulf and ensuring that they do not cause or contribute to the destruction of the very resources on which they rely.

Meeting this challenge requires cooperation by all of us, with the Gulf of Mexico Program facilitating new forms of collaboration and partnership amoung individuals, communities, industries, states and the nation. Through good stewardship and concerted efforts, no overall net loss of wetlands can be achieved and critical wetland habitats can be restored; multitudes of waterfowl and shorebirds will continue to fill our skies and coastal wetlands; and our beaches can be made free of litter. Our legacy will be that our grandchildren and their grandchildren will be able to swim in these waters, and play in the sand, consume the Gulf's delicacies, and support thier families in a healthy Gulf economy.

Goal: The Goal of the Gulf Of Mexico Program is to protect, restore, and enhance the coastal and marine waters of the Gulf of Mexico and its coastal natural habitats, to sustain living resources, to protect human health and the food supply, and to ensure the recreational use of Gulf shores, beaches and waters -- in ways consistent with the economic well being of the region.

Five-Year Environmental Challenges: We, who share a common vision for the Gulf of Mexico, issue the following environmental challenges to ourselves and to others allied in our efforts to restore and maintain the environmental and economic health of the Gulf. Within the next five years, through an integrated effort that complements existing local, state, and federal programs, we pledge our efforts to obtain the knowledge and resources to:

- Significantly reduce the rate of loss of coastal wetlands.
- Achieve an increase in Gulf Coast seagrass beds.
- Enhance the sustainability of Gulf commercial and recreational fisheries.
- Protect human health and food supply by reducing input of nutrients, toxic substances, and pathogens to the Gulf.
- Increase Gulf shellfish beds available for safe harvesting by 10 percent.
- Ensure that all Gulf beaches are safe for swimming and recreational uses.
- Reduce by at least 10 percent the amount of trash on beaches.
- Improve and expand coastal habitats that support migratory birds, fish, and other living resources.
- Expand public education/outreach tailored for each Gulf Coast county or parish.

Whereas the President of the United States of America on January 10, 1992 proclaimed 1992 as the Year of the Gulf of Mexico, and; whereas the Congress of the United States of America through Public Law 102-178 designated 1992 as the Year of the Gulf of Mexico, we pledge our cooperation to build the support and obtain the resources necessary to meet these challenges and to attain our long term goal of protecting America's Sea.

Governor of Alabama	Soil Conservation Service	U.S. Air Force
Governor of Florida	NOAA	Department of the Navy
Governor of Louisiana	U.S. Fish & Wildlife Service	Food & Drug Administration
Governor of Mississippi	U.S. Army	NASA
Governor of Texas	National Parks Service	U.S. Coast Guard
U.S. EPA	CAC Chairman	

December 10, 1992

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Summary of Presentations from the Concurrent Sessions

I. Florida Educators' Panel

Teachers Team Up To Teach About Estuaries And The Economy

Rick Meyers
Manatee County Public Schools
Bradenton, Florida

A small group of middle school classroom teachers produced an interdisciplinary curriculum model for their peers to use in the classroom and during student field trips. All area businesses and private residents are directly or indirectly affected by the health of the estuary, a cornerstone of our local environment and its economic vitality. Therefore, this model focuses on "the estuary and the local economy."

Teacher training consists of:

- a voyage on the Carefree Learner, a floating classroom built and staffed by Sarasota teachers -- activities include grassflats seining, water sampling, bird watching, lectures on bay life, and shell collecting,
- exploration of estuary restoration sites, such as the Sarasota Bay walk -- these projects restore natural shorelines which are vital and productive habitats for marine life and wading birds,
- a visit to a commercial fishery, enabling teachers to learn the processing of fish product going to the market,
- a sojourn on Tampa Bay to an uninhabited barrier island -- this daylong venture investigates the geology and biology of the island's ecosystems, and
- during all of these trips, teachers are asked to pay particular attention to man's impact upon the environment, noting that, whether a resident, tourist, industrialist, or environmentalist, they have a vested interest in the physical and economic health of the estuary.

It is in this health that they have a voice.

Using their custom-designed lessons and field trips, teachers have built on the strengths of their students and are now revising for next year.

The primary environmental issues being addressed are:

- altering the mangrove coast in regard to development and keeping natural areas intact,
- the need for high water quality standards to educate students in their responsibilities to treat their natural resources,
- people must live within Florida's environment for it to continue to exist as it is presently,
- beach renourishment,
- non-point source pollution, and
- understanding life requirements of endemic plant and animals. displacement of natural species by exotics.

The most significant educational benefits have been:

- 5,000 middle school students in Manatee County, Florida will experience first-hand the fragile ecosystems of Sarasota Bay and Tampa Bay,
- involving local businesses and organizations,
- demonstrating how environmental strands are intertwined through all subject areas,
- expanding knowledge of the coastal ecosystem and demonstrate the interdependence of Florida's environment and the economy,
- demonstrating the importance of protecting Manatee County's coastal watershed,
- understanding that once the resources are depleted, they cannot be replaced or renewed in our lifetime, and
- providing, through this experience, a vested interest in the student to protect the local ecosystem and the community.

Without the financial and strategic support from the Sarasota Bay National Estuary Program, the Tampa Bay National Estuary Program and the Environmental Education Foundation of Florida, Inc., this program would not be

Seaside Science: Hands-On Learning About Salt Marshes And Energy Flow For Elementary Students

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The Stanford Early School Achievement Test (SESAT) is administered to Pasco County kindergarten students in the fall semester each year. Since the test is given within the first month of school, scores reflect the impact of pre-school and early home experiences rather than formal kindergarten instruction.

District-wide results indicate markedly lower results in the Environmental Content Cluster, which tests knowledge of the natural and social environments. While there has been a steady increase in performance across all subtest areas of the SESAT over the past years, the environmental section always remains the lowest.

The discrepancies in this area are most notable in schools with students from lower socioeconomic backgrounds. The literature suggests that positive early experiences in science assist children from all socioeconomic levels in language and logic development.

Recently, work done at the Mystic Marinelife Aquarium, in Connecticut, and the University of Rhode Island has shown a positive attitude change results from children handling live specimens. The Seaside Science Program utilizes this approach to stimulate interest in the natural world and the activities are designed to be accomplished by parent/child teams.

The program provided the parents with skills for the development of their child's natural curiosity, promoted a positive attitude towards education, encouraged growth in knowledge of the natural world, increased reading skills, and demonstrated that science can occur outside of school. Teams were encouraged to continue exploring the coastal environment, and many have made it a regular portion of their activities.

The Project That Wouldn't Die

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Most good teachers are willing to try something new, to take risks. Most new projects are worth doing once, some projects are worth repeating, and some are so special that they continue to grow and expand. This is the story of one such project that has evolved and continued in spite of many obstacles. What makes this project special is an amazing blend of high school and elementary students that were recognized and supported, not only by the teachers and the students involved, but the school principals and community members, as well.

In 1983, the author attended a FMSEA (Florida Marine Science Education Association) conference during which stocking doll manatees were made. The idea was brought back to the author's school chapter of the Save-The-Manatee Club. It later expanded its scope and grew into the Lemon Bay High School Environmental Club, which is now 83 members strong. A major focus of this club continues to be raising awareness of environmental issues, including the plight of the Florida manatee.

The doll project began as an after school club activity in which each member made a doll. Because doll making is more appropriate for younger children, members suggested bringing the materials to an elementary school. Funds were raised, materials purchased and prepared, and the club took a trip to a local elementary school classroom. The following year, materials were included for the teacher before the visit to teach the students about manatees, such as worksheets with dot-to-dot puzzles and coloring pages. The highlight of the mini-unit was the high school students' visit and making the dolls. To bring the students there, the bus driver volunteered to drive them during his layover.

Each year, the project grew. After-school sessions were held for club members to train new members and prepare the packets for each elementary school student. The packets included directions, an already-threaded sewing needle, patterns, stockings, and two beads for the doll's eyes. With the principal's blessing, club members obtained teachers' signatures to excuse them from the day's classes.

But problems arose. The bus could not be used free of charge, so arrangements were made for parents to drive the students to the elementary school. When this practice was later discouraged, the local chapter of the Littoral Society endorsed the project and provided rides. As the requested number of elementary student participants increased, funding

the purchase of materials became a real problem. With year-round water restrictions, one of the best fundraisers, car washes, was no longer an option. Again, community groups came to the rescue of the program, donating funds for materials. Also, candy sales and drawings were held to obtain enough materials for three classrooms.

Club members expanded the awareness projects and joined a community effort to document the presence of manatees in local waters. In 1989, a sighting report form was developed, and students prepared a large map of the area on which each sighting was recorded with a flagged pin. The mapping project is now in its fourth year.

A life-size manatee model was made as part of a float of an animal refuge for the Labor Day parade, and it has been used in three parades and to increase public awareness at other events. Students have prepared exhibits and manned booths. They received certificates for the President's Environmental Youth Award signed by President George Bush. Field trips with a manatee theme have been taken to places like Epcot Center and Homosassa State Park, as well as to the Lowry Park Zoo in Tampa and the Crystal River to swim with the manatees.

The most popular and requested activity is the elementary school field trips in which high school students work with small groups (2-3) of elementary students to make a stuffed doll to take home and share the story of the Florida manatee with their family and neighbors. Last year, 100 dolls were made in four elementary school classes, and packets are being prepared currently to use in this year's version of the doll project.

To succeed, a project of this type needs more than dolls. One year, club members prepared a game and made a classroom set to deliver to a local elementary school. The club president wore his high school letter jacket with his many pins and ribbons while visiting the classroom. Being an Olympic competition year, the Olympic Games were on TV and in the news each day. One little third grader looked up at the boy and asked, "Were YOU in the Olympics?" That illustrates the magic of the project.

The project may be expanded in the future by creating a training team of Environmental Club members that, not only would train new freshmen club members, but, also, other high school clubs.

There is a familiar maxim "to learn something best, teach it to someone else." What can be more special than matching students across the ages? This project will not die.

References

Florida Game & Freshwater Commission, The Skimmer, Vol. 4, No. 2., Tallahassee, Florida, Spring 1988.

Sharing Success In Environmental Education

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Sharing Success in Environmental Education is a new award program initiated in 1991-92 by Florida Commissioner of Education Betty Castor to identify and recognize Florida's finest school-based environmental education programs.

The program has four purposes. First, it offers examples of effective programs implemented by local schools with community and business participation, illustrating essential components of Florida's new school improvement and accountability initiative, Blueprint 2000.

Second, "Sharing Success" highlights how schools sustain existing programs, and it provides information on and encourages the development of new programs, despite recent budget cuts. Community participation is a strength of the school programs recognized by the Sharing Success awards. In many of the programs, students performed environmental service for their communities at the same time that parents, local businesses, and other community members began participating more fully in activities at the school. A mutual respect emerged during this process.

Third, "Sharing Success" identifies and communicates the common factors that make school-based programs successful, and transferable. Many of the award-winning programs have common characteristics. For instance, some are based on annual themes that schools select to unite teachers, students, and parents in reaching common objectives, such as learning about coastal issues, recycling, or water-conserving landscaping. Programs also have been created to address a need recognized by the community or school. For example, some schools started landscaping projects to beautify an unattractive campus, developed learning activities to teach urban students mathematics by measuring and graphing physical data in saltwater aquariums, or adopted multidisciplinary, hands-on environmental learning to interest at-risk students in school. Other schools participated in beach clean-ups and maintained cumulative records for a marine conservation-oriented nonprofit organization, or adapted existing programs, such as "The Voyage of the Mimi", to have students investigate coastal issues relevant to their communities.

Most of the programs employ innovative or creative strategies, such as peer teaching in which students teach other students. Other techniques include using a "team" of teachers from different disciplines to teach courses, focusing on local

environmental issues to reinforce conceptual learning and stimulating student learning about government through interaction with public officials. The most successful programs periodically assessed outcomes, using both objective and subjective means, such as tests, reports, presentations, videos, and portfolios. Many evaluated student attitudes and behavioral changes resulting from program participation. Some programs track long-term changes in students, such as career choice or continued participation in community issues. Programs reported that, in some cases, parental attitudes and behavior toward the environment improved as a result of student interaction. Several programs survey students and teachers annually to solicit suggestions for the next year. Systematic evaluation boosts accountability and credibility and guides improvements.

Fourth, "Sharing Success" encourages existing programs to improve by offering examples of how other schools developed award-winning programs. Results of the program, including profiles of the winning schools and sections on research and resources, are available in Natural Selections, the 1992 "Sharing Success" Directory.

As recipients of awards, these programs should continue to generate community and parental support, enabling them to recruit more volunteers, obtain funding and donations more easily, and secure other forms of assistance to sustain programs.

The Office of Environmental Education (OEE), Florida Department of Education, developed and carries out the program, with assistance from a broad-based Advisory Committee composed of representatives from business, state agencies, and non-profit organizations. In late 1991, the Committee first developed awards standards, and then it reviewed and ranked nominations from schools, participated in site visits to schools, and made final award recommendations to the OEE.

In April 1992, the Committee selected 35 meritorious programs from the 68 submitted for consideration. Three Programs of Excellence were selected to receive a framed certificate and new environmental education materials of their choice, valued at $300. Seventeen Programs of Quality each received a certificate and environmental education materials valued at $100. Fifteen Programs of Promise each received a certificate and environmental education materials valued at $50. Commissioner of Education Betty Castor presented the certificates to school representatives in a special ceremony just prior to Earth Day 1992.

What Is A Manatee Doing In A Geography Classroom?

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What comes to mind when one hears the word geography? Most people think of memorizing states and capitals, labeling maps, naming continents and oceans, latitude and longitude, and knowing the location of countries around the world. Well, all those items are important and part of geography, but there is so much more.

The author's motto is, "Everything is connected to geography." More than just the name of a country make it unique; its culture, climate, plants, and animals are important. And to keep a place unique, all that is there naturally should remain.

At the beginning of the school year, the author tries to be interesting and enthusiastic about geography for her students. To keep the students' interest level high, the author starts off the school year with what is familiar, like one's own backyard. For the author's students, Florida is their backyard.

Geography curriculum in the State of Florida requires teachers to cover the world during the seventh grade. To do this, little time can be spent on any one area. Students are cheated because the curriculum moves so fast. Even though there isn't much time for Florida, time is made for it because it is important.

Now, to explain the title of this paper, "What Is A Manatee Doing In A Geography Classroom?" One must be willing to accept the fact that everything can be connected to geography. Once one sees the light, coming up with materials is the easy part.

In the beginning of this paper, the word unique is used. Florida is a very unique state, and anyone who lives there should feel honored to share it with some unique animals and habitats. For instance, there is only one Everglades, the only coral reef along the continental U.S., the manatee, panther, and a variety of other wildlife found nowhere else. This is where the manatee fits in.

In the author's unit on Florida, students locate various places where manatees are known to live. In comparison, a county map is color coded according to population. Questions are asked of the students, such as, "Where are there concentrations of people?" and "People who live near the water enjoy what type of recreation?" It doesn't take long for students to figure out the connection between manatee deaths and the number of boats in that area.

Students also design T-shirts and create slogans to make people more aware of the manatee. Letters are written to local and state government officials requesting that they enact legislation to help the manatee. Students have drawn examples of boat propeller covers. After students have viewed videos and seen pictures of injured manatees, most come to the same

conclusion -- the manatee must be helped. Now, if only this concern would stay with them as adults, the manatee might win its battle for survival.

A good way to end a lesson about the manatee is to actually visit one. One place manatees can be found in the wild is near power plants which discharge warm water. During periods of cold weather, manatees gather near power plants. Tampa Electric's Big Bend Power Plant, near Apollo Beach, is a great place to see them. Most power plants welcome students who have come to see manatees.

A very nice place to view captive manatees in their natural habitat is Homosassa Springs State Park. Blue Springs State Park, near Orange Park, Florida, is the home of many wild, "adopted" manatees that spend the winter at the park on a regular basis. Of course, it is not possible for all students to visit manatees, so manatees are brought to classrooms through pictures and video.

An important part of this lesson, as with any lesson taught about the environment, is making connections. The manatee's survival is not an isolated problem with an isolated solution. A good example is the Everglades. The entire Everglades ecosystem will not survive if only the small area within the National Park boundaries is protected. Humans are only part of a complex web of life. They have no right to put themselves at the top, only an obligation to fit in as well as possible without damaging the web.

Children must understand that everything they do effects something else. They should be taught to act in a positive and responsible manner when it comes to the environment. Through education, both positive and negative can be stimulated in children so they can make a decision based on trial and error.

II. Technical Issues Forum

A. Marine Debris

MARPOL V: Responsibilities For Enforcement And International Aspects

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The International Maritime Organization (IMO) has 180 member countries which are interested in all aspects of shipping. In 1973, IMO adopted the International Convention for the Prevention of Pollution by Ships, known as MARPOL 73/78. It consists of five annexes, each dealing with a particular class of pollution. Annex V regulates the discharge of garbage from ships. It took effect on December 31, 1988 and has been ratified by 52 countries.

The United States ratified it through enactment of the Marine Plastic Pollution Research and Control Act of 1987. Two major issues of MARPOL V are the requirements to control the discharge of garbage into the sea and identify onshore reception facilities for ship garbage. The Coast Guard drafted regulations to administer MARPOL Annex V. The regulations apply to all inspected or uninspected marine craft, fixed and floating platforms, associated vessels, and recreational vessels. It also requires all terminals and ports capable of receiving garbage from ships to be inspected. Subpart D establishes the parameters for what garbage can be disposed in the sea and how far offshore. Dumping plastics is strictly prohibited; they are the worst hazard to marine life.

The Gulf of Mexico Program and other agencies are having this information translated into other languages to disseminate it widely. There is a need to ensure that all crews can read, understand, and obey the regulations on discharging garbage.

Enforcing MARPOL V on ships calling on U.S. ports begins when the vessel gives advance notice of its arrival, which is entered in the Marine Safety Information System computer. The Coast Guard has access to this system at all major ports. It determines if a vessel is making its first U.S. port call, whether it is in compliance or has any deficiencies from other port calls, and if the ship's paperwork is current. The petty officers check the file systems of local ports for particular violations or vessel alerts, and the data is given to the boarding officers.

Not all vessels are boarded every time they come into a U.S. port. There are too many in port at any particular time, and the Coast Guard does not have the personnel to do this. Therefore, the vessel history contained in computer records are used to identify which vessels to board. When a vessel is boarded, an inspector will have to check for compliance with regulations. The regulations are reviewed before boarding, and then the vessel records and other items are checked.

The Coast Guard inspector may be accompanied by a U.S. Department of Agriculture Animal and Plant Health Inspection Service representative, and they will check off items on two detailed forms to determine if a ship is in compliance with MARPOL. Later, the Petty Officer meets with the ship's Master to review the paperwork.

The inspectors review pollution record books for proper entries and determine if the vessel has gone into any ports anywhere in the world or the U.S., if it discharged garbage en route to the U.S., and if it has the proper receipts to show that this has been done. They will check the vessel's waste management plan to see that it is posted and located where crews have access to and can read it. They check to see that placards are posted, are in the proper language, and located in places where garbage and foodstuffs are handled. They inspect the areas used for collecting, processing, storing, and discharging ship-generated garbage. They also determine if plastics have been mixed in with other wastes. After the inspection is completed, the inspectors meet with the Master, Mates, and crew and determine if the vessel is or is not in compliance with MARPOL regulations.

A port must have a Certificate of Adequacy in order to receive ships and their cargo. The facility submits an application to the Coast Guard Marine Safety Office to ensure that the vessel operator knows there are means to remove and store garbage and waste. The certificate must be present before vessels can dock.

New Coast Guard guidelines have stricter standards and will increase enforcement initiatives to remedy past violations by ships from other countries. Enforcement has been extended to the 200 mile limit of the Economic Exclusive Zone, and if any discharge occurred, or if garbage is not handled in compliance, the Coast Guard will take action. First offenders receive a $10,000 civil penalty assessment, $20,000 for a second offense, and $25,000 for repeated offenses.

It will take more than the United States and Mexico to remove all of the garbage from the Gulf of Mexico. Countries

in the Wider Caribbean must be involved. The IMO and World Bank are involved, and a workshop on reception facilities and marine waste will be held in early 1993. These forums are important because many less-developed nations have no garbage collection facilities, but, instead, dump into rivers or on land. Therefore, financing must also be made available in addition to technology. Once all countries in the Wider Caribbean have reception facilities, the area can receive MARPOL Special Area Designation.

Many other initiatives are being undertaken to reduce the amount of debris in the Gulf of Mexico. Education is highly emphasized, and the information must be presented in languages that each person can understand. The Coast Guard is planning seminars, port studies, and training programs within port areas in the U.S. and will disseminate educational information. The Coast Guard has an outreach program for the fishing industry through vessel coordinators in the Gulf States. These officials work with ports and local commercial fishing industry associations to educate the industry as well as conduct compliance inspections on vessels and at marinas.

The Coast Guard Auxiliary has done a lot to help the Gulf of Mexico Program and disseminate information on rules and regulations on MARPOL V. In addition, they have taken the program into the classroom to teach rules and regulations and individual responsibility in regard to the environment, as well as marine safety.

Report On The Implementation Of The Treaty Relating To The Prevention Of Pollution By Ships Known As MARPOL Annex V

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Clean beaches. Clean seas. Regrettably, these are becoming just a fading childhood memory. We are all too familiar with shorelines marred by floating garbage, oil spills, and litter of the modern world. The images of seabirds trapped in discarded six-pack rings, or turtles poisoned by indigestible wastes have been seen the world over, but it doesn't have to be that way. The general public wants progress and demands a clean marine environment. Responsible marine executives and users of the sea want the same thing. Not only is it common sense in today's times, but, ethically, it is mandatory to be environmentally responsible. Together, we can help make these visions of a cleaner marine environment a reality. There are many sources of marine pollution, but let us focus on one key issue, the trash generated by oceangoing vessels.

In recent years, there has been growing international pressure to restrict the dumping of waste into the oceans. Communities and businesses are concerned about unsightly and unhealthy littering of seashores and other areas used for recreation. Ethics, livelihoods, and money are all at stake.

Rigorous new rules on ocean dumping of waste and its proper disposal are now in place and supplement other laws aimed at cleaning up the world's oceans and shorelines. These new regulations, covered by the International Protocol Relating to the Prevention of Pollution by ships, or Marpol Annex V, restricts the discharge at sea of certain types of garbage. Additionally, the Marine Plastic Research and Control Act of 1987 prohibits the dumping of plastics at sea within the 200 mile Exclusive Economic Zone surrounding the United States coastline. Infringement of these regulations are not only damaging to the marine environment but costly to the violator. Failure to follow these regulations can result in civil penalties up to $25,000.

Marpol Annex V is not the only law affecting the improper disposal of waste generated by oceangoing vessels. The United States Department of Agriculture (USDA), through the Animal, Plant, Health Inspection Service (APHIS), is charged with protecting the nation's agricultural interests. Through its APHIS programs, USDA monitors the disposal of wastes derived in whole or part from fruit, vegetables, meat and poultry, as well as packaging material that might carry disease or infection that could damage or destroy our nation's crops or livestock industry (7 CFR 330.400 and 9 CFR 94.50).

The land based disposal of these wastes is a business for the expert. Under current USDA regulations, APHIS wastes must be treated by either steam sterilization or incineration prior to landfilling. Fortunately, there are solutions. At BFI Shipboard Waste Services, a division of Browning-Ferris Industries, Inc. (BFI), experts understand the problem of marine pollution and have solutions in place. Its unique service is to provide the maritime industries with a one-call, all inclusive solution to their waste disposal requirements.

BFI is one of the world's largest publicly-held companies providing collection, transportation, process for recycling, and disposal of a wide range of commercial, industrial, medical, and residential solid wastes. BFI Shipboard Waste Services has a comprehensive, efficient collection and disposal program for marine wastes. How does it work? A simple telephone call sets the process in motion.

BFI Shipboard Waste Services provides its programs at major ports in the United States, Canada, and other countries. Its experience in the development of currently approved Marpol Annex V disposal procedures is the maritime industry's guarantee that its wastes are handled in an environmentally responsible manner.

When a vessel docks, BFI Shipboard Waste Services provides it the appropriate containers to properly dispose of, or package for recycling, its wastes. These containers are then loaded onto specially designed vehicles and transported to licensed waste facilities where disposal, treatment, or sorting occurs. BFI guarantees the public and maritime industries that shipboard wastes are handled in an environmentally responsible manner.

In order to educate the maritime industry on the provisions of regulations such as Marpol Annex V, BFI Shipboard Waste Services distributes, as a public service, plastic laminated "placards" outlining the waste discharge restrictions of current international treaties. These "placards" serve as a constant reminder to the crew and passengers of oceangoing vessels of the discharge provisions and penalties for non-compliance. Currently, they are available in English and Spanish. Information in other languages will be available soon.

In summation, BFI Shipboard Waste Services is committed to a marine environment free of floating garbage and beaches littered with debris. Through continued enforcement of existing regulations, enhancement of international treaties, and increased education in the maritime industry, the public demand for a cleaner environment will become a reality. BFI will carry out this goal efficiently, safely, and in an environmentally-responsible manner with respect to the role of government in protecting the public interest.

Responsibilities Of The Shipping Industry And How They Are Being Addressed

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The ship owners' responsibilities appear to be rather simple. They must comply with governing laws and international treaties. One such treaty is MARPOL Annex V, which governs the disposal of waste at sea.

The ship's owner establishes procedures to follow on-board and, then, leaves it up to the vessel's Master and officers to implement and enforce them. Having to comply with international treaties is nothing new. There are currently some 20 treaties in effect world-wide, requiring about 60 different certificates to be carried and with which the vessel must comply. It is important for the instructions to be simple and easily understood, and it is sometimes necessary to provide instructions and placards in more than one language.

In the final analysis, it is also the responsibility of the ship owner to make certain that the officers and crew follow the instructions. Towards this end, the ship owner must rely on the captain to motivate everyone on-board do their share. The sanctions and/or penalties against a crew member are somewhat nebulous, although frequent reprimands due to non-compliance or disregard of instructions will be observed in the individual fitness reports. For the Master and officers, their license is at stake for non-compliance with international treaties.

Fortunately, most of these treaties are so long in the making that ample lead-time is available for planning and preparation.

Marpol Annex V is first and foremost a prohibition against dumping plastics into the sea, but it also prohibits all dumping all garbage except ground food waste if Special Area Designation has been made. The ship owner must address the disposal of all trash and garbage in addition to plastic materials.

How have operations changed and what must be done that wasn't required before?

These international agreements, including Marpol Annex V, are part of the curriculum at the maritime schools and training centers. It is taught at the traditional maritime colleges, and also at new schools in Third World countries to ensure high quality crews from countries that are major providers of seafarers.

Most older vessels found the best way to comply was to use 55-gallon drums at strategic locations to collect plastics. Compactors and grinders are also frequently installed on board. If plastic materials originate primarily from foods or household goods, the amount generated is rather small, and it does not take many drums to provide storage, even for extended voyages. As older vessels are phased out of service, they will no longer be contributors to garbage in the ocean. Over a period of time, 20 years is considered by many as a normal operating life, a particular ocean-going vessel will be totally out of the picture.

As the ship owner contemplates replacing ships in the fleet, a modern system for waste management and disposal is included in the plans for the new building. There are basically two alternatives to choose from. One, which for obvious reasons appears to be the most popular, is disposal by incineration. This system will not only take care of solid waste, but oily waste, slop, and other unusable, oil-tainted leftovers. After the incineration process, only a small amount of ash remains. Indeed, many vessels have been refitted with incinerators to make sure they leave behind nothing but their wake.

The second alternative is proper on-board segregation and storage for disposal in port. This system also can be managed with extreme efficiency, particularly where the ship regularly trades in certain ports where it is easy and economical to

off-load what needs to be disposed.

A modern vessel operating under that system could be a container ship on a fixed run between Europe and the United States. The round-trip takes about six weeks. All plastic materials are collected continuously in the galley and on a daily basis from all cabins. It is then compacted and stored. On every deck, there are two chutes, one for glass, the other for paper. The glass falls directly into a receptacle where it breaks into small pieces. The paper chute goes directly into a compactor. At a designated port in North Europe, the paper, plastic, and glass containers are off-loaded, and empty containers are put back on board for the next round-trip. Slop is pumped off, and all these services are provided without additional cost to the vessel. It is included in the port fees paid for dockage and other services.

On modern vessels, overboard fluid discharge is monitored for clarity and purity. If a discrepancy is detected, the automated system shuts down and redirects fluids into holding tanks. Nothing substandard can be pumped overboard unless tampering occurs.

Another effect of Marpol Annex V has been that ship owners have changed their buying habits, avoiding plastics to the greatest extent possible. Once that trend became clear, providers of food and goods found it to their competitive advantage to offer substitute packaging and, thereby, retain the ship owner's business. Styrofoam cups are gone -- sailors are back to good, old ceramics with their name on them.

The opportunity to have garbage and waste removed from the vessel varies greatly from port-to-port and continent-to-continent. It is generally held that northern Europe offers the best service. The removal process and facilities are provided by the port authority, and the cost is included in the normal harbor expense. In the U.S., the facilities are, generally, privately owned, and the removal process is handled by contractors engaged and paid by the vessel, resulting in large differences in price and services. It is important that gains continue to be made to improve the availability of disposal at an economical price.

One procedure that seems to work well was introduced by one of the large national waste management firms. Empty boxes are provided in advance to terminals and vessel agents or delivered to the vessel upon arrival. After the ship's crew has filled the boxes, the contractor will pick up and arrange for proper disposal. This method is also approved to handle galley waste restricted by the U.S.D.A. Animal Plant and Health Inspection Service, and it has proven efficient and reasonable in a number of Gulf ports.

B. Toxic Substances And Pesticides

Contaminant Levels In Sediment And Biota In The Gulf Of Mexico Estuaries

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In 1991, the Environmental Monitoring and Assessment Program (EMAP) initiated a long-term monitoring program to assess the ecological status and long-term trends of the estuaries of the Louisianian Province. The Louisianian Province consists of the biogeographic region from Anclote Anchorage, FL, around the Gulf Coast to, and including, the Rio Grande, TX.

The area evaluated includes all tidally-influenced water bodies, or estuaries, greater than 2 km^2 in surface area. These include 27 large estuaries (Mobile Bay, AL; Mississippi Sound, MS; Lake Pontchartrain, LA; Galveston Bay, TX), large tidal rivers (Mississippi River), and 154 small estuaries/tidal rivers (Withlacoochie River, FL; Grand Bay, AL; Back Bay of Biloxi, MS; Amite River, LA; and Lavaca Bay, TX).

EMAP-E focuses on determining the status of response indicators to ascertain a measure of the ecological condition of the estuaries of the province. It is unique among monitoring programs in that it is nationwide in scope, focuses on ecological status and trends, and is based on unbiased sampling. These characteristics allow the data to be used to represent large biogeographic regions so that statements concerning the status of the estuarine resources as a whole can be made with a known level of confidence. EMAP-E is also active in other biogeographic regions of the country using

the same sampling design, indicator collection methods, and assessment approaches.

The samples are taken primarily in late summer (July and August) in the Louisianian Province. A total of 202 sites were selected to be sampled during a 7-week interval in 1991. Sampling included collecting habitat and water quality information (temperature, dissolved oxygen concentrations, salinity, clarity), deploying continuous monitoring apparatus for water quality (obtaining bottom dissolved oxygen concentration every 15 minutes for 24 hours), collecting sediments (benthic evaluation, sediment toxicity testing, organic content, grain size, and contaminant concentrations), fish trawling (characterization of fish communities, examination of pathology incidence, and tissue contaminant concentrations), and benthic dredging (to characterize large bivalve communities and marine debris).

Benthic evaluations (species-level abundance, composition, and biomass) were completed for 3-5 replicates at each site. While full distributions of the data were compiled for each indicator, as well as several species- or group-specific indicators (percentage of community that were amphipods), an overall index of benthic condition was developed using the following approach. A subset of the collected sites was determined to represent locations having poor environmental conditions (high sediment contamination and low dissolved oxygen concentrations), and a second set of sites was selected as reference sites having good environmental condition (little or no sediment contamination and high dissolved oxygen levels day and night).

The approach was to statistically analyze this subset to determine which benthic characteristics best differentiated between poor and good environmental quality. The result showed that the combination of benthic biodiversity and proportions of the benthic community represented by bivalves and tubicifid worms could be combined in an index score that correctly classified poor sites and good sites without any error, explaining about 90% of the variability observed in the data set. This analytical result, the Benthic Index, was then applied to all the benthic data collected from the 202 sites in the Louisianian Province. Once the scores were determined, their distribution was examined to assess the percentage of estuarine sediments in Gulf of Mexico estuaries characterized by poor benthic community structure. Approximately 30% of the sediments in the estuaries could be described as having this level of poor benthic community structure -- low biodiversity and, either, a low proportion of bivalves, or a high proportion of tubificid oligochaetes.

The frequency of external pathologies in finfish is another ecological response that can represent the condition of an estuary. The incidence of external pathologies was determined from an examination of all fish collected at the sites. Over 5,000 fish were examined. In the Louisianian Province, the background rate of occurrence of external pathologies (finrot, lesions, discolorations) was $0.7 \pm 0.3\%$. Most groupings of fish in Gulf of Mexico estuaries did not display pathology frequencies different from the background expectation (catfish 1%, demersal fish 1%). However, commercial and recreational fish displayed a combined pathology rate of 1.5% (Atlantic croaker, permit, seatrout), and pelagic fish showed a rate of 3.2% (seatrout, permit, menhaden).

The bottom waters of Gulf estuaries were examined to determine the extent of hypoxia during the sampling period by mooring a continuous monitoring device approximately 0.3m above the bottom. Using an algorithm determined in earlier studies, the minimum concentration, the average nighttime concentration, and the concentration at dawn were used to determine the sites that experienced hypoxia (ppm) greater than 20% of the time during the sampling period. In addition, instantaneous measures of dissolved oxygen were taken at each site. About 6% of the bottom waters of the estuaries of the Gulf of Mexico were continuously hypoxic throughout the sampling period, while an additional 6% were hypoxic in a cyclic manner, with the hypoxia occurring for more than 40% of the nighttime hours. Thus, the total proportion of the bottom waters displaying hypoxia in Gulf estuaries was 12%.

Sediment Quality And Toxic Inputs To The Gulf Of Mexico

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States bordering the Gulf of Mexico discharge hundreds of thousands of pounds of toxic pollutants into the Gulf waters each year. Most notable are Texas and Louisiana, with their massive petrochemical complexes that generate more toxic waste in total volume and on a per capita basis than any other state in the nation. Although Florida is an exception, the Gulf states also produce the most dangerous chemicals, those that cause either cancer, birth defects, or nerve damage.

Recognizing the importance of assessing the amounts, kinds, and potential impacts of toxic releases into Gulf estuaries, the Toxics and Pesticides Subcommittee of the Gulf of Mexico Program developed two important databases -- the Toxics Release Inventory (TRI) and the Contaminated Sediments Inventory. This paper provides an overview of the information contained in these databases and discusses briefly the results of preliminary evaluations designed to identify both chemicals and estuaries of concern of the Gulf coast.

The TRI identifies and quantifies point and non-point source inputs of toxic chemicals to the Gulf -- specifically,

industrial and municipal discharges, pesticide inputs from agricultural activities, and produced waters. Data retrieval for industrial and municipal activities for the year 1989 came from EPA's Toxics Release Inventory System and Permit Compliance System. The information was evaluated based on chemical toxicity, volume of receiving water, and waste water treatment reductions at Publicly Owned Treatment Works. Data retrieval for agricultural activities for the years 1987 and 1989 came from NOAA's Resources for the Future Database. The information was evaluated for chemical toxicity, propensity for bioaccumulation, and soil half-life. Data on oil and gas activities came from a preliminary report published by Avanti, Inc. Because produced water discharges occur further offshore, this information was not evaluated by estuary.

Results of the TRI evaluation indicated that approximately 13 million pounds of toxic substances were discharged from industrial and municipal sites into the Gulf of Mexico in 1989. Calculated toxicity indices showed Galveston Bay to be the most susceptible, followed by Calcasieu Lake, Tampa Bay, Brazos River, Corpus Christi Bay, Sabine Lake, Escambia Bay, Mississippi Delta Region, Mobile Bay, and Atchafalaya/Vermilion Bay. The ten most toxic chemicals released to Gulf estuaries were ammonium sulfate, chlorine, ammonia, chromium, hydrazine, copper, zinc, cyanide compounds, ethylbenzene, and sulfuric acid.

Approximately ten million pounds of pesticides were applied to agricultural fields in Gulf coastal counties in 1987, and five million pounds were used in 1989. According to NOAA's rating index, potential contamination of the Laguna Madre estuary was greatest in 1987, followed by Tampa Bay and Charlotte Harbor. When the index was applied to the 1989 database, Laguna Madre again was depicted as having the greatest potential contamination, followed by Atchafalaya/Vermilion Bays and Matagorda Bay.

In 1991, produced water discharged from oil and gas platforms and coastal processing plants in near coastal waters of Louisiana and Texas contained approximately 28 million pounds of metals (minus calcium and magnesium) and 2.5 million pounds of organic pollution.

The Contaminated Sediments Inventory (CSI) contains coastal sediment chemistry and biological effects data collected by State, Federal, and academic sources for the past 13 years. The database, which contains almost 27,000 records, consists of detailed information on each sample collected, as well as QA/QC information, when available. Data consists largely of bulk sediment chemistry information, a large proportion of which utilizes detection limits above many threshold effects levels. Due to the nature of the CSI, Florida's draft sediment quality guidelines were used to evaluate the data to identify both chemicals and estuaries of concern.

It is noteworthy that evaluation of bulk sediment chemistry data on many chemicals, particularly pesticides, is difficult. In addition, characterization of Florida's coastal sediment was more complete than much of the rest of the Gulf coast. Therefore, it is likely that many areas not listed may be a concern, but data is limited at this time. Consequently, the information contained in this database should be used keeping these limitations in mind.

Analysis of the CSI showed that Tampa Bay ranked highest in potential ecological impact caused by contaminated sediments. Galveston Bay, Escambia Bay, Ten Thousand Islands, Choctawhatchee Bay, Calcasieu Lake, St. Andrew Bay, Apalachicola Bay, Perdido Bay, and Mobile Bay also ranked high as potential hot spots based on historical sediment quality data. Gulfwide contaminants of concern were also identified with chlordane leading the list, followed by phenanthrene, anthracene, mercury, silver, 2,4-DDD, chrysene, nickel, zinc, and 4,4-DDD.

A Gulf of Mexico Toxics Characterization Report integrating the results of the Toxics Release Inventory and Contaminated Sediments Inventory, including fish advisory information, also has been written. Information is presented on a Gulf-wide and estuary-specific basis.

To receive a copy of the three reports and data bases, please contact: Catherine Fox, (202) 260-1327

C. Habitat Degradation

Impact Of A Persistent "Brown Tide" Algal Bloom On The Laguna Madre Of South Texas

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Regions of the South Texas coast centered around the Laguna Madre have experienced a dense algal bloom since January 1990, referred to as the brown tide. This nearly monospecific bloom has been caused by high densities (1-5 x 10^9 cells l^{-1}) of a small (4-5 m diameter) chrysophyte. This dense, persistent algal bloom has reduced the penetration of

sunlight in the Laguna Madre, shading out seagrass beds and disrupting sport fishing.

The Texas brown tide shares many similarities with brown tides which have occurred repeatedly in the northeastern U.S., especially in Long Island Sound and Narragansett Bay. The northeastern brown tide is caused by high densities of the chrysophyte *Aureococcus anophagefferens*, causing extensive damage to important commercial populations of shellfish. The Texas brown tide is caused by a different, unidentified species of chrysophyte that is slightly larger than *Aureococcus*.

Most studies of toxic and nuisance phytoplankton blooms began after the bloom was well established, making it difficult to determine the factors causing the bloom and analyze its effects due to the lack of pre-bloom data. In this case, the researchers were fortunate to have been studying the Laguna Madre ecosystem for nearly a year in the same area where the brown tide occurred. Before the brown tide, the upper Laguna Madre was characterized by relatively clear waters overlying extensive seagrass beds, making it a popular area for sport fishing.

In January 1990, populations of the brown tide chrysophyte occurred in the upper reaches of Baffin Bay in the Upper Laguna Madre. The onset of the brown tide bloom in these regions followed an unusually hard freeze in South Texas in December 1989 that caused widespread fish kills in the Laguna Madre. Dissolved inorganic nitrogen (DIN) concentrations increased abruptly preceding the bloom (up to 20 mole l^{-1}), but they declined to lower concentrations during the bloom. High DIN concentrations may have been caused in part by decomposition of organisms killed in the freeze, and this nutrient pulse may have helped fuel the initiation of the bloom. A prolonged period of drought preceded the freeze, raising salinity above 50%. A crash in the planktonic and benthic filter feeding populations coincided with the establishment of the brown tide in the upper reaches of Baffin Bay. The high salinity and rapid drop in temperature may have decimated grazer populations in these shallow waters, releasing the brown tide from grazing pressure when it was first established.

Concentrations of brown tide cells ranged from 0.5 - 6 x 10^6 cell ml^{-1} throughout the course of the bloom, and chlorophyll a concentrations approached 80 g l^{-1}. The most obvious impact of this dense concentration was the dramatic reduction in water transparency. It reduced underwater irradiance to 60-70% of pre-bloom levels in the Laguna Madre, which is normally characterized by extensive seagrass beds. The highest brown tide concentrations, and lowest light penetration, usually occurred during spring and summer, when most photosynthetic activity in seagrass occurs.

Zooplankton are the major consumers of phytoplankton in most marine systems. It is puzzling that zooplankton populations have not increased during this algal bloom and that these grazers have not brought the bloom under control. Zooplankton populations were abundant before the onset of the brown tide bloom, with mesozooplankton populations dominated by the copepod *Acartia tonsa*. These populations declined sharply at the beginning of the bloom and remained low in areas impacted by the brown tide. The size of adult copepods was significantly lower in brown tide areas, and adult female copepods had significantly reduced egg production rates. The brown tide may be too small to be grazed efficiently by copepods, but it is within the range of sizes that microzooplankton prefer. Microzooplankton populations, composed mainly of ciliates, were responsible for grazing approximately 90% of the daily standing stock of phytoplankton before the bloom. But, they also declined during the brown tide, grazing less than 5% of the brown tide standing stock per day.

The brown tide also had a dramatic effect on the benthic organisms of the Laguna Madre. In 1989, the macrofauna community was abundant and diverse. From August 1989 to January 1990, however, abundance increased while diversity and biomass decreased. The benthic community in Baffin Bay was dominated by a single species, the polychaete worm *Streblospio benedicti*, a typical pattern in disturbed benthic communities. During the onset of the brown tide, abundance, biomass, and diversity decreased to near zero in the benthos.

The density of larval fish was also severely reduced in areas impacted by the brown tide. In pre-brown tide samples from the Laguna Madre, catches of larval bay anchovy averaged 150-250 larvae per 100 m^3. During the brown tide, catches averaged only 50-80 larvae per 100 m^3. Black drum and spotted sea trout larvae fared much worse. Pre-bloom densities averaged 4-5 larvae per 100 m^3 for spotted seatrout and 20-30 larvae per 100 m^3 for black drum. During the brown tide, very few larvae of either species were taken, and densities averaged 0.5 larvae per 100m^3. In the nearby Port Mansfield Channel, which has not been impacted by the brown tide, both bay anchovy and black drum densities have been almost an order of magnitude higher during the brown tide years than in pre-bloom collections. Larvae of spotted sea trout are rare in these collections, however. Egg densities observed in the brown tide impacted areas indicate that spawning activity is normal, suggesting that, either eggs fail to hatch, or that larval fish survive poorly in areas impacted by the brown tide.

The brown tide is still present in the Laguna Madre, having persisted for over 34 months, which may be the longest-known monospecific phytoplankton bloom ever documented. Although there have been no massive fish kills or other acute affects to capture the public's attention, the brown tide's impact on seagrass beds and planktonic and benthic diversity may cause fundamental, long term changes in the Laguna Madre ecosystem.

Seagrass Die-Off In Florida Bay

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Rapid and widespread mortality of the seagrass *Thalassia testudinum* (turtle grass) in Florida Bay at the southern tip of the Florida Peninsula is continuing. Since 1987, more than 4,000 hectares (ha) of seagrass beds have been lost, and an additional 23,000 ha have been affected (Robblee et al., 1991).

Die-off has been most widespread in central and western Florida Bay, affecting about 30% of the dense seagrass beds of this region. However, in early 1989, an isolated, dense *Thalassia* bed in Sunset Cove experienced significant die-off. Sunset Cove is over 30 km east of the main area of die-off; it is adjacent to the Everglades National Park boat dock where the research vessels that sample in die-off areas are moored. Die-off at this location indicated that a transmissible agent might be involved in this phenomenon.

Die-off appears to be density dependent and, thus far, has only been observed in areas that previously supported very dense *Thalassia*-dominated populations. Many patches appear to spread and coalescence in a contagious distribution pattern. Older die-off patches are frequently revegetated by *Halodule;* the presence of *Thalassia* rhizomes in sediment cores confirms that an unvegetated, or *Halodule*-dominated patch, has developed after a die-off event.

Die-Off Associated Changes In Thalassia Community Structure

Short-shoot and rhisome apical densities, leaf lengths, and leaf area indices generally decrease along transects from visually healthy beds to die-off patches. The transition zone between die-off patches and apparently healthy beds is characteristically abrupt, reflecting the rapidity at which die-off occurs. High leaf numbers for isolated survivor short-shoots result from rapid leaf initiation rates and are probably a response to loss of the leaf canopy and an increase in light availability. Overall reductions in values of several shoot-specific parameters between 1989 and 1990 coincided with a shift in demographics to a younger population. This shift reflects recolonization of die-off patches rather than an increase of stress and illustrates the importance of demographic information for correct interpretation of changes in seagrass structural and dynamic characteristics.

Potential Causative Agents In Die-Off

The contagious distribution patterns, density dependence, spread rates, and leaf necroses associated with die-off of *Thalassia* suggest the involvement of a pathogenic organism. The marine slime mold *Labyrinthula,* related to the pathogenic species involved in the catastrophic wasting disease of the temperate eelgrass, *Zostera marina,* is the most common eucaryotic organism isolated from affected *Thalassia* during die-off episodes. Seedling bioassays of toxicity and pathogenicity of chemical and biological system elements indicated no acute toxicity associated with water, sediment, or plant material from the die-off sites. All seedlings inoculated with *Labyrinthula* developed necrotic lesions. *Labyrinthula* infection also reduces photosynthetic capacity and increases respiration rates.

Measurements of alcohol dehydrogenase (ADH) activities, an index of cumulative, chronic hypoxic stress, suggested that hypoxic stress of below-ground *Thalassia* tissue may play a role in the die-off phenomenon. Because carbonate sediments lack significant amounts of iron to precipitate sulfide produced by bacterial sulfate reduction, root and rhizome hypoxia may be exacerbated by high concentrations of dissolved sulfide in sediment porewater. Sulfide concentrations approach levels which may cause cytotoxic effects in October, a period of peak intensity of die-off. Etiological studies of a die-off episode showed that elevated porewater sulfide and rhizome ethanol concentrations preceded the appearance of necrotic *Labyrinthula* lesions on *Thalassia* leaf blades by two months. Measurements of oxygen transport rates through healthy and diseased shoots indicated that diseased shortshoots exhibit reduced conductance of oxygen, thereby making *Thalassia* more susceptible to hypoxia and sulfide toxicity -- which may be the proximal cause of death.

Seagrass Recovery Potential

Isolated survivor *Thalassia* short-shoots have the ability to initiate new lateral growth, but the rate of shoot initiation is quite low. Dead branch rhizomes and short-shoots are frequently observed, suggesting cyclic recurrence of the die-off. The occurrence of flowering short-shoots and seedlings is very patchy, and no flowering short-shoots or seedlings have been observed in Rankin Lake, the basin most affected by the die-off. These observations suggest that recovery of *Thalassia* will be, primarily, by vegetative growth of surviving plants.

Photoquad and map patch data also indicate a general trend toward vegetative recolonization by *Thalassia* at the individual patch level. However, basin level observations of frequency

of occurrence, abundance, and density reveal that recovery of *Thalassia* in Rankin Lake is being outstripped by rapid recolonization of the pioneering species, *Halodule wrightii.*

System Responses To Seagrass Die-Off

Water column nutrient characteristics have been significantly affected by the mortality and decomposition of seagrass in Florida Bay. Inorganic nutrient levels are highest in basins experiencing die-off and in areas now devoid of living seagrass. Total organic carbon and total organic nitrogen concentrations are 6-fold higher in Central Florida Bay compared to the adjacent Gulf of Mexico, probably the result of decomposition of seagrass necromass originating from the die-off. Thus, seagrass die-off is adding both inorganic and organic nutrients to the normally oligotrophic waters of Florida Bay. This eutrophication may be a driving force behind the damaging algal blooms that are presently occurring in various portions of the Bay.

Conclusions

Anthropogenic nutrients and xenobiotics are unlikely contributors to the die-off phenomenon in Florida Bay. The recurring episodes of rapid, but patchy, mortality are distinct from the gradual loss of seagrass due to eutrophication reported in other estuaries. A growing body of evidence suggests that environmental stresses weaken *Thalassia,* making it vulnerable to disease (Figure 1). Reduced freshwater flow into Florida Bay due to drought and diversion of upland runoff has caused significant increases in salinity changing the Bay from an estuary to a marine lagoon. This change, coupled with the lack of major storm perturbations in the recent past, has allowed *Thalassia* to develop very high densities and biomass in basins adjacent to the Everglades shoreline. Water temperatures and salinities were elevated during the recent drought period, with salinities exceeding 65% in Rankin Lake in the spring of 1990. The shallow water and restricted circulation of Florida Bay, coupled with the lack of buffering by freshwater sheetflow from the Everglades, and exacerbated by increased seagrass biomass and necromass, probably amplified the effects of these recent temperature and salinity fluctuations. These events may have acted synergistically to precipitate and then propagate the widespread and recurring outbreaks of seagrass die-off that are still ongoing.

References

Carlson, P. R., M. J. Durako, T. R. Barber, L. A. Yarbro, Y. deLama, and B. Hedin, *Catastrophic mortality of the seagrass Thalassia testudinum in Florida Bay,* Fla. Dept. Environ. Reg., Offc. Coastal Zone Mgmt., Annual Completion Report Grant CM-257, 52 pp. 1990.

Robblee, M.B., T.R. Barber, P.R. Carlson, M.J. Durako, J.W. Fourqurean, L.K. Muehlstein, D. Porter, R.T. Zieman, and J.C. Zieman, *Mass mortality of the tropical seagrass Thalassia testudinum in Florida Bay (USA),* Mar. Ecol. Prog. Ser. 71: 297-299. 1991.

Ecological Condition Of Benthic Habitats In Gulf Of Mexico Estuaries

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In 1991, the Environmental Monitoring and Assessment Program (EMAP) initiated a long-term monitoring program to assess the ecological status and long-term trends of the estuaries of the Louisianian Province. The Louisianian Province consists of the biogeographic region from Anclote Anchorage, FL around the Gulf Coast to, and including, the Rio Grande, TX.

This evaluation includes all tidally-influenced water bodies greater than 2 km^2 in surface area. These include: 27 large estuaries (Pensacola Bay, FL; Mobile Bay, AL; Mississippi Sound, MS; Lake Borgne, LA; Laguna Madre, TX), large tidal rivers (Mississippi River), and 154 small estuaries/ tidal rivers (Watsons Bayou, FL; Pelican Bay, AL; Bayou Casotte, MS; Belle River, LA; and Cedar Bayou, TX).

EMAP-E focuses on determining the status of response indicators to ascertain a measure of the ecological condition of the estuarine resources of the province. EMAP-E is unique among monitoring programs in that it is nationwide in scope, focuses on ecological status and trends, and is based on unbiased sampling. These characteristics allow the data to be used to represent large biogeographic regions so that statements concerning the status of the estuarine resources as a whole can be made with a known level of confidence. EMAP-E is also active in other biogeographic regions of the

country using the same sampling design, indicator collection methods, and assessment approaches.

EMAP-E focuses its sampling efforts in late summer (July and August) in the Louisianian Province. A total of 202 sites were selected to be sampled during a 7-week interval in 1991. Sampling included the collection of habitat and water quality information (water temperature, water column dissolved oxygen concentrations, salinity, water clarity), the deployment of a continuous monitoring apparatus for water quality (collection of bottom dissolved oxygen concentration every 15 minutes for 24 hours), the collection of sediments (for benthic evaluation, sediment toxicity testing, sediment characterization in terms of organic content, grain size, and contaminant concentrations), fish trawling (characterization of fish communities, examination of pathology incidence, and tissue contaminant concentrations), and benthic dredging (characterize large bivalve communities and marine debris). Approximately 125 contaminants were evaluated at 202 sites distributed throughout the Gulf of Mexico estuaries. These contaminants included alkanes and isoprenoids, PAHs, PCBs, pesticides, heavy metals, and butyltins. The criteria used to determine whether a contaminant exceeded an acceptable level are the Long and Morgan criteria that reflect concentrations resulting in ecological effects in at least 10% of the organisms or populations exposed to that concentration. No Long and Morgan criteria exist for alkanes or tributyltins, for which we used 5,000 ppb and 1 ppb for criteria, respectively.

About 11% of the sediments in Gulf estuaries contained greater than 5,000 ppb total alkanes and isoprenoids. The primary contributors to these exceedances were pristane and phytane and located west of the Mississippi Delta in Louisiana and Texas. Only 4% of the sediments showed total PAH concentrations greater than the Long and Morgan criteria (4,000 ppb). The primary contributors to this PAH exceedance were fluorene, naphthalene, and phenanthrene. Individually, these excesses ranged from 1-9% of estuarine sediments Gulfwide. No individual PCB congeners or total PCB's exceeded 25 ppb or 400 ppb, respectively, in Gulf estuarine sediments.

Tributyltin was measurable in about 13% of the estuarine sediment of the Gulf of Mexico and exceeded 5 ppb for 4% of those sediments. Tributyltin exceeding 5 ppb was found, primarily, in small estuaries, while concentrations between 1-5 ppb were mainly found in the Mississippi River and some large estuaries in Texas. About 62% of the estuarine sediments in Texas had measurable tributyltin, while 26% of Florida estuarine sediments contained this contaminant. Less than 6% of the sediments in Louisiana, Mississippi, and Alabama contained tributyltin.

Of the pesticides examined, only total DDT, chlordane, dieldrin, endrin, and hexaclorobenzene exceeded the 10% Long and Morgan criteria in Gulf estuarine sediments. These exceedances ranged from 1% for DDT and hexachlorobenzene to 23% of sediments for dieldrin. None of these contaminants was observed in edible fish tissues in concentrations exceeding the FDA action limits. While no criterion for Mirex is available from Long and Morgan, 0-0.11 ppb were observed in sediments. However, Mirex concentrations in the edible flesh of shrimp, Atlantic croaker, and catfish edible tissue did not exceed FDA action limits. No toxaphene was observed in Gulf estuarine sediments, but, 7% of croaker and 3% of catfish examined contained toxaphene levels in edible tissue exceeding the FDA action limit of 500 ppb.

Of the heavy metals determined from Gulf sediments, arsenic (1%), chromium (10%), lead (%), mercury (22%), nickel (16%), and zinc (6%) exceeded Long and Morgan criteria (criteria do not exist for aluminum, selenium, and tin). Concentrations of arsenic, mercury, zinc, and chromium occurred in edible tissues of shrimp, croaker, and catfish in exceedance of FDA action limits for mercury and World Health Organization guidelines (mercury is the only metal for which FDA has set action limits). Arsenic levels exceeded 2 ppm in 4% of shrimp, 3% of croaker, and 8% of catfish examined. Mercury exceeded 1 ppm and zinc exceeded 60 ppm in 1% and 2% of catfish, respectively. Chromium exceeded 1 ppm in 4% of shrimp. These tissue residue exceedances were observed primarily along the Mississippi River corridor and in northwestern Florida and Alabama estuaries, although local exceedances were observed throughout the Gulf Coast.

Coastwatch Change Analysis Program (C-Cap): An Overview

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Quantifying changes in the areal extent of wetlands and adjacent uplands is critical in linking land-based human activities to the productivity of the coastal ocean. Changes due to human population growth and its impacts on fishery habitat, adjacent uplands, water quality, and living marine resources occurs faster and more pervasively than scientists could monitor in the past.

There has not been sufficient long-term monitoring of changes in fisheries habitat and land cover for the coastal region of the nation. In response, NOAA's Coastal Ocean Program instituted the CoastWatch: Change Analysis Program (C-CAP) using satellites and aerial photography to monitor the areal extent, functional status, and changes in location and acreage of wetlands and uplands.

This information is needed to determine the biological consequences of changes in quality and quantity of estuarine and coastal habitats. It is essential for models and statistical means of relating habitat change to changes in fisheries production.

The C-Cap Change Detection Protocol

A major focus for C-CAP has been the development of a standard protocol for mapping submerged aquatic vegetation (SAV), emergent coastal wetlands, and adjacent uplands. It includes sources and procedures for data acquisition, processing, and presentation and is based primarily on information generated at regional workshops in South Carolina, Florida, Rhode Island, Washington, and Michigan. Numerous meetings concerning statistical validation and classifying wetlands and uplands also played a role in developing the protocol. Nationwide acceptance of it will allow comparable data to be obtained by the national program regardless of which agency funds or conducts the effort. It will be reviewed by the 200 or so Federal, state, and academic officials who attended the workshops prior to its completion in Fiscal Year 1993.

Protocol Testing

In order to test and refine the procedures outlined in the protocol, C-CAP initiated two "prototype" studies. The Chesapeake Bay was used as a prototype for change detection of emergent wetlands and uplands using satellite imagery, and coastal North Carolina was used as a prototype for mapping and change detection of SAV using aerial photography.

Chesapeake Bay Prototype

The Chesapeake Bay habitat change analysis was conducted by comparing Landsat Thematic Mapper (TM) imagery for 1984 and 1988-89. Conducted by personnel at the Oak Ridge National Laboratory, the study area encompassed four TM scenes covering over 30,000 square miles. Field verification and statistical validation consisted of initial field tests with USFWS's National Wetlands Inventory, preliminary field tests by 40 specialists for the Salisbury, Maryland quadrangle, an error estimation workshop to design a statistical validation approach for habitat change analysis, and statistical validation of the prototype based on the workshop and field work performed by the Chesapeake Research Consortium.

North Carolina Prototype

The National Marine Fisheries Service Beaufort Laboratory, with joint funding from C-CAP and the Environmental Protection Agency Albemarle-Pamlico National Estuary Program, is nearing completion of its effort to map SAV in eastern North Carolina from Bogue Inlet to the Virginia border. Aerial photography for the project has been conducted by the Photogrammetry branch of NOAA's National Ocean Service, Coastal and Geodetic Services. The final photographs to complete the coverage were taken in fall 1991 and spring 1992. Photointerpretation, habitat signature verification, and compilation will be completed by December 1992. Three SAV habitat charts have been published as a result of these efforts.

Protocol Development Research

Based on the two prototype studies and the Salisbury field test, C-CAP has funded research to refine the protocol. Presently, C-CAP protocol development research is focused on error estimation in change detection data bases, the effects of tides on detecting emergent wetlands with TM imagery, and improving techniques for detecting forested wetlands. Research on C-CAP protocol development is being conducted at the University of South Carolina, North Carolina State University, universities of Rhode Island and Connecticut, University of Virginia, University of Maine, University of New Hampshire, and the NMFS Beaufort Laboratory.

Regional Change Analysis

As both prototype projects wind down, C-CAP will focus more effort on regional programs to expand the geographic coverage of the change detection data base. To accomplish this task, cooperative efforts have begun in the following areas: Galveston Bay, Texas; St. Croix River estuary and Passamaquoddy Bay in Maine and Canada; Columbia River and Willapa Bay in Oregon and Washington; Russell Fiord and Hubbard Glacier near Yakutat, Alaska; South Florida where Hurricane Andrew struck; SAV in the northern Gulf of Mexico (Tampa, FL to Brownsville, TX); SAV in Florida Bay; and SAV in coastal Massachusetts.

Wetland Functional Health Assessment Using Remote Sensing

In addition to change detection analysis, C-CAP is also working to determine the feasibility of using remote sensing to measure the health of emergent wetlands. As a preliminary effort, scientists at the University of Delaware completed a literature search and review to summarize the feasibility of remotely sensing biomass, productivity, and the functional health of coastal marshes. Also, in 1992, a pilot study in Louisiana marshes was conducted jointly by scientists from the University of Delaware and Louisiana State University (the latter funded by EMAP) to relate spectral characteristics of marsh to aboveground biomass density.

Wetland Value Assessment: A Methodology For Prioritizing Projects Under The Coastal Wetlands Planning, Protection, And Restoration Act

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The Coastal Wetlands Planning, Protection, and Restoration Act of 1990 provides funding for constructing long term restoration, protection, or enhancement projects for Louisiana's coastal wetlands and their dependent fish and wildlife resources.

Section 303 of the Act requires that projects proposed for funding be prioritized according to cost effectiveness after evaluating the effects of each project on wetland quality. The Wetland Value Assessment (WVA) methodology was developed to quantify the projected changes in fish and wildlife habitat quality and quantity, and the results are combined with economic data to measure cost effectiveness.

The WVA consists of four community-level habitat models developed to estimate the suitability of Louisiana's fresh, brackish, and saline marshes and cypress-tupelo swamps as habitat. WVA development was guided by three constraints. First, community habitat models were deemed more appropriate than species-based models to address the different responsibilities and goals of the six resource agencies making up the Coastal Wetlands Act implementation Task Force. Second, the Task Force's emphasis on restoring and protecting vegetated wetlands required that the WVA be sensitive to changes in those areas. Finally, because ranking the proposals is required quickly, the WVA was designed to use existing or easily obtainable data.

The WVA is a community-level modification of the species-based Habitat Evaluation Procedures developed by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service 1980). The WVA operates under the assumptions that optimal habitat can be characterized and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality, which is estimated through the WVA habitat models.

Each WVA model consists of variables considered important in characterizing fish and wildlife habitat, a Suitability Index graph for each variable, and a mathematical formula that combines the Suitability Indices for all variables into a single value for wetland habitat quality (the Habitat Suitability Index).

Habitat variables for each wetland type were selected according to three criteria: importance in characterizing habitat quality, ease in estimating and predicting based on existing data, and sensitivity to changes caused by typical wetland projects proposed under the Coastal Wetlands Act.

Variables were selected based on general knowledge of parameters thought to be important in characterizing fish and wildlife habitat in coastal marsh or swamp systems, and by reviewing variables used in species-based Habitat Suitability Index (HSI) models published by the U.S. Fish and Wildlife Service.

Suitability Index (SI) graphs representing how habitat quality changes relative to changes in variable values were constructed for each variable in each wetland type. Thus, a numeric value, ranging from 0.1 to an optimum of 1.0, describes the habitat quality of a wetland area relative to each variable.

The final step in WVA model development was to construct a formula combining all SI variables into a single HSI for the overall habitat quality of the area evaluated. The HSI uniquely defines the aggregation of SI's for each wetland type depending on how the formula is constructed. Each variable's importance relative to others in the HSI formula can be increased by assigning an exponent and raising it to the appropriate degree. A larger exponent will increase the influence of that variable's SI.

Because the Task Force has determined that the Act's primary focus is vegetated wetlands, variables addressing aquatic vegetation and emergent marsh were weighted to the second and third power, respectively, to increase their role in determining the HSI's. An exception is the formula for the saline marsh model, where the aquatic vegetation variable is not weighted due to its scarcity in Louisiana tidal saline marshes. Finally, the aquatic organism access variable was weighted to the second power in the brackish and saline marsh models to reflect their importance in providing estuarine habitat.

All HSI formulas developed for the WVA use a geometric mean to aggregate SI's within a wetland type. This is used when the relationship between variables demonstrates some compensation (i.e., a low SI for one variable will be partially compensated by a high SI of another); however, optimum conditions exist only if all SI's are equal to 1.0. A geometric mean is computed by multiplying the SI's together and raising the resulting product by the reciprocal of the sum of all SI

exponents. Like SI's, the HSI ranges from 0.1 to 1.0.

The benefits of a proposed project are estimated by predicting how habitat conditions and model variables will change with and without the proposed project. HSI's are established for baseline (pre-project) and for future with- and without-project conditions in selected target years. Those HSI's are then multiplied by the acreage of wetland type known or expected in the target years to arrive at Habitat Units. Habitat Units represent a mathematical product of quality (HSI) and quantity (acres) at a point in time. The "benefit" of a project can be quantified by comparing HU's of the with- and without-project scenarios. The difference between the two represents the net project benefit in terms of habitat quantity and quality.

To be compatible with normal Federal accounting procedures, the HU's resulting from the with- and without-project conditions are annualized, averaged over the project life, and compared to determine the net gain in Average Annual Habitat Units (AAHU's) attributable to the project. Net gain in AAHU's is then divided into averaged annualized cost data to arrive at a cost per AAHU and ranked in order of cost effectiveness (cost per AAHU).

References

U. S. Fish and Wildlife Service, Habitat evaluation procedures (HEP), Div. Ecol. Serv. ESM 102, U. S. Fish and Wildl. Serv., 141pp. (1980).

Table 1. Wetland Value Assessment Habitat Model Variables.

Description	Models
Percent of wetland area covered by emergent vegetation	all marsh models
Percent of open water area dominated by aquatic vegetation	all marsh models
Marsh edge and interspersion	all marsh models
Water duration in relation to marsh surface	all marsh models
Percent of open water area 1.5 feet deep, in relation to marsh surface	all marsh models
Mean high salinity during the growing season (March through November)	fresh marsh
Average annual salinity	brackish and saline marsh
Aquatic organism access	all marsh models
Water regime	cypress swamp
Water flow/exchange	cypress swamp
Average high salinity	cypress swamp

D. Nutrient Enrichment

Introduction And Status Of The Impacts And Effects Of Nutrient Enrichment In The Gulf Of Mexico

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One of the key areas first addressed by the Gulf of Mexico Program Nutrient Enrichment Subcommittee was the status of the impacts and effects of nutrient enrichment in the Gulf of Mexico and determining identifiable trends. This information, coupled with knowledge of the sources and quantities of nutrients entering the Gulf, was determined to be critical to understanding the extent of nutrient enrichment and finding a solution.

The basic biological responses to nutrient enrichment are increases in phytoplankton production, biomass, abundance, and, in some cases, changes in species composition. Less obvious, indirect effects include changes in secondary production, altered energy flow pathways, altered habitats, oxygen depletion (hypoxia), and, in the extreme, fish kills.

A review of the available data and information on impacts and effects of nutrient enrichment showed four primary areas of concern in the Gulf and adjacent waters. They are:

- zones of hypoxia that affect fisheries and their supporting food webs,
- noxious algal blooms that have toxic effects on marine life and human consumers,
- phytoplankton shading of submerged aquatic vegetation, and
- alteration of the trophic structure of phytoplankton communities.

Although there are other areas of concern, these four exemplify the growing interest in the eutrophication in the Gulf of Mexico.

Hypoxia refers to conditions of low dissolved oxygen. In the Gulf of Mexico, hypoxic conditions have been defined as dissolved oxygen levels below 4 mg/L (Whitledge, 1985), although some have defined it as below 2 mg/L (Rabalais, 1987, 1988). In the northern Gulf of Mexico, hypoxia has been associated with nutrient enrichment from the Mississippi River. The input of nitrogen and phosphorus to the River and the Gulf Coast, which leads to hypoxic conditions, has increased greatly over the last three decades.

On the Continental Shelf of the northern Gulf of Mexico, hypoxia develops as early as April and continues as late as October. Dissolved oxygen concentrations below 2 mg/L have occurred over a large area of the Continental Shelf from the Mississippi River Delta to the Upper Texas Coast. Hypoxia has also been observed in Wolf and Perdido bays, Mobile Bay, Mississippi Sound, and Lake Pontchartrain. On occasions, total oxygen depletion, or anoxia, has been observed. Severe hypoxia has caused mass mortalities of benthic organisms and fish in several areas of the Gulf (Boesch and Rabalais, 1991).

Some species of algae have toxic effects on marine life and may contaminate shellfish. Excessive algal blooms are sometimes called red tides and plague the entire Gulf. Typically, the toxin released by red tide algae is a neurotoxin causing serious health effects in humans when ingested through contaminated shellfish. While there is no consensus on the relationship of red tides to nutrient enrichment, there is some indication that red tide algal population explosions are associated with nutrient imbalances.

Algal population blooms associated with excessive nutrient loading has been shown to reduce the level of sunlight penetrating the water column. This shading reduces the photosynthetic activity of microorganisms and submerged aquatic vegetation. In some cases, the turbidity caused by nutrient enrichment eliminated large areas of seagrass beds. An example can be found in Hillsborough Bay in Florida (Johansson and Lewis, 1991). The loss of seagrass beds impacts other plant and marine life that are dependent on them and, if uncorrected, causes severe declines in desirable species of fish and shellfish.

Although there are many factors that influence changes in phytoplankton and consumer fish populations, the supply, relative availability, and timing of nutrient inputs is one of the most important. Any significant shifts in the phytoplankton community structure may upset the balance of important aquatic food chains. There is evidence that changes in phytoplankton communities are occurring globally in response to nutrient enrichment, and, in some cases, this has led to an increased abundance and seasonal dominance of noxious, harmful, or toxic species. It has been shown that the sinking and decomposition of nutrient enriched algal populations causes increases in hypoxia and anoxia in both the water column and along the sea floor.

One area where phytoplankton species shifts have occurred is in the northern Gulf influenced by the Mississippi River where the silicate to nitrate ratio has decreased from 4:1 to approximately 1:1 over the last three decades (Turner and Rabalais, 1991). The reductions in silicate concentrations are

believed to be the primary factor in the shift from diatoms to flagellate and cyanobacterial phytoplankton communities. The shift from diatoms to other phytoplankton species effects the structure of the invertebrate and fish communities, impacting the entire food chain.

Assessing the status of the effects of nutrient enrichment is a challenging problem. The Nutrient Enrichment Subcommittee has reviewed large amounts of published and unpublished literature on Gulf environments, but the data bases are diverse and often insufficient in resolution or duration to indicate trends. In many cases, information is nonexistent or inaccessible. Several useable data sets, however, have been retrieved, examined, and summarized in a subcommittee sponsored report (Rabalais, 1992). The subcommittee is continuing to collect and review large amounts of unanalyzed data worthy of more detailed analysis in an effort to further address nutrient enrichment problems in the Gulf of Mexico and prepare an Action Agenda to determine and implement solutions.

References

Boesch, D. and N. Rabalais, "Effects of Hypoxia on Continental Shelf Benthos: Comparisons Between the New York Bight and the Northern Gulf of Mexico," Pages 27-34 in: R.V. Tyson and T.H. Pearsons (eds.), Modern and Ancient Continental Shelf Anoxia, Geological Society Special Publication N. 58, The Geological Society, London, 470p. 1991.

Johansson, J. and R, Lewis, "Recent Improvements of Water Quality and Biological Indicators in Hillsborough Bay, A Highly Impacted Subdivision of Tampa Bay, Florida, U.S.A.", A manuscript submitted to the International Conference on Marine Coastal Eutrophication, March 21-24, 1990, Bologna, Italy, 16 p. 1991.

Rabalais, N., "Oxygen Depleted Waters on the Louisiana Continental Shelf," Pages 314-320 in: Proceedings of the Seventh Annual Information Transfer Meeting, Minerals Management Service, November 4-6, 1986, OCS Study MMS 87-0058, U.S. Dept. of the Interior, Minerals Management Service, New Orleans, Louisiana. 1987.

Rabalais, N., "Hypoxia on the Continental Shelf of the Northwestern Gulf of Mexico," Pages 81-87 in: T. Mitchell (ed.), Physical Oceanography of the Louisiana-Texas Continental Shelf. Proceedings of a Symposium, May 24-26, 1988, Galveston, Texas, OCS Study MMS 88-0065, U.S. Dept. of the Interior, Minerals Management Service, New Orleans, La, 198 p. 1988.

Rabalais, N., "An Updated Summary of Status and Trends in Indicators of Nutrient Enrichment in the Gulf of Mexico", Louisiana Universities Marine Consortium, Prepared for Gulf of Mexico Program, Technical Steering Committee, Nutrient Enrichment Subcommittee, Publication No. EPA/800-R-92-004, U.S. Environmental Protection Agency, Office of Water, Gulf of Mexico Program, Stennis Space Center, Mississippi. 421 p. 1992.

Turner, R. and N. Rabalais, "Changes in the Mississippi River water quality this century: Implications for coastal food webs." BioScience 41(3):140-147. 1991.

Whitledge, T, "Nationwide review of oxygen depletion and eutrophication in estuarine and coastal waters," Executive Summary, Report to U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of Oceanography and Marine Assessment, Ocean Assessments Division. Brookhaven National Laboratory, Oceanographic Sciences Division, Upton, New York. 28p. 1985.

Policy Considerations For Recycling Wastewater Through Hydrologically Altered Wetlands

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The two major environmental problems that, currently, most affect Louisiana are a high rate of coastal wetland loss and high levels of surface water pollution. The application of secondarily treated wastewater to wetlands is proposed as a means of dealing with these problems. The benefits of wetland wastewater treatment include improved surface water quality, increased accretion rates to balance subsidence, improved plant productivity, and decreased capital outlays for conventional treatment systems.

Wetland treatment systems can be designed and operated to restore deteriorating wetlands to previous levels of productivity. Hydrologically altered wetlands in the Louisiana coastal zone have been selected as appropriate for receiving municipal, and some types of industrial, effluent.

While the U.S. Environmental Protection Agency has determined that wetland wastewater treatment is effective in treating municipal effluent, it has discouraged the use of natural wetlands for this purpose. As a result, hydrologically altered wetlands in the Louisiana coastal zone are being neglected and, ultimately, lost while scarce funds are being applied to the construction of artificial wetlands to treat municipal effluent. Effluent discharge to existing wetlands can be incorporated into a comprehensive management plan, similar in scope and objective to river diversion projects, designed to increase sediment and nutrient input into subsiding wetlands in the Louisiana coastal zone.

Criteria were developed for selecting both appropriate industries as dischargers to wetlands and appropriate receiving

wetlands. Industries were chosen based on the biodegradable nature of their effluent, on their current discharge into polluted surface water bodies, and on their proximity to wetlands. Wetlands were selected based on an absence of priority uses, on the degree of isolation and hydrologic alteration, on a size large enough to accommodate conservative hydraulic loading rates and provide back up receiving wetlands, on the rate of subsidence to ensure permanent burial of nutrients, and on the presence of spoil banks, or similar features, that could provide gradients suitable for nutrient removal.

To illustrate the potential for secondarily treated effluent to enhance degraded wetlands, three case studies are presented, including one food processor and two municipalities. The food processor produces potato chips and has been discharging its secondarily treated effluent to a partially impounded forested wetland for the past seven years. The impoundment appears to have led to the deterioration of one segment of the forest, although not adversely affecting an adjacent segment. Results of field studies indicate that nutrient levels in the effluent decreased with passage through the wetland and that the effluent has filled in the open water area and encouraged the replacement of former-but-dying woody vegetation with young woody vegetation.

The second case study involves the City of Thibodaux, Louisiana, where a cypress-tupelo swamp of low productivity receives secondarily treated effluent from a population of about 17,000 people. A baseline study was carried out for two years, measuring primary components of the ecosystem before effluent application began in March of 1992. Preliminary data indicates mean reductions in nitrate of 98%, and 44% in phosphate, from the effluent pipe to the wetland discharge point approximately 1,600 meters away.

The third wetland wastewater treatment study is being conducted at a site receiving municipal effluent from the town of Breaux Bridge, Louisiana, population 6,000, for almost 40 years. No visible stress is evident from the vegetation in the immediate vicinity of the current discharge pipe. A two-year study will analyze the productivity of the vegetation and compare it to other cypress-tupelo swamps in the southeastern United States. Parameters to be measured include stem growth, litterfall, herbaceous biomass, water and soil nutrient levels, benthos, and nekton.

Wetland treatment systems, such as the three described above, can be established in hydrologically altered areas as experimental systems designed to imitate the critical functions of previously healthy wetlands nourished routinely by sediments and nutrients. In attempting to replace wetlands, whether they were lost due to human alterations of the environment or naturally-occurring subsidence, the addition of sediments and nutrients to wetlands through effluent application constitutes a form of wetland restoration. The authors' basic hypothesis is that wetlands improve water quality and that added sediments and nutrients will benefit subsiding wetlands. Maintaining coastal wetlands will prevent the loss, not only of water purification functions, but also of flood control benefits, wildlife habitat and diversity, direct economic use, education, and research.

Nutrient Enhanced Coastal Ocean Productivity (NECOP) -- Mississippi-Atchafalaya River Outflow

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The National Oceanic and Atmospheric Administration is responsible for stewardship of the nation's coastal resources, including living marine resources. The NOAA Coastal Ocean Program (NCOP) provides a focal point through which the Agency, together with other organizations, makes significant strides toward accomplishing this stewardship.

The Mississippi River basin drains approximately 40% of the U.S., and runoff from the basin integrates the short term climatic and anthropogenic signals from that area. They are released into the northern Gulf of Mexico through two point sources -- the main stem Mississippi River accounts for 2/3 of the outflow and the Atchafalaya for 1/3 of the outflow as it drains into Atchafalaya Bay.

During the past 60 years, population growth and agricultural development within the Mississippi drainage basin has resulted in significant increases in nutrient loadings to the River and the Gulf of Mexico. A major concern is that micronutrient loadings, which stimulate production of fresh water and marine productivity, have changed drastically in the River and its outflow region. In other words, nitrate loads in the River have increased three fold, and phosphorous loads have also increased. At the same time that phosphorous has increased, silicate, a nutrient essential for development of diatom skeletons, has decreased.

The Gulf of Mexico has extensive commercial and recreational fisheries which have an annual value in excess of $1.5 billion, and these resources may be threatened by the increases in nutrient levels.

During the past decade, a consistent seasonal hypoxia has developed along the entire Inner Louisiana Shelf. During these events, bottom water oxygen levels decline below 2 mg/l, and it extends over thousands of square miles during the summer months each year. The oxygen levels are below values needed for healthy fisheries stocks, which is causing an especially high rate of mortality on benthic species, such as shrimp.

NOAA'S Contribution

As part of NCOP, a program was established to determine the impacts of nutrient enrichment on the Northern Gulf of Mexico coastal ecosystem. Emphasis was placed on the huge nutrient signal emanating from the Mississippi-Atchafalaya River outflow to determine the impact of anthropogenically caused changes in this signal, such as increases in nitrate and phosphorous and declines in silica. The project started in 1990 as a NOAA cooperative effort with state academic institutions; NOAA labs in Florida, Mississippi and Michigan were involved, as were universities in Texas, Louisiana, Mississippi and Florida. Federal vessels were used, as well as contract vessels from Texas A&M University, University of Texas, and the Louisiana University Marine Consortium.

Research and monitoring were focused on learning the impacts of changed nutrient loading, especially regarding development of annual hypoxia in shelf bottom waters. The researchers sought to determine whether nutrient control strategies are necessary and what is the likely impact of them if they are implemented.

NOAA Findings

Results of the NCOP program in the Northern Gulf of Mexico show that the Mississippi Atchafalaya River outflow nitrogen and phosphorous nutrient load drives extremely high production of marine algae (phytoplankton) along the Louisiana Shelf. This high population of algae is rapidly grazed by zooplankton which excrete the resulting organic mass as fecal pellets that rapidly sink to bottom waters along the shelf. In summer, when the water column is stratified by both surface warming and the flow of low salinity river water on that surface, renewal of oxygen in these bottom waters is "cut off", allowing decay of the sinking organic matter to deplete oxygen to values so low organisms can not survive.

At the same time, declines in silica concentrations in the outflow have resulted in a shift of diatom population to species with lighter silica skeletons. These lighter diatoms sink at lower rates and have a longer residence time in the water column which exacerbates oxygen depletion. Records revealed in sediment cores collected in the chronically hypoxic area show that these conditions probably started at the same time the Mississippi drainage basin was developed and the onset of huge nitrogen and phosphorous fertilizer applications, which started in the 1930's.

A model has been developed integrating the knowledge gained in NCOP into a useful research, monitoring, and management tool. The model is especially useful to define the present status of the system and reveal the impacts of nutrient control strategies that might be effected. The model will continue to improve as additional research is conducted and incorporated, and as it is used in monitoring the northern Gulf of Mexico to assess its status and its optimal management and use.

Aquaculture And Constructed Wetlands

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In 1990, a demonstration project was initiated by the Mississippi Soil and Water Conservation Commission (MSWCC) to evaluate catfish culture systems operated by Mr. Truman Roberts of Purvis, Mississippi. The overall objective of the project was to determine if the innovative approach used by Mr. Roberts could alleviate problems related to water quality and quantity normally encountered with traditional catfish farming protocols in the region. Mr. Robert's aquaculture operation utilizes several systems to recirculate water through constructed wetlands prior to return into the fish production ponds. The only water resource used in these culture systems is surface water.

The MSWCC's general approach was to systematically monitor various water quality indicators, including total ammonia nitrogen, total solids, total phosphorous, chemical oxygen demand, total nitrite nitrogen, PH, dissolved oxygen, and productivity indicators, including chlorophyll and phaephytin. Such monitoring was conducted in production ponds and constructed over 1 ½ years in two culture systems. Pond 1 became operational in March 1989, and pond 2 became operational in August 1990.

Pond 1

With respect to water quality, results obtained demonstrate that the wetlands associated with pond 1 play a significant role in reducing ammonia nitrogen, total solids, BOD, and total phosphate. With few exceptions, concentrations of these parameters in water entering the constructed wetland are substantially greater than concentrations of treated effluent water returning to the production pond. Also, it appears that retention of organic carbon, phosphorous, and organic nitrogen within the wetland occurs. This is demonstrated by values for these parameters in sediments of the production pond often being less than concentrations within the wetland filter sediments.

However, results of our analyses to date suggest that substantial accumulation of these materials is not taking place in wetland sediments; concentration changes are suggestive of seasonal cycles, but values obtained in June of 1992 are similar to those obtained in August of 1990.

Pond 2

Although pond 2 was initially filled and stocked with catfish in August 1990, the constructed wetlands with which it is associated were not planted until June 1991. Even as recently as May 1992, wetland plants had not yet become well established within the filter cells; we note very little impact of these wetlands on water chemistry. However, we anticipate that as the plants become established, an improvement of water quality will result, as noted for pond 1.

Fish production data provided by the culturist documented that approximately 34,000 and 31,400 pounds of fish were produced during the two successive culture periods during which we studied pond 1. The fish harvest from pond 2 yielded 28,670 pounds.

Results

We noted few water quality or culture problems during the study. During the first year, monitoring of phytoplankton populations in pond 1 showed that phytoplankton were abundant throughout most of the study period. However, phytoplankton concentrations remained low when compared to non-recirculating ponds in the region. Continual recirculation through a constructed wetland filter was probably advantageous in controlling algal blooms in the production pond. Cyanobacteria were dominant in the plankton samples taken during the summer months, but they were not numerous enough to cause persistent oxygen depletion.

One incidence of oxygen depletion accompanied ammonia and nitrite buildup, and some fish mortality resulted from a sudden die off of an algal bloom in pond 1 in the Autumn of 1990. There were no recorded incidences of off-flavor in harvested fish during the study period; however, a few fish with brown blood disease were collected during the period when nitrite concentration in the pond was elevated. In February of 1992, total alkalinity in pond 1 was O.Omg/l CaC03 equivalent. This problem was alleviated by the addition of 800 pounds of agricultural limestone to the production pond.

Results and conclusions from this demonstration project are encouraging with regard to the overall objectives of Mr. Roberts, the Mississippi Soil and Water Conservation Commission, the Mississippi Department of Environmental Quality, and other agencies. Use of constructed wetlands is a good management tool for catfish production in areas where groundwater is limited in availability or expensive to pump. Moreover, the ability to grow large quantities of fish in recirculating surface water also will provide for the conservation of water resources.

The MSWCC is hopeful that support for additional evaluation of these culture systems will become available in the future and feels that it is essential to continue to assess filter performance as the systems continue to age and determine the long term consequences of nutrient accumulation in the wetland filter sediments.

Sources And Quantitites Of Nutrients And What Might Be Done About The Problems

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There are many actions that will be necessary to reduce nutrient loadings in the Gulf of Mexico and eliminate the problems that have been identified.

Overall, the Gulf is probably not over-enriched with nutrients, but some parts of it are. For instance, several of the bays and estuaries are overloaded, including Tampa Bay, Mobile Bay, the Laguna Madre, Lake Pontchartrain, and the Louisiana Inner Continental Shelf.

Of the total sources of nutrients entering the Gulf from the United States, about 3/4 of the nitrogen and phosphorus come in via the Mississippi and Atchafalaya River systems.

Phosphorus is the nutrient of most concern as it contributes to eutrophication in fresh water. Nitrogen deposition is the greatest concern in marine ecosystems. In estuaries, water bodies where fresh and salt water meet and mix, the situation is more complex. In some places and at some times, phosphorus is the most limiting nutrient, although nitrogen is at other places and times.

A substantial part of total nutrient loadings enter the Mississippi before the river converges with the Ohio at the southern tip of Illinois. It is apparent that this part of the load cannot be controlled without action upstream.

While the nutrient loading in the Mississippi appears to have a substantial impact on the Louisiana Inner Continental Shelf and some impact on Lake Ponchartrain, the overabundance of nutrients in the Mississippi does not affect the entire Gulf. Tampa and Mobile bays, the Laguna Madre, and other areas are not particularly affected by the nutrients in the Mississippi River. Some corrective measures can be implemented which will benefit those areas without consideration of the Mississippi River drainage area.

Fertilizers, sewerage treatment plants, malfunctioning septic tanks, industry, concentrated animal feeding operations, and atmospheric deposition all combine to deliver the loads the Gulf receives, and some corrective action may be necessary in each of the major source areas before the problem is solved.

The National Pollutant Discharge Elimination System permitting process has been in place for about 20 years. While this system has produced dramatic reductions in some classes of water pollutants and moved society closer to the goal of fishable-swimmable water established in the Clean Water Act, total nitrogen and phosphorus are not among the pollutants which have been completely controlled by this system. Therefore, permit limits on these nutrients may be needed.

Section 208 of the Clean Water Act and Section 319 of its amendments have gone a long way toward reducing non-point source pollution, but more effort is needed.

When many people hear about nutrient over-enrichment, their response is "That's what farmers are doing to us." Although agriculture contributes to nutrient overloading, it is not wholly, perhaps not even predominantly, a problem caused by agriculture.

There are many urban and suburban contributions. For example, do most people know how much phosphorus is used in their households? Which suburbanites have never applied more fertilizer to their lawn than needed? After all, it doesn't cost much when you are just working on a small yard.

How many septic systems exist that always work correctly? How many pet owners clean up all of their pet's waste in the yard? The typical city has about one dog per four people, and most pet waste is not treated in the local sewage treatment plant. What golf course or city park is there which might get a little too much fertilizer once in a while?

A substantial amount of nitrogen is deposited in rainfall. Some comes from lightning, part of it originates in automobile engines, and part of it comes from electrical power plants.

The point is that everyone contributes to the problem, and the solution will require that each of us contribute to that as

E. Coastal And Shoreline Erosion

Coastal And Shoreline Erosion Action Agenda For The Gulf Of Mexico

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Erosion for the most part is a natural process that has affected the Gulf Coast for thousands of years. Erosion, however, has only threatened humans in the short time that towns and cities have grown along the Gulf of Mexico's beaches and bays. Erosion has become a critical problem as it threatens buildings, roads, and other infrastructure as well as beaches, marshes and other habitat as natural barriers that have bufferred devastating storms are lost.

Erosion is a problem in all Gulf Coast states, and it is a serious problem in certain areas. For instance, parts of Louisiana and Texas retreat 65 feet per year. Erosion rates of 15 feet per year can be found in many other areas of the Gulf coast. Primary causes of coastal erosion are almost infinite -- coastal storms, reduced or diverted river sediment loads, and relative sea level rise all pose threats. Another cause of erosion is dredging navigational channels and canals, especially when this material is removed completely from a system and placed in upland disposal sites or other places where it can't return to the sediment load. Some coastal protection projects are human developments, such as seawalls, jetties, and breakwaters. Now, for the first time, erosion must be viewed as a Gulf-wide problem to provide environmentally sound remediation.

The Coastal and Shoreline Erosion Subcommittee of the Gulf of Mexico Program is composed of Federal, State, and local agencies and citizens involved or concerned with coastal erosion. The goal of the subcommittee is to evaluate erosion Gulf-wide and determine which past approaches to shoreline stabilization have been successful and which should be avoided. The subcommittee is also developing an Action Agenda that will identify Gulf Coast shoreline trend changes and promote public education, all with the goal of reducing erosion of the Gulf Coast.

The scope of the Coastal and Shoreline Erosion Action Agenda hopes to address mainland shorelines, barrier islands, major bays and estuaries, major waterways, and peninsulas. A map showing the Gulf shoreline erosion problems will be published soon, but the bays have not yet been mapped. Perhaps the most valuable result of the subcommittee's work has been the start of a dialogue between the various agencies involved with coastal management.

In some places, people need to be educated that erosion is occurring rapidly, forcing some structures to have to be moved. A provision of the Flood Insurance Act provides 40% of a home's value to homeowners that move homes in imminent danger of collapse. The same act allows that person, who has flood insurance, to get 110% of the home's value if it is demolished and removed. These are examples of alternatives to limit the loss of life and property due to nature's rapid destructive powers.

A number of demonstration projects are being conducted

to limit erosion. Recent trends have moved from hard structures, such as groins and seawalls, to a softer method of beach replenishment and protection, such as planting vegetation as a barrier to allow dunes and low tidal areas to revegetate themselves. In areas along the Texas Coast where the Soil Conservation Service and Sea Grant program have planted vegetation, sediment has quickly collected, demonstrating the success of these traps.

Vegetation trapping has limitations, especially its high cost. Its success for massive beach replenishment projects is unknown, and it won't work in areas with high bluffs and heavy wave action because the beaches will not be able to restore themselves.

The State of Texas is way behind Florida, which has been dealing with its erosion problems for many years and builds beaches regularly. In many cases, Texas towns are realizing what they have and what they are losing. Galveston, which built a 10-mile long seawall in the early 1900's, has awakened to the fact that it has lost its beach. There is no beach in front of its seawall, and the citizens approved a bond package for a project with the Corps of Engineers to replenish the beach in between the groins that stick out into the Gulf of Mexico using sand removed from channel maintenance areas.

A Shore and Beach Preservation Committee was organized for the State of Texas, but it does not have close to the number of members as does the Florida Shore and Beach Preservation Association. It is, however, a good beginning.

Texas is drafting a coastal management program - albeit 15 years behind other states, but it is being done. There is significant interest for, not only solutions to erosion, but, solutions to the loss of habitat and other coastal problems.

Coast Of Florida Erosion And Storm Effects Study

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The Coast of Florida Erosion and Storm Effects Study (COFS) is a cooperative effort of the U.S. Army Corps of Engineers (USACE) and the State of Florida. The study is jointly funded and managed through the USACE Jacksonville District and the Florida Department of Natural Resources Division of Beaches and Shores. The COFS was authorized by Congress in 1985, and it is the first large scale study of the Florida Coast since the 1974 National Shoreline Study.

Study Interests

National interest in the study was generated by approximately 90 projects comprised of coastal and navigation works. Operation and maintenance costs for existing projects in the study area is over $32 million per year. The 15 constructed shore protection projects were implemented at a cost of over $100 million.

The State of Florida's involvement in the study is critical due to its responsibility for up to 75% of the non-Federal share of shore protection projects. The State is also responsible for permitting construction activities as a part of its Coastal Zone Management Plan. The study will assist the State in determining what lands are the most beneficial for its land acquisition program.

Study Authorization

Congressional authorization supported the recommendations of the 1985 reconnaissance report which recommended reviewing all of the USACE Chief of Engineers' previously published shore protection and inlet-related navigation reports. This authority enabled coupling coastal and navigation projects which often functioned independently. In addition, the reconnaissance report called for developing a comprehensive body of knowledge pertinent to coastal erosion and storm effects.

Post-storm monitoring is employed by the COFS to quantify the effects of major storms on the Florida shoreline. These efforts include aerial photography, site inspections, beach profile surveys, wave hindcasting, and storm surge investigations. Hurricane Andrew, which struck South Florida in August 1992, was the first storm to be monitored under this authority. The post-storm monitoring of Hurricane Andrew resulted in the collection of a wealth of data which will be used to calibrate coastal numerical models and serve as input to coastal zone management.

COFS Regions

The COFS divides the Florida shoreline into five study regions. From the Florida panhandle through the northeast coast, these regions are defined as the following:

a. Region I - Florida/Alabama border to the St. Marks River.

b. Region II - St. Marks River through Monroe County.

c. Region III - Dade County through Palm Beach County.

d. Region IV - Martin County through Brevard County.

e. Region V - Volusia County through Nassau County.

Studies are ongoing in Region III (which includes Dade, Broward, and Palm Beach Counties), and the draft feasibility report is scheduled for completion in 1994. Region IV includes Martin, St. Lucie, Indian River, and Brevard Counties. Region IV studies are being initiated in 1993 and will involve deployment of directional wave gages, among other work items.

Study Geographic Information System

A Geographic Information System (GIS) is being implemented to facilitate both the review of previous reports and the development of a comprehensive body of knowledge pertinent to Florida's coastal zone. The system will be comprised of one centralized data base with developing and updating data base elements accomplished by the State and the USACE. Quality assurance and control standards will be met before elements are accepted in the corporate data base. Access of the information by the public and government agencies will be controlled at the central repository through electronic networking. The major components of the COFS GIS are the coastal engineering, geotechnical, environmental, and economics data and analyses required to meet the goals of the study.

Wave Data Collection and Analysis

Wave and water level data is crucial in the development of viable planning alternatives for shore protection projects. The COFS has funded wave data collection at two locations in Region III to verify hindcast model results. Wave gages, such as the ones at Palm Beach and Hallandale (Region III), will be deployed to determine the effects of Cape Canaveral, Canaveral Harbor, and other areas of complex bathymetry on the incident wave climate in Region IV.

Conclusion

It is with a spirit of cooperation and coordination that the U.S. Army Corps of Engineers and the State of Florida join together in the Coast of Florida Erosion and Storm Effects Study. Findings and recommendations of the study promise to result in enhanced stewardship of a national treasure that is enjoyed by millions of people each year the Florida Coast.

Determining Shoreline Change: Methods And Examples From The Gulf Of Mexico

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Shoreline changes around the Gulf of Mexico are the results of a combination of complex natural processes, such as sea-level rise, subsidence, sand starvation, and storms, and the effects of human activities over the past two centuries. These detrimental changes to the coast are creating widespread environmental problems with few easy and no permanent solutions. Dealing in a cost-effective manner with present day coastal erosion problems and planning for future conditions will require a combination of solutions (construction setbacks, beach nourishment, hard structures) that should be based on long-term societal needs as well as sound scientific knowledge of coastal processes and the recent geologic evolution of coastal landforms undergoing change.

Working closely with other Federal agencies, academic researchers, and geoscience agencies in each of the five states bordering the Gulf of Mexico, the U.S. Geological Survey is conducting field investigations through the National Coastal Geology Program. The main objectives are to quantify and carefully document coastal and wetland changes that have taken place in the recent geologic past, up through historic times, and to enhance the scientific understanding of coastal sedimentary processes.

The USGS coastal investigations underway throughout the five Gulf states are in varying stages of completion, but provisional assessments of the entire region show that erosion in many places is critical and a serious hazard to people and development along the shoreline. In fact, results from the completed Louisiana Barrier Island Erosion Study document that much of the Mississippi River deltaic plain of south-central Louisiana is undergoing rates of land loss higher than any other region of the United States and, possibly, the world. Computer-generated maps have been prepared depicting barrier island changes over the past century and the implications of continued erosion. Such information on the Isles Dernieres and other barrier islands is included in a large format color atlas, the Louisiana Barrier Island Erosion Study Atlas of Shoreline Changes in Louisiana from 1853 to 1989, published as Miscellaneous Investigations Series I-2150-A by the USGS. A second atlas showing historic seafloor changes is in the final stages of preparation, and it and a series of papers to be published in a special issue of the Journal of Coastal Research constitute the final products from the 5-year Louisiana Barrier Island Erosion Study.

Dealing with coastal erosion and land loss is a long term process that is likely to become even more urgent in the near future with population increases and continued development of the coastal zone, potentially exacerbated by accelerated sea-level rise due to natural and anthropogenic climate changes. The various solutions available should be decided on long term (decades) coastal management plans based on sound scientific results and judgements.

F. Public Health

Risks Of Exposure To Environmental Contaminants: FDA Versus EPA

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The Food and Drug Administration and the Environmental Protection Agency often have widely differing estimates of human health risks due to the consumption of chemically contaminated fish and shellfish. Many of these differences can be explained by an examination of the regulatory authorities which govern each agency. EPA is responsible for administering the Clean Water Act (CWA) and the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). FDA's legislative mandate is governed by the Food, Drug and Cosmetic Act (FDCA). FIFRA and FDCA require cost-benefit analyses of proposed regulations while the CWA does not. This presentation described differences in estimates of exposure due to the application of the three acts and will illustrate these differences with examples.

Case Study - Human Health Risk From Exposure To Mercury In Fish

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The toxicity of mercury is a subject that societies have dealt with for hundreds of years, yet it reoccurs often. Recently, mercury has become a concern in Florida and the Gulf States.

While investigating concerns about fish contamination near a hazardous waste site, mercury became a factor. Rather than finding many contaminants at that site, only mercury was found in somewhat-elevated concentrations. This led to a multi-year monitoring project and the discovery that Florida, like many other areas, has extensive fish contamination by mercury.

The problem affects about one million acres in the Everglades. There, largemouth bass and other species of fish contain so much mercury that the State Health Officer recommended none be consumed. Another million acres in other parts of the State are under limited health advisories. Mercury levels are lower than the Everglades, but officials recommend that the fish be eaten no more than once a week, or once a month by children or women of child bearing age. The advisory was unprecedented as there never had been a warning by public health officials against consuming fish or game.

Some news stories on mercury exposure imply that many of the risks are not known. While this may be true in the case of low-dose, chronic exposure to synthetic chemicals, the extrapolation of animal studies to humans, or the problems that these present for assessing cancer risk, humans have been exposed to mercury for thousands of years. Many people have been poisoned on the job, through medicines, and through food.

What then is mercury? Mercury is a metal, a naturally occurring element found in soils, air, and water. It is liquid at room temperature and conducts electricity. Mercury occurs in the earth's crust as cinnabar -- mercury sulfide, or HgS.

One of the unique characteristics of mercury, being a liquid, is that it is appreciably volatile, contributing to its toxicity in the occupational setting. This property and its effects were known and carefully described hundreds of years ago. Mercuric nitrate was used for many years to make a fine grade of felt. Workers who were exposed to the mercury for many years became known for their odd speech, bizarre personalities and staggering, ataxic gait. However, despite its long history as a toxin, mercury has been used in a myriad of medicinal preparations and treatments, from Ancient Greece to the present.

The Japanese discovered the hazards of environmental mercury poisoning from an acetaldehyde and industrial intermediates plant on Minamata Bay. This plant used mercury in several ways, and organic and inorganic forms of mercury were discharged into Minamata Bay in large quantities. All the cats in the fishing villages around the bay died, and people became ill shortly thereafter. It took 15 years

to link the discharge of wastes into Minamata Bay and the illness of the villagers.

The answer illustrates two phenomena that were not understood prior to that time. One is biotransformation, by which inorganic forms of mercury released into the environment are changed into methylmercury, the most toxic form, through natural processes. The second phenomenon is biomagnification, whereby small concentrations of methylmercury in surface waters are concentrated 5-6 times in fish. Thus, small amounts of low-toxicity forms of mercury discharged into a water body can be biotransformed into methylmercury and biomagnified to levels in fish that can be toxic to humans consuming them.

Perhaps the most extensive poisoning occurred in Iraq in the early 1970's. Seed grain treated with methylmercury fungicide was shipped to Iraq, where it was milled into flour and baked into bread. Prior to processing it, the grain was washed to remove pink stain with which it was colored to signal that it was treated and poisonous. The stain came off, but the methylmercury did not. About 500 people died in local hospitals, and over 5,000 were treated for non-lethal doses. It is estimated that those figures are only about 10% of the total victims because, due to the remoteness of the area, many victims were not treated.

There are many other examples of methylmercury poisoning from diversions of seed grain to human use, representing environmental tragedies of incredible proportions.[1] However, they provide a basis for understanding the health risks of mercury.

At approximately 200 ng/ml of mercury in blood, the clinical effects of methylmercury poisoning, such as visual processing deficits and peripheral neuropathies, show up in a small percentage of adults exposed. There is concern about subclinical effects below 200 ng/ml, particularly in children, but these have not been demonstrated conclusively at the present time. At a few hundred ng/ml, the clinical syndrome of Minamata disease, stocking and glove parasthesias, coordination problems, sensory deficits (visual and hearing, primarily), and cognitive effects, become apparent in a substantial fraction of those exposed. The LD50 in humans, or the lethal dose for 50% of humans exposed and a datum that is not usually available, is about 3,000 ng/ml.

Risk assessment for mercury is straightforward because its toxicity in various forms is reasonably well understood, as are the dose-response relationships to exposure. Much of the work has been done already by expert committees of three standard-setting bodies. Their findings are published as the Acceptable Daily Intake (ADI), or the Risk Reference Dose. The ADI for mercury reflects the amount one can ingest before exceeding a threshold after which health effects are exhibited. The values are:

Organization	ADI (g/kg/day)
World Health Organization (WHO)[2,3]	0.43
U.S. Environmental Protection Agency (EPA)[4]	0.32
U.S.P.H.S. Agency for Toxic Substances and Disease Registry (ATSDR)[5]	0.02

If the WHO ADI of 0.43 g/kg/day is used, and if the plausible assumptions of a 70 kg adult eating 32 g of fish per day (equivalent to one 8 oz. meal/week) is used, the risk equation reduces to a maximum contaminant level of about 1 part per million (ppm), approximately the FDA guideline for fish, shellfish and other aquatic organisms.

$$MCL = \frac{\text{ADI x Body Weight}}{\text{Avg. Daily Consumption}} = \frac{0.43 \text{ g/kg/d x 70 kg}}{32 \text{ g/d}} \sim 1 \text{ ppm}$$

The following items from Eisler's monograph on mercury hazards to fish and wildlife, although somewhat modified, provide an excellent summary of the history and toxicology of mercury:[6]

1. Mercury has no known biological function -- it is not an essential nutrient and there is no countervailing benefit to exposure,
2. Low-toxicity forms are transformed to high-toxicity forms by natural processes,
3. Methylmercury is highly biomagnified -- bioconcentration factors are approximately 10^6,
4. Mercury is a mutagen and teratogen causing fetotoxic, cytochemical, and histopathological effects,
5. High body burdens in fish and wildlife can be found in remote areas -- high levels can be found in lakes far from its sources implicating long-distance atmospheric transport and a cumulative effect, and
6. The difference between natural background levels and harmful levels is small -- predacious fish typically accumulate the highest levels of mercury in their flesh.

Mercury is a global problem, and a myriad of emission types contribute to atmospheric loadings which are transported widely and result in increased deposition in watersheds and water bodies worldwide. Health advisories due to high levels of mercury exist in 26 states, Canada, Scandinavia, and western Europe.

A great deal of testing has been done on fish in Florida to determine the extent of mercury contamination. Among the species popular with anglers and commercial fishermen, no problem has been found. About 20 years ago, there was concern about swordfish and tuna having consistently elevated levels of mercury, and a similar concern was raised recently about shark. Extensive testing revealed that about 70% of the shark marketed in Florida exceeds the FDA guideline of 1.0 ppm, but no action has been taken yet.

References

D'Itri, P.A., and F.M. D'Itri, Mercury Contamination: A Human Tragedy, John Wiley & Sons, New York, 311 pp. 1977.

Who, Evaluation of certain food additives and the contaminants mercury, lead and cadmium, Sixteenth report of the Joint FAO/WHO Expert Committee on Food Additives, Tech. Rep. Ser. No. 505. 1972.

Who, Environmental Health Criteria 101: Methylmercury, World Health Organization, Geneva, Switzerland. 1990.

EPA, Mercury Health Effects Update: Health Issue Assessment, Final Report, U.S. Environmental Protection Agency, Office of Health & Environmental Assessment, EPA-600/8084-019F. 1984.

ATSDR, Toxicological profile for mercury, Agency for Toxic Substances and Disease Registry, ATSDR/TP-89/16. 169 pp. 1989.

Eisler, R., Mercury Hazards to Fish, Wildlife and Invertebrates: A Synoptic Review, U.S. Fish and Wildlife Service, Biological Report 85(1.10), Contaminant Hazard Reviews Report No. 10. 90 pp. 1987.

Applied Risk Analysis -- A Case Study Of The Calcasieu Estuary In Louisiana

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The degradation of water quality has resulted in increasing reports of chemically contaminated fish and seafood and has raised concerns regarding the potential for adverse health effects from consumption of recreationally-caught fish. The specific health risk assessment approaches used by the Office of Public Health are demonstrated based on contamination of fish in the Bayou d'Inde area of the Calcasieu Estuary.

Traces of chemical contamination with hexachlorobenzene (HCB) and hexachlorobutadiene (HCBD) and polychlorinated-biphenyls (PCB) were detected over a 2-year period between 1989 and 1991 by the Office of Public Health and the Department of Environmental Quality.

The mean concentrations for PCB, HCB, and HCBD were 20, 110, and 180 micrograms per kilogram (ppb) in the edible portions of blue catfish, seatrout, and other species.

Using a basic risk assessment approach, a determination was made regarding the potential for these chemicals to individually result in systemic (non-cancer) toxicity and evaluate the collective cancer risk. To make the determination, the toxicological data base for PCB, HCB, and HCBD were evaluated to determine the safe doses (mg/kg/day) for systemic effects and the cancer potency factors.

A search of U.S. Environmental Protection Agency databases resulted in the following risk assessment information:

Table Of Risk Assessment Values

	Absorption Factor	Reference Dose (systemic)	Cancer Potency Factor
PCB	0.9	none	7.7 $(mg/kg/day)^{-1}$
HCB	0.5	.0008 mg/kg/day	1.7 $(mg/kg/day)^{-1}$
HCBD	1.0	.002 mg/kg/day	0.08 $(mg/kg/day)^{-1}$

Using the above values, the exposure doses of PCB, HCB, and HCBD were calculated based on the following factors:

$$\text{Dose} = \frac{(\text{concentration in fish})(\text{consumption})(\text{absorption factor})}{(\text{body weight})}$$

or

$$\text{Dose} = \frac{(\text{mg/kg})\ (\text{kg/day})\ (\text{AF})}{(70\ \text{kg})} = \text{mg/kg/day}$$

The exposure doses for PCB, HCB, and HCBD were based on one meal/week (mw), two meals/month (mm), and one meal/month (mm). It was assumed that the average meal size was 8 ounces, or approximately 225 grams. The results were as follows:

Exposure Assessment Results
Dose (mg/kg/day)

	1 mm [.03 kg/day]	2 mm [.015 kg/day]	1 mm [.0075 kg/day]
PCB	7.7×10^{-6}	3.9×10^{-6}	1.9×10^{-6}
HCB	2.4×10^{-5}	1.2×10^{-5}	5.9×10^{-6}
HCBD	7.7×10^{-5}	3.8×10^{-5}	1.9×10^{-5}

It is clear that none of the above exposure doses exceed the safe doses for HCB and HCBD for non-cancer (systemic) effects. In the case of PCB's, acute effects would not be expected based on existing toxicity information.

The next step was to estimate the total cancer risks based upon potency factors developed from animal data extrapolated to humans using a body weight to surface area correction factor. The lifetime (70 year) cancer risks for the contaminants were calculated as follows:

Cancer risk (R) = Dose (mg/kg/day) x Potency Factor $(mg/kg/day)^{-1}$

The resulting lifetime risks were as follows:

Cancer Risk

	1 mw	2 mm	1 mm
PCB	5.9×10^{-5}	3.0×10^{-5}	1.5×10^{-5}
HCB	4.0×10^{-5}	2.0×10^{-5}	1.0×10^{-5}
HCBD	6.2×10^{-6}	3.1×10^{-6}	1.5×10^{-6}
Total Risk	1.1×10^{-4}	5.3×10^{-5}	2.6×10^{-5}

Following EPA guidelines, it is appropriate to add total cancer risk. The resulting total cancer risk for one meal per week slightly exceeds the acceptable risk (1×10^{-4}) for a Louisiana fish consumption advisory. The consumption of two meals per month yields a risk of 5.3×10^{-5}, which is below the acceptable risk level. Hence, an advisory recommending that consumption of fish and seafood be limited to 2 meals per month was issued for Bayou d'Inde on February 3, 1992.

References

Integrated Risk Information System, U.S. Environmental Protection Agency, Washington, D.C. (1992).

Ratard, R., Louisiana Department of Health and Hospitals, Office of Public Health, "Fish Consumption Advisories," Baton Rouge, Louisiana. (1992).

G. Living Aquatic Resources

Living Aquatic Resources As Indicators Of Ecosystem Health

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LMES, LAR, GOOS, LMR, long term monitoring, marine ecosystems health indicators. How are these acronyms and phrases meaningful to people concerned about the Gulf of Mexico?

LMES, or Large Marine Ecosystems, are regions with unique bathymetry, hydrography, and productivity and strong interaction of the subsystem to its living resources compared to organisms outside that subsystem.

LARS, or Living Aquatic Resources, include the full range of microorganism, plant, and animal kingdoms. They respond to their environment, indicating ecosystem health, and are self perpetuating.

GOOS, or Global Oceans Observing Systems, is the U.N. International Oceanographic Commission's (IOC) term for monitoring the world's oceans and their role in global climate change and the production of renewable natural resources. IOCARIBE is a regional component of IOC for the Gulf of Mexico and the Caribbean.

The Gulf is more than the shallow estuarine edge, even though the estaurine-coastal waters coupling is crucial to its fecundity. It is a large, open ocean with a substantial continental shelf driven by two primary currents. One of these geotropic flows is the Loop Current which moves north in the Gulf of Mexico after entering between the Yucatan Peninsula and Cuba. Eastern circulation becomes part of the Gulf stream. Anticyclonic eddies spin off and move over the shelf. A westerly component forms major eddies along the Texas and Mexican coasts. Also, meteorological and seasonal conditions affect currents and impact the number and dispersion of organisms. The other system is the Mississippi River, which drains 2/3 of the U.S. and fans out in the Gulf.

A critical part of stewardship is understanding the interface of ecosystems, including sea surface-air, sediment-benthic organisms, and wetlands-estuaries.The importance and severity of local ecological changes and human impacts on coastal areas is well recognized. The ultimate test is the impact on the entire ecosystem and LARS. Identification of indicator species is critical in determining the extent and cause of disturbances.

What is needed to identify and track such impacts is large area, long term monitoring, which varies in popularity over time due to resources and proponents, and its value is the subsequent analysis of trends. Successful monitoring requires significant government involvement, development, and commitment.

Federal and state efforts are addressing monitoring needs to assess ecosystem health. Several laboratories of NOAA's Southeast Fisheries Science Center are conducting such research. The Pascagoula Laboratory leads in monitoring shrimp and bottom finfish populations with faunal surveys. Additional surveys are being developed to monitor reef resources and smaller pelagic species not easily sampled by bottom trawling and regular ichthyoplankton surveys are conducted for this early, sensitive life stage. Other labs are conducting complimentary assessments.

The Gulf of Mexico scientific community is developing a greater understanding of the physical oceanography and processes through federal research initiatives and major academic efforts. The SEAMAP Program, a cooperative effort in resource assessment between the Gulf States and the National Marine Fisheries Service, provides and coordinates monitoring studies. The Gulf States Marine Fisheries Commission is coordinating this work.

Several Mexican programs, federal and academic, contribute to the basic knowledge of the Gulf of Mexico. The Instituto Nacional de Pesca surveys turtles, fish and shellfish, and ichthyoplankton. Such monitoring must be better integrated at the full Gulf of Mexico level to the degree considered necessary by the GOOS.

EPOMEX, a joint program between the Universidad Autonoma de Campeche and the Secretaria de Education Publica, was formed to coordinate studies of the ecology, fisheries,and oceanography of the Gulf. Programs are underway in ecology and management, coastal ecosystems, pollution and environmental impact, geology, demersol tropical fisheries resources, and oceanographic processes.

Continued monitoring and data analysis is being conducted to develop indices to characterize ecosystem health. Such

proposed indices should include quantitative measures descriptive of diversity, stability, economic yields, productivity, and resilience of the whole ecosystem. A single index has been proposed for origin, organization, and resilience to indicate ecosystem health.

System health indicators such as chronic disease, animal deformities, bio-accumulation of toxicants, weakening of the genetic pool, reduced adaptability, trophic web, carrying capacity, and increased incidence of harmful algal blooms degrade subsystems and lead to reduced abundance and diversity of LARS.

Fish catch and effort is a valuable long term indicator when described with detailed biological characteristics, such as age, size, spawning potential, and the resultant expansions into diversity, stability, productivity, and ecosystem resilience. The trends and prognosis for many fisheries is bad.

There is a continual need to *inform and educate the public* on the status and trends of LARS in this ecosystem. The researcher and resource manager must convey and convince user groups that conservation is the key to stewardship. All groups utilizing and benefiting from a shared ecosystem are its health provider.

The Gulf of Mexico Program permits the integration of the concepts developed through State, Federal and international programs. Tying these to the increased level of physical oceanographic studies will enhance monitoring regimes in the Gulf of Mexico, which is critical to developing ecosystem health indices, and an extensive program will enable scientists to determine human impact on the environment and build a data base. This will enable managers to develop the appropriate strategies to adjust to environmental change, control harvest to proper levels on an ecosystem basis, and reduce the negative impact of human perturbation and population.

Status Of Aquatic Resources In The Southwestern Gulf Of Mexico

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The high fish production in the southern Gulf of Mexico is supported mainly by multispecies fisheries -- shrimp and other crustaceans, several fin fishes, and mollusks, such as octopus and conch. The fisheries are typically demersal and most are small scale near-shore operations. They are characterized by a limited technology and infrastructure, and since the fisheries are close to shore, they are more vulnerable to the processes of industrial development and environmental impact which frequently coexist in the coastal area.

Critical Fish Resources

The catch of demersal fish for the Gulf of Mexico is approximately 240,000 tons per year, which is close to 40% of the total national production for the period between 1984 to 1988, excluding the pelagic species. An important feature of these fish resources is their intense use of the coastal area for feeding, growing, reproduction, and refuge. More than 300 species are known in the southern Gulf, and more than 75% of them use the coastal lagoons or estuaries at least one time in their life cycle.

Despite the high number of species, only a small group of less than 20 constitute the total commercial catch. We have called these Critical Fish Resources, and they contribute 80% of the volume and almost 100% of the commercial value.

Variability of the Catch

The diversity of habitats and species and the complexity of the biological and technological interdependencies condition the characteristics of the fisheries and their variation. Fishing is carried out on a multispecies resource, using a wide variety of gear and equipment, causing variations of effort and species composition of the catch. Natural changes in abundance related to coastal and ecological processes must also be considered, such as river drainage, rainy, and the north wind season.

Ecosystem Working Group Of Living Aquatic Resources (LARS)

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This Working Group developed interrelated strategies with appropriate objectives and action elements to accomplish its defined goal -- conserving and restoring species diversity and the health of living aquatic resources.

Monitoring, Trends, and Assessment

To develop a baseline of Gulf resources, it will be necessary to characterize the current status of living aquatic resources in the Gulf of Mexico. This will be achieved by determining the ecosystem boundaries and following a Nested Ecosystems model. Acquisition and evaluation of existing and historic LARS data sets and monitoring records will be required.

The assessment will be further enhanced by the coordination or development of monitoring programs that determine the diversity and relative abundance of selected populations.

Research

Based on the criteria developed to assess health of the ecosystem, research priorities will be established. Basic and applied research could entail filling in data gaps in temporal and spatial distribution, diversity, reproductive success, survival, and associated parameters.

Planning Standards

Initially, efforts will be made to reach consensus on the standards/elements to be used to define and measure ecosystem health. LARS will coordinate the workshops in which such determinations will be made. Standards must also be established to evaluate "allowable" variations and thresholds of biotic conditions as one measure of diversity. Definition and quantification of standards will be critical to establish ecosystem health baselines and measure the effects of management practices.

Legislation and Enforcement

The Working Group recognized the importance of state and federal legislative support to obtain regulatory assistance, interagency compliance and cooperation, enforcement of local, state and federal regulations, and funding needs to accomplish the objectives. Legislative and enforcement objectives will be made known and advanced through public workshops involving political decision makers and enforcement officials that demonstrate the needs of the Gulf of Mexico Program.

Public Outreach and Education

To augment and support the overall program, the Work Group recognized the need to develop an informed public and business constituency which actively supports the maintenance of a healthy Gulf ecosystem. The outreach program would be directed at and involve students, citizen activists, government representatives, and business interests. The program will demonstrate the importance of a naturally functioning ecosystem to public health, recreation, fish and wildlife populations, employment, and the economy.

The objectives would be achieved through printed materials, public meetings (workshops) and visual material, such as films, video programs, and posters.

Mass Mortalities Of Aquatic Resources

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Mortalities of Living Aquatic Resources (LARS) occur continuously in the environment, but only occasionally is physical evidence of these events found. Most often, diseased or stressed animals are weakened and fall to predation, and the dead animals are removed by scavengers. Mortalities are most often noted when a large number of deaths occurs in a short period of time (mass mortality), or because the species is unique (organisms with a high public profile, such as endangered or threatened species). These unusual, or notable, mortality events reflect a loss of organisms and signal public health dangers and/or a degrading environment.

The primary purpose for addressing mortality events in the Gulf of Mexico is to obtain and document evidence of probable causes. It is critical that the cause of mortalities be determined so that steps can be taken to reduce the risk of reoccurrence, to reduce the impact on the population and aquatic community, and/or to mobilize public health precautions. Therefore, the means must be developed to respond to selected mortality events with an appropriate scientific inquiry.

The Mortality Events Section of the LARS Subcommittee is developing guidelines to help the Gulf of Mexico Program proceed with these goals in the following areas:

Mortality Reporting Networks

- support and expand reporting networks for marine mammals and sea turtles,
- initiate reporting for other species (fish, crustaceans, bivalves, corals, sea urchins, shore birds, water fowl, seagrass), and
- encourage citizen participation through education and broad distribution of reporting procedures.

Scientific Response Teams

- establish and coordinate a network of federal, state, and private scientists to respond to selected mortality events and assign a probable cause,
- establish minimum standards for field and laboratory procedures and implement training for scientific response personnel, and
- streamline current authorization procedures for obtaining, transporting and disposing of protected species by qualified scientific personnel.

Research Support

- initiate and support research to validate findings of scientific responses to mortalities,
- support development of new diagnostic methods, especially in the area of forensic pathology, for determining cause-effect relationships, and
- support research that investigates the role of multiple and cumulative stresses in mortality events.

Mortality Event Documentation and Archival

- prepare and update a comprehensive historical inventory of unusual mortality events in the Gulf of Mexico,
- incorporate known events into a geographical information system, and
- establish and maintain a specimen and tissue archive that is supported by a centralized information storage and retrieval system.

Mortality Prevention

- estimate public costs associated with mortality events,
- identify and enforce legislation that will reduce mortality events, and
- recommend and implement, based on the findings of scientific response teams, legislative or regulatory changes to prevent reoccurrence of mortalities.

Impacts Of Fishing On The Ecosystem

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Impacts of fishing can be grouped in three major categories -- population effects, community effects, and habitat effects. It is known that fishing can and does affect populations by changing the abundance of and the size and age compositions of target species and those incidentally captured.

While some changes may be acceptable, excessive mortality may result in serious population declines. Also, fishing activities may cause altered predator-prey relationships or inter-species competition in a community or physically affect certain habitats.

The Living Aquatic Resources Subcommittee (LARS) recognizes that most of these concerns are not new, and research and management activities to address them are occurring. However, a lack of funding to address these concerns has hampered adequate treatment. The LARS Action Plan should provide leverage for additional funding to adequately address these problems.

Strategies considered by LARS include:

- assessing and monitoring the effects of fishing mortality,
- assessing the potential for aquaculture to reduce demands on overfished species,
- determining the relative impacts of fishing activities and habitat degradation on Gulf of Mexico LARS,
- determining the effects of fishing activities on habitat availability, structure, and function,
- developing alternative fishing gear, techniques, and methodologies,
- identifying gaps in data needed for population assessment and monitoring,
- determining the impact of fishing on community relationships,
- identifying appropriate uses of fishery dependent and independent data for bycatch monitoring and stock assessments,
- incorporating fishing impact objectives into large marine ecosystem research protocols,
- developing interjurisdictional fishery management plans for affected species,

- developing standardized data collection and analysis protocols for living aquatic resources,
- coordinating activities related to impacts of fishing,
- encouraging compatibility of regulations governing interjurisdictional resources Gulf-wide,
- supporting a compatible Gulf-wide enforcement program,
- coordinating a Gulf-wide education/outreach program regarding the impacts of fishing,
- assuring timely transfer of new gear technology to the fishing industry and public, and
- developing public awareness of the need for funding to deal with impacts of fishing.

It should be recognized that fishing is not the only factor affecting the living aquatic resources of the Gulf of Mexico, though it is often highlighted as a major problem. Other factors are probably equally important, such as habitat degradation, natural environmental changes, mass mortalities, and contaminants. However, the LARS is trying to focus on the problems of living aquatic resources as a whole and intends to support existing organizations and infrastructure established to deal with the problems associated with fishing.

H. Freshwater Inflow

Florida Issues And Opportunities In Management Of Freshwater Inflows

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Flows of Florida's rivers range over six orders of magnitude. Some in the Panhandle are Piedmont streams, but on the Peninsula, most are short, coastal plain systems. Many receive significant contributions from springs. The estuaries they maintain are equally diverse and include the largest U.S. mangrove-forested estuary, small to large enclosed bay systems, and a sediment-starved, marsh-dominated, open coastal system. The tidal freshwater environments between rivers and estuaries typically are compressed and low in plant and animal species richness in comparison with other regions.

Flows of many rivers have been altered by in-stream and off-stream impoundments built for water supply, hydropower, flood control, irrigation, and recreation. Inter-basin connections and adverse discharge schedules cause too little flow in some rivers or excessive flows into some estuaries. Efforts to mitigate historic impacts on rivers and estuaries are underway in several coastal areas, but these efforts are not consistent or coordinated. At the same time, demand for water continues to increase, and projects are being planned that will further alter freshwater inflows to estuaries.

Inflow conditions along the Florida Gulf Coast vary by geographic region. Panhandle rivers are Florida's largest. The possibility exists of reduced flows to Apalachicola Bay -- the state's leading producer of shrimp, crabs, and oysters -- as municipal, agricultural, and recreational uses of the Chattahoochee, Flint, and Apalachicola Rivers increase. Although not presently a problem, the potential for ecological changes caused by altered inflow has stimulated much new and productive research.

Peninsular rivers emptying into the Gulf are much smaller than Panhandle rivers. None of the small spring-fed rivers is a significant source of water for consumptive use, but the legal right to use at least one as a water supply does exist. The largest departures from historic inflow occur in urban rivers in and near Tampa Bay. The location, timing, quality, and quantity of inflows into and from these rivers has been affected by agriculture, phosphate mining and processing, and impoundments for hydropower and municipal consumption. The management emphasis for these rivers is restoration, but, at the same time, plans are being made to divert even more water from some streams.

The inflows of freshwater to Florida's southern-most estuaries are products of management decisions concerning Lake Okeechobee and surface waters of the general Everglades area. One river, the Caloosahatchee, is unique along the Florida Gulf Coast for having had too much discharge, the result of lockage and Lake Okeechobee stage control. Another "River of Grass" (the Everglades and its associated estuaries of South Florida and Florida Bay) presently receives too little water because of flood control projects, agricultural irrigation, and water-supply for southeastern Florida.

Such alterations to freshwater inflow to Florida's Gulf Coast estuaries have the potential to affect fisheries production. Several recent and ongoing studies show the relationship of freshwater inflow to shrimp, crab, oysters, and several fish species. Despite these correlations, data is insufficient to relate declining fishery landings specifically to altered freshwater inflow. In this regard, Florida has much left to do

in order to improve inflow, salinity, and fishery monitoring programs.

The overriding issue in river management in Florida has been the extent to which estuaries are recognized as "users" of fresh water. Existing state policy is vague, and policies of the state's five water management districts are uneven with respect to this issue. Two principal variations of this issue concern the amount to which a freely-flowing stream's flow can be altered, usually for consumptive uses, without damaging the estuary, and the amount of flow restoration (increase or decrease) needed to mitigate impacts from existing structures and operations. Quantity, timing, and location of inflow have not received as much attention as water quality, but new programs and projects are attempting to deal with these parameters.

The greatest opportunities for inflow management in Florida are adoption of uniform and statewide policies, transfer of methodological improvements from other states and countries, and new experiments in modeling. Florida's water policy is presently being revised, and an opportunity now exists to protect the freshwater inflow requirements of estuaries. If such policies are adopted, Florida could take advantage of recent advances in estuarine and fisheries science from Texas, other Gulf areas, including Mexico, and other countries to determine the technical details of policy implementation.

Modeling offers an opportunity to determine pre-settlement inflow patterns against which proposed changes or mitigative actions can be measured. This technique involves the use of a basin runoff model linked to historic conditions. Presettlement river discharges can then be linked to estuarine circulation and salinity models. The significance of differences between presettlement and modern inflow and salinity regimes can be calculated using predetermined criteria. This method holds the most promise for Florida rivers that are incompletely gaged and for estuaries with little data on status or trends in living resources.

Comprehensive Study Of The Alabama-Coosa-Tallapoosa And The Apalachicola-Chattahoochee-Flint River Basins

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The comprehensive study of the Alabama- Coosa-Tallapoosa (ACT) and Apalachicola- Chattahoochee-Flint (ACF) river basins is a study of the water resources of the two basins, the present and projected demands on those resources, the various alternatives that could serve to resolve conflicts over their use, and the mechanism for resolving those conflicts. The study resulted from recent conflicts among water users in the two basins, the three states affected by the basins, and various Federal agencies after reallocating water rights at the reservoirs to provide water for municipal and industrial use to the City of Atlanta, Georgia was considered. The study is being conducted through a partnership of the states of Alabama, Georgia, and Florida and the U.S. Army Corps of Engineers to develop the information needed to resolve issues and implement mutually agreed upon courses of action.

Chronological Events

In March 1989, the Corps prepared a Post Authorization Change (PAC) report and Environmental Assessment to address reallocating water stored in Carters Lake, Lake Allatoona, and Lake Lanier.

In November 1989, the Corps conducted public meetings on PAC reports for the three lakes. That same month, as a result of the possible reallocations, Congressman Tom Bevill of Alabama asked the Corps to develop a conceptual plan for a comprehensive study of the two basins which would address short- and long-term water resources in the ACF and ACT basins.

In February 1990, the Corps presented the conceptual plan to Congressman Bevill which outlined the short- and long-term approaches to the basin's water needs, and in May 1990, the Mobile District of the Corps submitted the final reallocation report. The primary reallocations at Carters Lake was set at 2 million gallons per day (mgd) and 11.5 mgd at Lake Allatoona.

As a result of the reallocation report, the State of Alabama filed a lawsuit against the Corps challenging the proposed reallocations. Negotiations were initiated between Alabama and Georgia and the Corps, which Florida joined later in the year.

In April 1991, Alabama, Georgia, and the Corps reached an agreement under which Georgia would withdraw its permit request to build the West Georgia Regional Reservoir. Georgia also agreed to participate in a comprehensive study of the two basins, and the Corps agreed to cease processing the reallocation reports. All parties agreed to a comprehensive study of the basins.

In July 1991, a draft Plan of Study was distributed for public review. From the end of July through the end of August 1991, a series of eleven public meetings were held throughout the basins. The purpose of the meetings was to inform the public about the study and solicit comments about the contents of the Plan of Study and region-specific water resource issues the public wanted addressed.

In January 1992, Alabama, Georgia, and Florida and the Corps approved the final Plan of Study. The governors of the three states and the Assistant Secretary of the Army signed a Memorandum of Agreement (MOA), signaling the end of 18 months of negotiations on many complex issues and providing a foundation for working as partners to address water resource issues.

MOA

In the MOA, the parties agreed to the following: the Corps would withdraw the Lake Lanier PAC report; current withdrawals of water would continue and increase to meet reasonable demands, however, written notice would be provided if they would be increased by more than 10 MGD or if new withdrawals greater than 1 MGD are initiated; during the study, the Corps would operate the Federal reservoirs to maximize water resource benefits; the parties would support the comprehensive study and contribute monetary and non-monetary support; a system to facilitate resolving future disputes over the comprehensive study and the water resources of the ACF and ACT basins would be established; and, last, the lawsuit filed by the State of Alabama would be assigned inactive status.

Study Management Organization

The study is being accomplished through a multi-level management organization. The Executive Coordination Committee (ECC) is composed of four members: the Mobile District Engineer and one designee each of the governors of Alabama, Georgia, and Florida. The purpose of the ECC is to manage the overall study effort within the basins. The Technical Coordination Group (TCG) is composed of four members, one designated by each member of the TCG. The purpose of the TCG is to provide interstate and intrastate coordination for the study process, recommend the technical content and direction of the study, and oversee the work that is performed. The study also has various technical review panels and support groups appointed by the TCG.

Study Accomplishments to Date

Scopes of work are developed or are being developed for surface and groundwater supply and for water demand elements, including agriculture, Apalachicola River and Bay, environment, power resources, industrial and municipal use, navigation, recreation, and waste assimilation. Scopes of work are also being developed to analyze the existing institutional frameworks and recommend a coordination mechanism.

Freshwater Inflow Requirements For Nueces Estuary

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Public policy of the State of Texas provides for conservation and development of natural resources, including maintaining a proper ecological environment in Texas' bays and estuaries and the health of related living marine resources.

Events and a change in emphasis over the past 15 years pushed environmental issues associated with water resources into the forefront of public awareness. Concerns for environmental protection of water are genuine, and, it goes without saying that, as demands for dependable water supplies increase, so to will the conflicts between balancing the needs of the human environment and those of the natural system.

The importance of our estuarine systems can be measured in both monetary and non-monetary terms. Industry, transportation, agriculture, and recreation contribute to the economic base of the coastal communities. While these activities can be measured in dollars, the intrinsic value of the aquatic community and its importance to the living resources of the Gulf is not easily quantified. It is nearly impossible to put a dollar value on the importance of providing adequate freshwater inflow for species such as the piping plover, Kemp's Ridley sea turtle, or whooping crane.

For the past 20 years, major research efforts in the State of Texas focused on how freshwater inflow has been affected spatially and temporally by human activities and intervention. Partial results of these studies formed the nucleus of a management plan for the Nueces River Basin and Choke Canyon/Lake Corpus Christi reservoirs which included freshwater inflow requirements to meet estuarine needs.

The Nueces Estuary has the sixth largest surface area of Texas' ten inland, primary bays. This highly compartmentalized, semi-arid system exhibits continual environmental variation and stress. The Nueces River is the only significant tributary and the main source of freshwater inflow to the estuary.

In December 1989, following seven years of low-flows in the Nueces River Basin, the Texas Water Commission (TWC) was asked to enforce a condition in the Choke Canyon Reservoir water use permit mandating freshwater inflows to estuaries in the Coastal Bend area. Following a preliminary review of the request, TWC created a Technical Advisory Committee of officials from Federal and State agencies, municipalities, special interest groups, and academic entities. The Committee was charged with reviewing all information pertaining to the estuary and developing new data and a management plan, including guidelines for operating Choke Canyon and Lake Corpus Christi reservoirs.

The Committee convened in June 1990 and completed its work in August 1991. Its final report characterized and identified issues involved with the estuary, including descriptions and analysis of existing data and research; characterizations of the riverine, estuarine, and reservoir systems; modeling results conducted at the request of the advisory committee; and recommendations for specific freshwater inflow levels.

The Texas Water Development Board and the Texas Parks and Wildlife Department are working on comprehensive studies of freshwater inflow characterizations for the 7 major estuaries on the Texas Coast. A portion of the study involves a step-by-step procedure utilizing salinity, nutrient, and sediment criteria in conjunction with a multi-objective optimization model to determine a range of freshwater inflows to meet predetermined constraints.

The process uses the Texas Estuarine Mathematical Programming Model, a non-linear, stochastic, multi-objective, mathematical programming, optimization model. This allows the use of non-linear equations, incorporates chance constraints, and analyzes the problem using a multi-objective approach. Those objectives define the criteria for a mathematical evaluation of the system's performance by establishing minimum Q., minimum volume of water, maximum Q., maximum volume of inflow, and maximum harvest to determine how much production can be obtained with the optimum salinity range for the estuarine systems.

The salinity limits were established by committee consensus based on survivability, growth, and reproduction of target species. Harvest targets were represented by the historical mean harvest, 20%. Inflow bounds were set at monthly mediums for the upper bound and in the tenth percentile of monthly inflows on the lower bound.

Since the amount of freshwater inflow contained in the special condition of the water use permit (151,000 acre feet) fell within the range of acceptable answers, the committee formulated its recommendations for monthly inflows using that amount as the target for inflow to the Nueces Estuary. Once the inflow numbers and the management guidelines were identified, one final analysis was conducted -- conditional probability modeling. The program was developed to determine a safe yield for a reservoir system that is independent of a long string historical hydraulic sequences by assessing the probability of starting any given year at a particular reservoir system level or capacity, placing the predesignated demands on it, and identifying the number of failures for the number of months in which the prescribed demand could not be met.

The Management Plan, covering a 5 year period, establishes specific minimum monthly inflow requirements which can be met through natural spills, releases from storage, and return flows. The plan also includes measures for spill banking, drought, and low flow conditions and calls for a continuous monitoring program to provide data for assessing the management plan's effectiveness.

The TWC order which established the plan also created an Estuarine Advisory Council to implement the plan and recommend a permanent management plan. It has met three times and will review and assess the impacts of the operating plan over the next 3 to 3-1/2 years and recommend any modifications to the interim plan.

The importance of freshwater inflow to marine ecosystems cannot be overstated. Society must remember that human activities occurring in watersheds draining into the Gulf can and will have a profound effect on the condition of the receiving system, creating an obligation to ensure that adverse effects are minimized by maintaining natural resources.

III. Educators' Forum

A. Educational Opportunities: Grants, Networking -- Who, How, Where & Why

Prospects For A Career In Science: The Myth Versus The Reality

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What is a scientist, and why would anyone wish to become one? A scientist is a person with expert knowledge allowing one to observe, identify, describe, experiment, and develop theories of natural phenomena through a process termed the scientific method. This wordy definition belies the fact that SCIENCE REALLY IS FUN, and it has been repeated many times and may sound trite. But, this fact has brought the best minds of the world into the realm of science. The job of being a scientist is extremely satisfying and personally rewarding, is a necessary and fundamental part of society, and is never tiresome.

How does one become a scientist? One goes to school for a long time and earns good grades. One develops the capacity for creative thought and masters some phase of technology. Then, one writes a thesis, passes some difficult exams, and graduates and finds a job. Students might ask if there will be a job available upon graduation, which is a valid question.

There have been some pessimistic, disturbing estimates predicting a major shortfall of scientific and engineering professionals. These include a National Science Foundation estimate that there will be a shortage of 275,000 engineering students alone in the next 20 years. However, these estimates have been shown to be wrong through critical analysis.

The NSF models were inadequate and the data insufficient for the evaluation. It now appears that there will be little or no shortage in the immediate or near future. Indeed, with the current layoffs in defense and other industries and the importation of significant numbers of scientists from the former Soviet Union, there appear to be more scientists than jobs.

What is not in question is that there are relatively few new science graduates in the U.S., and many are foreigners. There are too few women and minorities despite the fact that these are the fastest growing segments of the college population. At the heart of this matter is the fact that most elementary and secondary students are not being prepared scholastically for a technical career, whether or not they choose to have one. What are the reasons for this situation? Some probable factors include:

- 80% of the nation's students receive inadequate preparation for a career in science and engineering by the 10th grade,
- 50% of new high school teachers lack appropriate certification for the science courses they teach, and
- Only 34% of all elementary science teachers meet the minimum standards of the National Science Teachers Association.

In general, while it is clear that teachers must be better trained, they are insufficiently recognized and rewarded for their critical societal role. Teachers must be better paid, specifically rewarded for science teaching, and rewarded for individual achievement. There are many factors involved in the failure of U.S. students to compete in science with those of other developed nations. Surely, education is one of those factors. The author believes, however, that parental support and demand for educational excellence from their children is of greater importance. It is also the author's belief that a widespread societal malaise is fundamental to the education crisis in which we find ourselves.

What is the reality of a scientific career for a current elementary or secondary student? The best opportunities appear to be in the "green sciences" -- biotechnology, environmental sciences, health sciences, earth science (geology, geophysics, and the ocean sciences), space science, and teaching.

It appears that the greatest need will be for good teachers because education is the foundation of society; without able, dedicated teachers nothing else will work. It also appears that society is, finally, waking up to this fact.

The health sciences will seek and find cures for cancer, AIDS, heart disease, and the common cold. The social sciences must address and, ultimately, solve the greatest problem facing this planet -- overpopulation. The environmental sciences must address decreases in biodiversity, increases of greenhouse gases, global warming, and pollution control. The earth sciences will continue to seek an understanding of the fundamental truths of our planet.

Well-qualified and able teachers can provide the knowledge and inspiration to develop and produce students who can solve these problems and make these discoveries. There will always be a place for the best and the brightest. There is also room for the almost- best and brightest who work hard in their chosen field.

There will be an increasing need for well trained science teachers at all levels, particularly in K-12 and junior or community colleges. The compelling requirement in K-12 is for teachers who understand the basics of science and can impart the wonder and love of discovery to their students.

Syndicated columnist William Rasberry made an important point in a recent speech. Most college students who do not go to law or medical school will work in careers unrelated to undergraduate majors. Their elementary, high-school, and undergraduate college education was spent learning generalized, liberal arts -- some math, general science, and reading, writing, and arithmetic, providing a position of reference to figure out where to go next.

Students shouldn't worry that they don't know precisely where to go. Most don't really need to know what they'll be doing in 10 or 20 years, and if they wanted to know, they probably couldn't because things change so quickly. Technology changes so rapidly that many future occupations are unimaginable at this time.

The most important thing for a student to learn now is how to learn and become a productive member of society. While only relatively few students may chose to become scientists, all will become citizens of an increasingly technological world. It is the teacher's duty to prepare them for it to the best of their ability. Indeed, teachers have the daunting responsibility of guaranteeing the future of this nation and the world. To fail is inconceivable, to succeed will require one's best continuing efforts.

In Search Of Funding: Preparing A Winning Proposal

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Environmental education is gaining popularity among educators as a way to teach students required skills by using content that holds student interest, is conducive to hands-on activities, and relates to daily living and current events. School districts and, in the case of Florida, state departments of education are beginning to require environmental education content at all levels. But beyond the institutional requirements of the school system, educators are finding that teaching environmental issues is an exciting way to help students develop required skills through content that inspires, as well as educates. Through environmental education, students can learn math, science, geography, and language arts skills while developing life-long attitudes and behavior which fosters environmental stewardship.

While environmental topics may be compulsory topics now or in the future, depending on state education policies, the quality of environmental education may rely on the educator's ability to design and implement effective instructional programs. In many cases, this type of effort requires more than creativity and subject knowledge. Most school districts are suffering from extensive budget cuts which effect class sizes, field trips, and teacher training opportunities. For those educators with vigor and persistence, tapping into the right funding sources can be the difference between merely meeting institutional requirements and providing students with exciting, innovative projects that stimulate them to protect their environment.

A funding strategy is integral to good project development, whether the goal is to develop curriculum, provide teacher training, or fund field trips. Likewise, a well-formulated project is essential to gain financial backing, whether the potential funding source is public or private. The following are some practical tips for project development and successful fundraising:

- make sure the project is needed and desired, be able to show proof of strong demand;
- projects are more easily approved by school administrators, more easily implemented, and more easily funded if they are compatible with existing curricula;
- most grant sources for education are geared toward "people" issues, not the environment; find ways to tie the environment and people together (such as environment and the economy);
- many funding sources like to be involved in action-oriented projects that have a tangible result and benefit the community;
- when proposing your project for funding, be sure to understand the source's priorities -- a phone call or proposal writing workshop can provide the detail required to push the source's hot buttons in the written proposal;

- be certain of the types of projects or products the source would be willing to fund -- many funding sources may discourage capital expenditures for vehicles, computers, or other equipment;
- examine all likely options for funding, such as government agencies, private foundations, civic organizations, businesses, and student fundraising activities;
- when developing the project budget, be sure to account for over-time for the project manager, travel, lodging, and, perhaps, most importantly, administrative assistance -- many funding sources are willing to pay for administration during the funding period, and project managers often find that paperwork for maintaining the grant is quite time-consuming -- be sure to account for benefits and taxes when figuring personnel costs;
- the successful fundraiser always keeps promises made to funding sources, so be sure to follow through. This will also enhance the potential of securing funding for future requests; and
- one of the best ways to gain a thorough introduction to funding environmental education projects is to talk with someone who has been successful in similar efforts -- study any proposals or prospectus packages that were part of a successful project, or even join forces with a more experienced project manager to get a headstart.

Managing funding for an educational program is a significant responsibility. But if the choice is fundraising vs. little or no environmental education in schools, many educators are opting for the challenge of developing and managing a project from beginning to end.

Education Networking Through Environmental Experiences

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It is easy to visualize the networking of computers that link office to office, where computers talk to each other. Webster defines networks as a system of crossed roads, canals, or a chain of transmitting stations. The author believes that the education system must be revitalized by reestablishing the excitement of teaching and utilizing teacher networking.

Carl Sagan wrote, "We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology." During Congressional hearings in 1992, Sagan also stated, "Less than half of all Americans know that the Earth moves around the Sun and takes a year to do it." Currently, the United States ranks 7th in the world in science and technology and is falling behind fast.

A USA Today-Time magazine report in 1991 stated that, by the year 2,000, 14,000 jobs will be available for individuals with PhD's in math, science and engineering. Students from the United States will only fill half of these positions, the rest will go to foreign students. Students do not find math and science exciting and, therefore, tend to shy away from those courses. High school students today believe that mastering algebra can be accomplished by sitting in the classroom for 50 minutes, not by doing homework. Teachers know that to truly understand the life sciences, mathematics, and the technology of the world, we must invest in time -- a commodity that will continue to be the most limiting as the 21st century approaches.

In the United States, teachers are prepared as well as any in the world, but society tends not to consider teachers professionals. Today, emphasis is placed on money, not education, and, in general, parents are too caught up in their own monetary acquisition to realize that, without proper education, the quality of life we enjoy today will not be achieved by future generations.

Some of the newest methods of teaching, such as virtual reality, create TV screen images of a trip through the frog, or an excursion under the ocean, further removing real life experiences from our learning process.

This author believes that the methodology of teaching must change. Teachers must become excited about their subjects themselves and reflect this to their students. It is axiomatic that the teacher's enthusiasm is felt by the class.

The old proverb, "I HEAR AND I FORGET, I SEE AND I REMEMBER, I DO AND I UNDERSTAND," (anonymous) is the basis of hands on learning. Many teachers employ this methodology in their classrooms, and many more should. Teachers must move from the abstract to utilizing everyday reality.

Personnel at the Dauphin Island Sea Lab in Alabama have worked with the Alabama Department of Education to utilize Title II monies on a project titled "World of Water for Teachers". For four years, 238 science teachers a year from grades K-12 have travelled to the Lab during 7 one-week sessions in the summer. Utilizing the lure and excitement of the oceans, the teachers learn subject areas can be taught in a manner that stimulates thinking and learning. Experiencing the environment firsthand is one of the best learning tools one can have.

In 1869, Major John Wesley Powell, a retired Union officer who lost his arm in the Civil War, set out to traverse the Colorado River through the Grand Canyon. Major Powell's strong background in natural sciences allowed him to document many wonders of Nature that continue to inspire

scientific writing on the Earth's origins. Look around your school and examine the possibilities of experiential learning. Science classes may utilize a drainage ditch, math classes may visit an engineering office or a new construction site. The possibilities are unlimited.

In addition, teachers learn how they can infuse the marine materials into their classrooms no matter how far they are from the sea. They learn how to examine what excites the students and utilize that excitement to teach a subject. Then, the teachers are challenged to go back to their schools and act as a resource satellite teacher for both the school and region and establish a network with them.

The following quote from John Kennedy reflects the author's philosophy of teaching about the world's oceans:

> *I really don't know why it is that all of us are so fascinated with the sea, except I think it is because in addition to the fact that the sea changes, and ships change, it is because we all came from the sea. It is an interesting fact that we all have in our veins the same percentage of salt that exist in the sea, therefore we have salt in our blood, sweat, and tears. We are tied to the sea, and when we go back to the sea whether it is to sail or to watch it, we are going back from whence we came.*

Rekindle the excitement of teaching within yourselves and act as a beacon to lead your students into the 21st century.

B. Educational Programs: A Key To The Future

Shoreline Erosion Education: A Hands On Approach

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Since the Gulf of Mexico Symposium in New Orleans in 1990, the authors have been concerned about involving both the public and educators in conservation activities. Recognizing that there is a lack of communication between the scientific community and the general public, the authors cooperated with the Galveston Bay Foundation to improve the link between some of the scientific community, federal and state agencies, industry, and private citizens.

The authors feel strongly that a "hands on" approach to teaching salt marsh ecology and coastal erosion problems is a high priority, and it has been an extremely successful technique that is well received. The authors train volunteers in wetland creation methods using smooth cordgrass, *Spartina alterniflora.*

The Galveston Bay Studies Program is a compendium of bay-related activities and courses offered by area groups and institutions. The program offers educational experiences in wetland creation as an environmentally sound method of shoreline erosion protection. A combination of classroom sessions and a field trip provide a valuable learning experience for teachers. Six hours of Advanced Academic Training credit is offered in the course. The authors have taught this course for the past two years.

An educational video detailing the problems of shoreline erosion and wetland loss was recently developed. The video, entitled "Texas Shores, Saving What's Left" was produced by Texas A&M Sea Grant, in cooperation with the Soil Conservation Service, and the Texas State Soil and Water Conservation Board. The purposes of the video are to create an awareness of shoreline erosion problems in Texas and link the importance of the presence and health of wetlands to our local coastal economy. The authors coordinated the production of the video, including filming site determinations, interviews of erosion and wetlands experts and affected property owners. The video was funded by the Moody Foundation of Galveston, Texas. The video is made available to secondary and high school age students and teachers and is also utilized as a teaching resource in the Galveston Bay Studies Program.

Before participating in wetland creation efforts, volunteers are briefed on the planned activities and purposes of the project. Safety concerns, care in obtaining wetland plants for transplanting purposes, and site selection are discussed with the participants. A major portion of the orientation includes an overview of the concerns of wetland losses, the importance of estuaries to water quality improvement, shoreline erosion protection, and habitat for fish, shellfish, and coastal birds. A comprehensive orientation is important to give participants a thorough understanding of the purposes of the session.

A "hands on" approach to teaching marine ecology and wetland creation techniques is a valuable tool. Volunteers are encouraged to participate in transplant collection and care. Volunteers frequently participate in seining to see marsh productivity first-hand and learn to identify common estuarine fish and shellfish. Finally, volunteers are taught transplanting

techniques using hand implements.

Based on feedback from participants in wetland creation efforts, there is a positive impact of teaching marine ecological concepts combined with "hands on" approaches. Participants have indicated to the authors that the project provides self-satisfaction and the opportunity to contribute positive action toward the improvement of Galveston Bay's habitat loss and water quality problems. Many participating corporations, groups and organizations have pledged their labor and financial resources toward efforts promoting the marsh creation concept.

Teacher Training/Student Enrichment: Project Sea Oats

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Located on the north-central Gulf Coast, Mobile County is Alabama's second most populated area, with over 378,000 residents. The county's public school system is the largest in the state, having an average enrollment exceeding 67,000 students.

During the past decade, curriculum planners have recognized the vital importance of Alabama's coastal environment and sought to place greater emphasis on oceanography and marine biology as part of the system's course of study in science.

Project Sea Oats (Special Enrichment Activities in Oceanography for Area Teachers and Students) is an attempt to strengthen this initiative through a multi-faceted approach involving teacher inservice, field study, acquiring resource materials, establishing an aquarium, and coordinating a student seminar in marine biology.

The project features a unique cooperative effort utilizing the resources of the Mobile County Public School System's Environmental Studies Center (ESC), Auburn University's Sea Grant Extension Program, and the Marine Environmental Sciences Consortium (Dauphin Island Sea Lab). Project coordination and implementation is the responsibility of the ESC. Both Sea Grant and the Dauphin Island Sea Lab provide guidance in program development, instructional resources and assistance, and a funding mechanism for the project.

Project Objectives

The project seeks to increase the effectiveness of classroom teachers in the delivery of marine related concepts and content, strengthen student awareness and knowledge of the marine/estuarine environment and its link to the overall quality of life, provide greater access to marine related teaching materials, provide a saltwater teaching aquarium at the school system's Environmental Studies Center, and focus attention on marine and coastal issues through establishing an annual "Marine Science Seminar".

Methodology

The project is coordinated by the Mobile County Public School System's Environmental Studies Center, with cooperation from Auburn University's Sea Grant Advisory Service and the Dauphin Island Sea Lab. The focus is on designing and implementing marine science workshops for elementary and secondary teachers, planning and coordinating field study for high school marine biology students, identifying and acquiring marine-related educational materials, establishing and maintaining a saltwater teaching aquarium, and coordinating a seminar for high school marine biology students.

Results

A series of workshops, for both elementary and secondary school teachers, has been conducted at the Dauphin Island Sea Lab each year. The workshops helped participants identify key marine science concepts appropriate for their grade level, expanded the teachers' content base, revealed innovative teaching techniques, familiarized participants with the latest marine education teaching materials, and allowed preparation of representative specimens to include in a classroom teaching collection. Pre/post tests results indicate a 56% average increase in cognitive performance among randomly selected participants.

Project Sea Oats has coordinated field excursions for over 850 students enrolled in the school system's high school marine biology program. While at the Dauphin Island Sea Lab, students collect and identify local marine organisms, study the island's dune system and maritime forest, and undertake an interpretive walk through the salt marsh. Results from pre/post tests in this group indicate a 35% increase in cognitive development.

Other accomplishments include adding 55 new marine education titles to the ESC's resource materials collection, installing and maintaining a saltwater aquarium in the ESC's demonstration lab, and establishing an annual marine science seminar attended by 450 students, on average.

Conclusions

Project Sea Oats has enhanced and expanded marine education in Mobile County's public school system. Participation by teachers and students has led to increased awareness of the vital importance of marine/estuarine resources to the environmental quality of coastal Alabama. Moreover, the project has demonstrated that cooperation between area agencies can maximize the use of fiscal, natural, and human resources to provide meaningful experiences in marine science and promote emphasis on marine education as part of the curriculum.

Wetlands Weekend: An Environmental Education Experience For Middle School Students

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The burgeoning human population has steadily degraded the environment by directly destroying habitat and over-harvesting resources, and by indirect means, such as discharging toxic pollutants. Few habitats have escaped these impacts, but our tendency to colonize areas near rivers and coastlines has resulted in the loss of as much as 46% of the wetlands originally in the contiguous U.S. (Niering, 1985).

Increased awareness of the importance of wetlands has led to greater involvement of regulatory agencies in their management, yet much of the general public views wetlands as mucky, insect-infested areas having little value. The primary goal of the Wetlands Weekend Program is to provide an experience for area middle school students and teachers to heighten their awareness of the environment, in general, and the importance of wetlands, in particular. Key issues covered in the Program are the ecological values of wetlands, causes of wetlands loss, pollution impacts on wetlands, and using constructed wetlands to treat wastewater.

A broader problem concerns the public perception of science and the declining scientific literacy of students. Many people have the impression that science is a subject only a few people can master and that the stereotypical scientist is a dull person specializing in an obscure field. Only about 50% of students receive a science education beyond high school biology (Voss, 1983).

The secondary goal of the Wetlands Weekend Program is to demonstrate to middle school-aged students that science is exciting and relevant to their lives. Florida's Comprehensive Plan states, "The best way to interest students in mathematics and science is to make these subjects concrete, real, and exciting from the start" (Florida Chamber of Commerce and Florida Department of Education, 1989). The ecosystem concept is an important component in the core of essential knowledge and skills which all Americans should have (AAAS, 1989), and wetlands provide an ideal example.

Local natural resources and research at the University of West Florida led to the development of two Wetlands' Weekend experiences -- River Swamp Day and Salt Marsh Day. The sponsor of a group of up to 24 youngsters selects one of these experiences, which are scheduled on alternating weekends. In 1992, as part of the Year of the Gulf of Mexico, Wetlands Weekend emphasized the connection between river swamp and salt marsh wetlands to the Gulf of Mexico, and regional issues involving human impacts on the Gulf.

River Swamp Day is staged at the UWF campus, which is located near the junction of the Escambia River and Escambia Bay. Many campus acres are categorized as swamp forest, and Thompson's Bayou, a tributary of the lower Escambia River, is surrounded by University land.

River Swamp Day participants are split into two sub-groups -- The Swamp Stompers and The Eco-Engineers. The Swamp Stompers spend part of the morning touring portions of the 18,000-acre Lower Escambia River Preserve on a 28-foot pontoon boat learning about river swamp ecology and the adaptations of the common plants and animals found there. The remainder of the morning is spent learning about a coal-burning power plant adjacent to the UWF campus and about thermal pollution and its control. Swamp Stompers make a modest set of water chemistry measurements, and they collect and observe samples of plankton and benthic decomposers from the Bayou.

Eco-Engineers spend the morning touring display tanks containing river swamp plants and animals before focussing on constructed wetlands. Participants learn about modern sanitary landfills and the nature of landfill leachate before touring a greenhouse operated by UWF's Wetlands Research Laboratory. There, they observe experiments designed to evaluate the abilities of different wetland plant species to cleanse landfill leachate. Eco-Engineers also learn about household wastes and visit UWF's state-of-the-art wastewater treatment plant to see how constructed wetlands are used to treat nutrient-rich wastewater. After lunch, the two groups switch activities for the remainder of the day.

Salt Marsh Day is staged on the Big Lagoon side of Perdido Key, a portion of the Gulf Islands National Seashore. This area contains extensive salt marsh, and Big Lagoon is designated a Florida Aquatic Preserve. Salt Marsh Day participants are split into two sub-groups -- The Trawl Team and The Marsh Marchers.

The Trawl Team spends the morning on a 28-foot pontoon boat examining the contents of a series of tows taken in 6 to 20 feet of water using a small otter trawl. They learn about the adaptations of the common plants and animals collected and note the sizes of the animals collected. Trawl Team participants also observe dolphins and seabirds and learn about issues associated with shrimp trawling, such as Turtle Excluder Devices and bycatch.

Marsh Marchers begin their morning by visiting a raised platform overlooking a large saltmarsh. They learn about the production of detritus and its role in the food chain. Marsh Marchers then use a seine net to make several collections in shallow water over both sand and grass covered bottoms. They learn about the adaptations of the common animals collected on each type of bottom and note the sizes of the animals collected. After lunch, the two groups switch activities for the remainder of the day. Participants compare the size of individuals collected within a single species in both deep and shallow water, and, thus, they learn directly the role of tidal channels and nearshore grassbeds as nursery

areas for species whose adults inhabit deeper water.

The Wetlands Weekend Program completed its first year in 1992, running from May 1 through November 13. The Program took place on 29 dates, and the participants numbered 491 students and 130 teachers. Most of the adults were science teachers. Post-participation comments have been quite positive, and some presentation dates for 1993 have been reserved.

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References

American Association for the Advancement of Science, "Biological and Health Sciences," AAAS, Washington, D.C., 33 pp. (1989).

Florida Chamber of Commerce and Florida Department of Education, "A Comprehensive Plan to Improve Mathematics, Science and Computer Education in Florida," Tallahassee, FL, 79 pp. (1989).

W.A. Niering, Wetlands, Alfred A. Knopf Publ., N.Y., 638 pp. (1985).

B.E. Voss, "Objectives for middle school science," Science and the early adolescent, M.J. Padilla (ed.), pp. 6-9, National Science Teachers Association, Washington, D.C. (1983).

Marine Education Field Experiences For Teachers And Students

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The thesis of this paper is that "Teachers and Students Are the Key to the Future". Without competent classroom teachers who can convey to their students the excitement and wonder of science and the world around them, the future is bleak, at best.

The University of Texas Marine Science Institute, through the Marine Education Services (MES) program, provides opportunities for over 800 teachers and 9,500 students to gain first-hand experience with the marine world each school year. The students participate in a research cruise aboard the R/V KATY during which they collect water samples and determine salinity, temperature, and oxygen levels at different depths, collect plankton samples and view them through a video microscope, wash and pick through samples of the benthos, and sort through, identify, and compare trawl samples from different depths and stations in the bays and channels adjacent to the marine laboratory.

Another MES program, with the support of the Texas A&M University Sea Grant program, provides opportunities for teachers at all grade levels to come in contact with research scientists, marine educators, exemplary classroom curricula, field experiences,and teaching strategies. Workshop topics offered include Basic Marine Science, Biological and Physical Oceanography, Barrier Island Ecology and Geology, Seaweeds and Sea Grasses, Plate Tectonics, Coastal Birds, and Global Environmental Change. Exemplary curriculum projects featured include the Marine Science Project FOR SEA, Hawaii Marine Science Studies, and Foundational Approaches in Science Teaching to name a few. Curriculum project facilitators are brought into the workshops to train the teachers, who then introduce their faculty and students to the programs. Once again, it is evident that the teacher is the key.

The objectives of the weekend workshops are to improve the teachers' content and pedagogical knowledge of marine science and the Gulf of Mexico, train them in field experiences so they can lead their classes into the field, and provide an appreciation of the interdisciplinary nature of the study of the ocean, a theme which crosses all traditional subject boundaries.

National Environmental Education Act

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In 1990, the National Environmental Education Act was enacted, authorizing environmental education programs by the EPA. Until that point in time, EPA's primary means of motivation had been enforcement and regulation.

While regulation and enforcement remain foremost in EPA's mission, education is becoming a strong supporting role for the agency. Perhaps, if 10% of what was spent on Superfund enforcement over the last decade had been spent on education, the nation's understanding of environmental issues would be greater and there would be less pollution. Over the past 20 years, much has been done to increase awareness of environmental issues that has been good and useful. The next step, however, will be based on action, as many of the problems that exist have been identified.

There are four points that must be remembered as the agenda takes shape.

First, we must utilize our expertise to make the pursuit of excellence the hallmark of environmental education. For more than 20 years, there have been many good outlets for environmental information -- the National Audubon Society and Mote Marine Lab to name two. Also, there are many advisory boards involved, whether made up of citizens or other governmental organizations. A network must be created so that efforts are not wasted through duplication, and it will become easier to obtain information.

As part of this effort, new partnerships must be explored to provide formal and informal educational settings. The Boy Scouts, 4-H Clubs and Future Farmers of America, environmental groups, state and local government, academia, industry, and health organizations all must work together. In the 1960's and 70's, business was perceived as evil and environmentalists as blissful idealists. More often than not, the two sides would only interact in a courtroom. Industry has learned that environmental protection initiatives can enhance the bottom line, and new partnerships, once unimaginable, are being formed.

For instance, Dow Chemical, the National Audubon Society, and the EPA recently formalized a partnership to benefit the Great Lakes. Also, utilities and big corporations, like General Motors and IBM, are working with EPA to develop new ways to save energy.

However, grass roots efforts will continue to be important to environmental education initiatives. EPA encourages partnerships with these groups; however, funds will continue to constrain its participation. For instance, in 1992, the agency received over $100 million in requests from grass roots environmental groups for grant funds, but only had $2.5 million to distribute. Although some may view this as being oversubscribed and think potential partnerships may feel slighted, EPA views this as a good beginning by providing seed money to these groups.

The second goal is to target youth for environmental education initiatives and provide them with high-caliber programs. There are many specific targets for this. The EPA funded a very large, nationally-networked consortium for teacher training based at the University of Michigan, and it is working on a pollution prevention education project that looks at pollution prevention as part of environmental education.

EPA is working with the University of Michigan Consortium and the National Environmental Education and Training Foundation to develop an environmental resource library and clearinghouse. An index will be published within a year and available free of charge or at a limited cost that will provide teachers, administrators, media, science centers, and libraries with a wealth of information.

Goal three is to promote an interest in students to explore environmental-related careers. A new, multi-discipline curriculum will need to be developed that transcends all subject areas. For instance, EPA is organizing environmental training for business school curricula. Traditional career paths must not be overlooked, and the EPA is developing fellowship and internship programs to support these initiatives.

The fourth goal is not a mandate, but it is germane to the Gulf of Mexico. Because environmental issues do not stop at borders, programs must become international in nature. In fact, more than 80 countries visited the EPA recently to seek advice or plan for multi-lateral initiatives.

In November 1992, the environmental ministers of the U.S., Canada, and Mexico signed a tri-lateral agreement on environmental education, linking the three countries together for future environmental education endeavors. This is a very promising initiative, and a commission is already at work.

The Action Agendas being drafted through the Gulf of Mexico Program strongly emphasize public education to maintain and improve the viability of the Gulf ecosystem. The Boaters' Pledge, for instance, provides tangible results through educating boaters, anglers, and marine operators on the impact of marine debris on fish and wildlife and beaches. The Office of Environmental Education recognizes the importance of public education to preventing environmental degradation and will lend its support to achieving the goals of the Gulf of Mexico Program.

C. Science And Technology: Pathways For Learning

Gulf Literacy: Promoting Scientific Literacy Regarding Gulf Of Mexico Environmental Issues

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The word literacy is linked to many different movements such as cultural literacy, critical literacy, fundamental or functional literacy, technological literacy, math literacy, and scientific literacy. The new literacy described in this paper will be named Gulf Literacy. The model used comes from scientific literacy movements, especially those espoused by science-technology-society proponents.

Current notions of scientific literacy arose in response to calls for reform in science education. Since the report A Nation At Risk was released, over 200 reports have been published identifying the need to improve science education. Scientific literacy is the ultimate goal of the authors and is the slogan for much of the improvement.

Motivations for increasing science literacy have changed. The initial stimulus was a function of post-Sputnik defense concerns; currently, it is survival in a global market economy. It is interesting to note that in Third World countries, the call for literacy is generated by agricultural needs. Farmers need to be able to read and understand labeling and application directions for fertilizers, herbicides, and pesticides -- all of which are, coincidentally, adversely affecting the Gulf of Mexico.

What is scientific literacy? There are many definitions, but all have the following factors in common: an awareness that science and technology are independent human enterprises with strengths and limitations, understanding key concepts and principles of science, understanding newspaper articles and graphics related to science issues, and using scientific ways of thinking for individual and social purposes.

What should a person know to be considered Gulf-literate? Such a list can be generated by brainstorming, surveys, or other means. It might be interesting to generate such a list among your peers and colleagues. The following are three discussion topics and examples of literacy goals:

- marine debris, especially plastics, is unsightly and a hazard to marine life because animals, such as the endangered Kemp's Ridley Sea Turtle, ingest or become entangled in it,
- pouring used motor oil down storm drains can have far reaching effects because they often empty into a body of water connected to a larger body of water, eventually connecting to the ocean, and
- fishery management results in conflicts between commercial and recreational fishing groups, as in the case of red drum, which was harvested to the point that the fish stocks could not replenish themselves and a population crash occurred.

The idea is not to generate a quantum of knowledge or catalog all environmental concerns along the Gulf of Mexico, but to establish broad topics where each is useful for understanding the Gulf of Mexico as a large ecosystem. Note that the first topic allows for discussion of solid waste disposal, maritime law, and endangered species. The second topic is a stimulus for non-point source discharge, material disposal issues, and the ability to clean an ecosystem and whether it can recover. The last topic involves basic economics of supply and demand, how technology has made fishing more efficient, species management, and the concept of sustainability. The issues combine complex interaction between science and technology.

How is environmental literacy through science and technology promoted? First, one should align oneself with the subject matter. Befriend a scientist or a laboratory and find some way to experience modern methods. Or, utilize the resources of the many government agencies in the Gulf coastal zone. If one is a scientist, conduct a workshop for teachers, speak to the public or a citizens group. If one is involved in a job with a public outreach program, conduct a weekend program in which scientists talk about their work and their latest developments.

Another important component that shouldn't be overlooked is utilizing the media. Write a series of newspaper articles or produce short, but meaningful videos. Increase daily exposure to the Gulf of Mexico and how, as literate citizens, everyone can participate in managing its resources to keep it a "shining sea."

The IBM Personal Science Laboratory System As A Tool For Environmental Modeling In Middle School

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One very effective way to interest middle school students in environmental science is through realistic simulations of space-based environmental monitoring. Discussions of forthcoming NASA "Missions to Earth" and the concept and methods used by the space program to study earth itself always elicit excitement. What is required to turn this interest into a powerful learning experience is a simple, rugged system for collecting and analyzing such simulated data.

The IBM Personal Science Laboratory System (IBM PSL) is a powerful, simple, and rugged tool ideally suited to modeling environmental monitoring as well as collecting, analyzing, and storing data. The IBM PSL is a microcomputer-based laboratory that attaches to any of IBM's Personal Computer and Personal System/2 microcomputers. It consists of a base unit which collects data from modules and sends it to the supporting software. The base unit has four module ports, plus an expansion bus. Two types of modules are available -- a temperature, light and pH module and a motion and mechanics module.

Temperature probes have a range of -55 degrees C to +105 degrees C, with a resolution of .05 degrees C. Light probes are of two types: photometric, with a spectral range from 400 to 950 nm, and pH probes, which function in the range of 0 to 12 pH and have a resolution of 0.01 pH.

The motion and mechanics probe has a sampling rate of 418/second and may be used for distance, acceleration, velocity, and movement. The system uses PSL EXPLORER software, which is very user-friendly, with full-function, pull-down menu structure. It permits the user to gather data from any probe, scale and plot it in real-time, analyze it using many types of calculations, and store and retrieve it. Results may be displayed and stored in both tabular and graphical formats. The whole system is extremely reliable, sturdy, and problem free.

The PSL EXPLORER system permits experiments to be designed, but it also includes a series of self-contained experiments to which students can add their own data. For temperature, self-contained experiments include cooling curves and evaporation, heat gain, and specific heat in a variety of substances, exothermic and endothermic chemical reactions and temperature changes in water and soil. For light, these include reflection from different surfaces, angle of incidence, light intensity, polarization, scattering, and absorption. Self-contained motion experiments include studies in velocity, acceleration, harmonic motion, and force.

To adapt the system to simulate space-based environmental monitoring, all that is needed is a little theater. The keyboard and screen are placed inside a simple, cardboard control panel, with appropriate space-like markings, and the probes extend into an area concealed from the astronauts in which they are applied to a variety of objects.

The first activities involved using the light probes to model vegetation reflectance. In order to prepare the students, the standard reflectance studies in the system were reviewed, and the probes were used to discriminate actual leaves from a variety of evergreen and broad-leaved plants. Then, an explanation was given of how to use reflectance to map vegetation over a wide area. In this simulation, the probes are simply moved over colored vegetation maps. These maps need not be realistic in their reflectance.

The point of the exercise is to challenge the students to convert graphical representation of reflectance back into vegetation types correlated with the scan of the probes across the Earth. Once the basic idea is grasped, then special problems can be developed, such as a rainforest mission in which denuded areas are to be located and mapped by reflectance.

The techniques used in vegetation mapping can easily be modified to water studies. For example, the location and spread of algal blooms, or eutrophic and polluted areas, can be determined by simulated reflectance.

Temperatures at the sea and land surface can be simulated easily by placing light bulbs at various distances from the probes. In this way, weather, currents, and, even, the buildup of cyclonic storms can be understood and modelled. The motion detectors can be used to simulate the movements of organisms such as whales or terrestrial mammal herds, merely by moving small objects at an appropriate rate across a map! The effects of volcanic eruptions on light scattering are easily simulated.

Young students enjoy trying to challenge the astronauts with original problems once the basic techniques have been mastered. The astronauts have been given tasks such as pinpointing a source of thermal pollution along a river and pursuing illegal whalers. The adventure aspect of these simulated "Missions to Earth" make them very popular. At the same time, young students learn how to store and analyze data in a realistic manner.

Share The Thrill Of Discovery With The JASON Project

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What is the JASON Project? The JASON Project is a unique and innovative educational project conceived by Dr. Robert Ballard (the oceanographer and explorer who discovered the wrecks of the R.M.S. *Titanic* and the German battleship *Bismarck*) to excite students about scientific research and encourage them to pursue careers in science. Each year the JASON Project takes a two-week voyage of scientific exploration that is broadcast live to thousands of students and the public at receiving sites across North America and beyond with new 1993 sites in Bermuda and England.

Who is the JASON Project?

The JASON Project, named for the Greek mythological hero who sought the golden fleece, is a partnership of industry, scientific research organizations, museums, and educational organizations, including Mote Marine Laboratory. This partnership makes up the JASON Foundation for Education, which is committed to sharing with students the thrill of scientific discovery and exploration.

How did it begin?

Dr. Ballard's idea for the JASON Project grew from his discovery of the wreck of the R.M.S. *Titanic* in 1985. As the Titanic loomed into view, he was struck by the thought that only he and his two colleagues were able to experience the absolute thrill of this discovery. Dr. Ballard knew then that he wanted to find a way to share this pure adventure of science and the tremendous rush of feeling that accompanies discovery of the unknown. And, so, the project was born. His dream intensified after the researchers returned with images never before witnessed. At a time when students were choosing not to go into science, Dr. Ballard received thousands of letters from children about their discoveries.

Given this overwhelming response, Dr. Ballard saw a way to transform this youthful enthusiasm in the Titanic into a broader interest in science and engineering. Through telepresence, using satellites and two-way audio hookups to enable students to see exploration and talk to scientists as they work, large numbers of students could be involved in the most exciting phase of science -- discovery.

What is the goal?

In the 1990-91 International Assessment of Educational Progress (IAEP) study, U.S. 13-year olds scored 13th out of 15 countries in science achievement and had the least positive attitudes toward science. Throughout the United States, there is concern that our nation is slipping in science and technology as talented students pursue other careers. The JASON Project's goal is to inspire students about these subjects and encourage them to pursue careers in these fields through participation in live scientific expeditions via a proven interactive learning technique.

Is there more?

The JASON Project is not just a better-than-usual field trip. Students are active participants. Not only do they talk with scientists at the expedition site, but select students can use a joystick to operate and navigate by remote control the submersible robot, Jason. Before they participate in the JASON experience, most students will have studied a six-week curriculum prepared by the National Science Teachers Association, covering everything from the state of-the-art technology used in the voyages to the geology, geography, and biology of the expedition sites.

What is the past history of the JASON Project?

This is the fourth JASON Project, and each year's expedition is more exciting and innovative than the previous year's as new technology and real science are used. The first JASON Project expedition explored the Mediterranean Sea, discovering the first hydrothermal vents on its floor and examining the deepest-known ancient shipwreck site. The second explored battleships from the War of 1812, sunken, but perfectly preserved, on the bottom of Lake Ontario. The third JASON expedition took place in the Galapagos Islands and, for the first time, explored land as well as underwater sites, examining unique animal species.

What are the plans for JASON IV and beyond?

Plans are underway for the fourth JASON Project to take place during the first two weeks of March 1993 on the Baja Peninsula of Mexico. There will be broadcast sites in both the Sea of Cortez and the Pacific Ocean. From the breathtaking majesty of the Pacific gray whales to the exploration of hydrothermal vent systems, JASON IV will bring students, teachers and the public to the leading edge of scientific research at sea.

Other projects being planned include expeditions to the Amazon Basin, the Mayan areas of coastal Central America, and the Arctic and Antarctic regions as more student voyagers will be able to join these electronic expeditions of discovery.

What are the results?

The JASON Project is succeeding in its goal of changing student attitudes about science. Studies by the Lehigh University College of Education show that attitudes about science dramatically improve once students have participated in the JASON Project. Lehigh's evaluation also indicates that this positive impact is true, regardless of race or gender.

Conclusion

There is a crisis in science education today. The JASON Project marks a combined effort on the part of the business, education, and scientific communities to counter this crisis. This effort shows consistently positive results in exciting

students about science and technology through the use of innovative techniques and a strong, interdisciplinary curriculum. Clearly, those who have shared the thrill of discovery today will set the course for new discoveries in science and technology tomorrow.

D. Alternative Teaching Tools: Puppets, Poets, And Things That Go Splash In The Gulf

Using Natural Science Museums As Teaching Resources

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There are over 6,000 museums in the United States accommodating millions of visitors each year who seek knowledge, understanding, and enjoyment. Museums teach visitors about their culture and the natural world through an informal or voluntary approach. At their best, museums empower these visitors to discover and search for the answers to society's current questions. Museums also act as catalysts, introducing people to new ideas and concepts. All this educating is done with objects in a concrete, hands-on manner. A museum is largely defined by its collections, but its place in the community is determined by how the museum uses its collections of objects.

The 1992 Official Museum Directory lists 416 natural history or natural science museums in the United States, including 23 officially-recognized state museums. The educational benefits provided by museums will never be the same in any two institutions, since it is how museums differ, not how they are alike, that makes for exciting, innovative programs and exhibits. But model programs used in one museum can be adapted to take full advantage of the unique opportunities found in others.

State and federal agencies developing educational materials about the Gulf of Mexico should consider partnerships with local museums. There are several important advantages to forming cooperative projects with museums:

- museums have a high visibility, name recognition, and an accessible location,
- museums have established integrity with a repeat audience, and
- museums possess objects that have a proven capability to aid in teaching the principles that environmental educators want conveyed to the general public.

Museums provide the hands-on experiences needed to involve visitors in active learning. By bringing people into close contact with living things and supporting their exploration, museum programming helps stimulate environmental awareness, and it provides a basis for understanding relationships. Because our modern living patterns make nature study less accessible and nature more abstract, the concrete experiences museums offer are more important than ever.

The Mississippi Museum of Natural Science (MMNS) located in Jackson, Mississippi is an example of a state museum that utilizes environmental education in its programming. The MMNS is making strides to educate its audience about the flora and fauna of the State of Mississippi through dioramas, educational exhibits, an interior garden, and aquariums. Presentations for visitors, Project WILD workshops for teachers, and classroom outreach programs, such as INLAND WAVES and WET Mississippi, use objects to teach adults and children about ecology.

Project WILD, available in all 50 states, is an environmental education curriculum designed for teachers and youth leaders working with grades K-12. The Mississippi Museum of Natural Science sponsors Project WILD in Mississippi and conducts WILD workshops throughout the state. During a six hour workshop, teachers and youth leaders gain skills and knowledge needed to implement Project WILD and coordinate WILD activities with classroom curriculum. Aquatic WILD workshops are conducted to place added emphasis on the importance of freshwater and marine environments.

Over 5,000 teachers in Mississippi have been trained to use Project WILD and Aquatic WILD. Project WILD helps develop skills in creative problem-solving and critical thinking in order to prepare children to make wise decisions about natural resources. The Aquatic WILD activity manual contains many activities that deal with topics vital to the Gulf of Mexico.

WET Mississippi is a museum out-reach program providing freshwater ecology instruction in classrooms throughout the state. An aquatic ecologist brings live animals into a classroom setting to interact with students as they learn about freshwater ecology. Students begin to assess and evaluate the positive and negative effects of human actions

on freshwater environments.

INLAND WAVES is a marine ecology out-reach program similar to WET Mississippi. Students observe marine organisms up close as they study the importance of estuaries, saltwater marshes, and open ocean habitats. The commercial, aesthetic, ecological, and recreational value of marine environments is emphasized.

Museums throughout the country are conducting similar programs and should play an important role in the emerging educational emphasis being placed on marine ecology. Museums attract a diverse group of visitors who have the express purpose of encountering new ideas and information. Issues concerning the Gulf of Mexico need to be presented to this audience through exhibits and educational programming. Many museums and nature centers in the Gulf States are already deeply involved in changing the public perception of natural environments, including coastal wetlands. Partnerships between museums, State and Federal agencies, and non-profit organizations will strengthen these efforts.

References

Bloom, Joel N., E. A. Powell III, E. C. Hicks, and M.E. Munley, "Museums for a new century: a report of the Commission on Museums for a New Century," Amer. Association of Museums, Washington D.C., 144 pp. (1984).

Deisler-Seno, Jane E., and Judith Reader, "Development of curriculum-oriented programs for natural history museums: an example in Corpus Christi," Cato, Paisley S. and Clyde Jones, (eds.), Natural History Museums: Directions for Growth, Texas Tech University Press, Lubbock, Texas pp. 137-259. (1991).

Draper, Lee, Museum Audiences Today: Building Constituencies for the Future, Museum Educators of Southern California, Los Angeles, CA, 139 pp. (1987).

Pitman-Gelles, Bonnie, Museums, Magic and Children: Youth Education in Museums, Association of Science Technology Centers, Washington, D.C., 262 pp. (1981).

Roger Tory Peterson Institute, "Bridging Early Childhood and Nature Education," Proceedings of the 1990 Forum sponsored by the Roger Tory Peterson Institute of Natural History. 22pp. (1990).

Screven, C. G., The measurement and facilitation of learning in the museum environment: an experimental analysis, Smithsonian Inst. Press, Washington, D.C., 91 pp. (1974).

Weil, Stephen E., Rethinking the Museum and Other Meditations, Smithsonian Inst. Press, Washington, D.C., 173 pp. (1990).

Marine Gang: Theater Used As A Teaching Tool

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Museums, particularly science centers, are known for their nontraditional approach to education. Demonstrations of scientific fact, enhanced with the showman's fancy, have become a favorite attraction at science museums across the world. Through exhibit hall and auditorium demonstrations, puppetry, and formal theater, science museums have attempted to impart knowledge of contemporary science and technology principles and issues to their valued audiences.

The Museum of Science & Industry (MOSI) in Tampa, Florida uses many forms of entertainment to capture and hold the attention of its quarter of a million visitors each year. Theater programs to accompany temporary exhibits, table top demonstrations, and large group demonstrations are but a few of the ways in which the museum interests its audience in science and technology.

Perhaps the most successful program thus far is a theater piece entitled "Marine Gang." The "Marine Gang" began as a volunteer education effort of the Marine Information Network (MIN), which owns the characters. When the demand for programs outgrew the ability of MIN to supply the requested services, MIN approached the Tampa Bay National Estuary Program (TBNEP) for help. The TBNEP, in turn, approached MOSI with a request for contract services to provide "Marine Gang" performances in elementary schools in Hillsborough, Manatee, and Pinellas counties. The success of the program is astounding; over 50,000 elementary age children have seen the program in their schools in only 4 months.

The "Marine Gang" is an example of a thriving partnership between three organizations that consider education part of their missions. The "Marine Gang" is also an excellent illustration of the success of nontraditional methods of teaching.

E. Youth At Risk: Everybody Belongs

From Trust Games To Environmental Action: Coastal Environmental Programs For Youth-At-Risk

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Today, an appropriate definition of youth-at-risk would be every child between the ages of birth and 18 -- every child in our society. This is because in the 1990's there is a high probability of a child being from a low income family, coming from a single-parent home, being involved with drugs or alcohol, being physically or sexually abused, having a learning disability, having a conflict with teachers or other authorities, or having trouble adjusting to the world.

The Florida Sea Grant program, 4-H Club, several State of Florida agencies, and non-profit organizations worked together to develop several coastal and marine education programs for youth-at-risk. One of the programs is an annual Marine Institute for young people 8 to 18 years old. The Marine Institute is a week-long residential camp with 120 participants each year. It includes favorite Aquatic WILD activities, seining and cast netting, working in a marine lab, discussing the Marine Debris Timeline, moonlight bay walks, tours of the Gulfarium, and a local fishermen's co-op. The youths also visit with local shrimpers and try their hand at the Japanese art of gyotaku, or fish printing, and at sand sculpture.

There are two big group challenges during the week of the Marine Institute. A canoe expedition into a back bayou is the most physically challenging activity. It offers a chance to become immersed in the world of an estuary. The beach cleanup provides an opportunity to help wildlife and make the Gulf a little cleaner and healthier.

By preceding traditional marine programs with some initiatives and group-building activities, efforts to reach youth-at-risk audiences are more effective. Instead of just learning facts and concepts, the participants are involved in something positive which offers them the opportunity to express themselves and excel. At the beginning of each program, the youth participate in trust games, initiatives, and, if time permits, a low-ropes course and a high-ropes course. Activities were adapted from New Games, Project Adventure, and others. These activities help develop trust and make the programs applicable to the youth's lives.

If the project is successful, youth feel good about themselves, are willing to take risks, and work together. It is easier to complete a task when the youth are excited or challenged by it. They will talk about differences and begin to realize that they are a lot more alike than they thought.

In addition to the week-long residential Marine Institute, several other programs are offered for youth-at-risk. They can go on Marsh Walks and Estuary Canoe Trips, giving them a chance to develop an appreciation for local wetland areas. Coastal Cleanups were extended and coordinated with underwater cleanups. Other activities for the youth groups include constructing wooden fishing line recycling boxes which are located at marinas, boat ramps, and bait and tackle stores throughout the area to encourage fishermen to deposit used monofilament fishing line in the boxes. Young people collect the line from the boxes as they fill, and the discarded fishing line is shipped to Berkley Recycling to be recycled into reels, toys, or for other uses.

On sailing trips, marine biology students have the opportunity to see the marine environment up close. Water and plankton samples are taken in the bays, bayous, and the Gulf. During the day, a survey of marine mammals is conducted, and youths learn navigation and sailing techniques. At night, astronomy is studied. The boat sails to barrier islands so that forts can be explored and ospreys, foxes, and other wildlife can be observed. As always, there is a beach cleanup on the islands.

On the Mermaids and Manatees dive trips, youth-at-risk go skin diving and have the rare opportunity to see, swim with, and photograph the endangered manatees. The young people also have a chance to "adopt" a manatee. About 360 people have been involved in the Mermaids and Manatees program.

Throughout all of these marine education programs, the overall goal is to help the participants develop a greater sense of self esteem, interact well with others, accept risks and challenges, see a connection between their lives and the natural world, and feel a sense of ownership and responsibility for the environment. This is a tall order, but in the five years that the program has worked with youths-at-risk, exciting results have occurred.

Youth At-Risk: Teaching Kids To Survive In The Real World

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A population that could be considered equally as endangered or threatened as brown pelicans once were and sea turtles are now is youth at-risk. This may seem melodramatic, but the fact is that young people are killing each other, or themselves, at an alarming rate, and substance abuse threatens a generation of youth faced with many stresses over which they may have no control.

The Drug-Free Schools and Communities Act of 1986 defines an at-risk youth as one under the age of 21 at risk of becoming, or has been, an alcohol or drug abuser, a victim of physical, sexual, or psychological abuse, committed a violent or delinquent act, experienced mental health problems or attempted suicide, or experienced long-term physical pain due to injury. Also, youth at-risk are impoverished, members of a minority group, malnourished, homeless, handicapped, or have low self-esteem. If these special young people are not identified and assisted, they may accelerate from dropping out of school to dropping out of life.

It would be easy for educators to blame the dropout problem on factors that have nothing to do with school. However, it is almost impossible to ignore these students because the effects of their problems spill over into every aspect of the classroom. Although many find labeling potential dropouts distasteful, the positive aspect is that identifying at-risk youths provides special programs and assistance. Administrators and educators face enormous challenges in reaching them and preventing them from dropping out.

There has been a great deal of publicity about Louisiana's at-risk youth -- the 40% drop out rate, child abuse in the home and day care centers, and economics -- these are the poorest children in the nation. All students, particularly those at-risk, respond to their environment, and how they fit in depends on how they perceive themselves. When one doesn't look good to oneself, it is difficult to perceive one's surroundings positively or feel acceptable to others. Try convincing these youths they belong.

The Louisiana Department of Education and dedicated administrators and teachers are doing that with programs that increase self-esteem in the student and develop positive attitudes and life-affirming skills to make it in the real world. One such program is FOCUS. The FOCUS program is replicated and recognized by the National Diffusion Network, a delivery system of model educational programs administered by the U.S. Department of Education Office of Educational Research and Development. FOCUS targets academic and social problems, and it is a school within a school, aimed at disaffected youth in grades 9-11 who can learn but, for various reasons, have been turned off.

Twenty-five at-risk students and two carefully selected FOCUS teachers participate in this program. Teacher selection is crucial. They must be student advocates and in tune to the special needs of at-risk students. Students attend their regular classes, two of which are taught by FOCUS teachers who provide individual attention to each student by using cooperative learning techniques and teaching study skills. Though the students receive special attention, they are not singled out as problem children.

In addition, students attend a class entitled "Peer Facilitation" which functions as a support group and teaches problem and conflict resolution skills in order to improve attitudes toward scholastic achievement. It is through Peer Facilitation that students learn how to survive in the world. Each FOCUS teacher facilitates these classes, which students refer to as "The Family" because they receive recognition and a sense of belonging through this course. As the lead facilitator, the teacher guides the students through confidential sharing as they learn about self-awareness and acceptance, personal relationships, family dynamics, communication, suicide prevention, responsible decision-making, refusal skills, substance abuse, and how to maintain a drug-free environment. Students realize their value as individuals in society through the dynamics of a support group.

The FOCUS program has produced positive results in Louisiana for more than five years. Between 1988 and 1991, the no-show and dropout rate in St. Tammany Parish, for example, fell from 24% to 4%.

Louisiana also has a nationally recognized Drug Free Schools and Communities Program to keep these areas drug free. Students in grades K-12 receive 8 hours of mandated substance abuse prevention education each year in different subject areas. Information on prevention, intervention, and postvention is provided. Drug-free zones are established within 1,000 feet of the school to maintain a clean environment, and penalties are harsh for possessing alcohol or drugs in the area.

Three types of support groups dealing with substance abuse are established in schools throughout Louisiana. Each has Student Assistance Teams, comprised of key school personnel, in full force to help students solve problems. Also, programs for positive parenting and parental involvement engender a positive response from the students to their parents' efforts to create a positive environment at home. Additionally, many community agencies create a powerful referral network for these students.

The Drug Free Schools and Communities Act of 1986 requires each state to provide education on substance abuse prevention, but Louisiana had Substance Abuse Prevention Education teams in schools throughout the state with teachers extensively trained to carry out classroom instruction on substance abuse prevention. They are adapt at making interventions and referring the student for proper care. Louisiana is the only state in the U.S. to give the Parents Resource Institute on Drug Education survey, an anonymous survey of alcohol and drug use, to every student in grades 7-12. The Louisiana Department of Education works hard to educate its teachers and students to provide a healthy, drug-free environment.

The State of Louisiana is committed to implementing effective programs for all students. The programs that focus on at-risk youth do so with a determination to guide them through high school and increase their chance of surviving in the real world.

F. Global Environmental Education: What The World Needs Now

Developing A Global Perspective Of The Marine Environment Through Educational Exchange Programs

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Over 70% of America's residents inhabit a narrow rim of territory on, or near, the nation's coastal fringes. Yet, few of this country's youth, who will be making tomorrow's critical environmental, social, and economic decisions, have been sufficiently challenged to gain a keener appreciation and understanding of the earth's predominant features -- it's oceans shorelines. An additional pressing concern is that even fewer have found the opportunity to immerse themselves in learning experiences which generate a global perspective of the co-dependency between man and the marine environment.

Therefore, the 4-H programs of four mid-coast Texas counties carefully considered the need for an effective delivery system which could provide marine-oriented discoveries of the natural history, heritage, and culture of differing coastal regions in a positively charged atmosphere of learning adventure.

As a result of this assessment, an educational exchange trip between four county 4-H programs from Washington's Olympic Peninsula and these Texas coastal counties was initiated and executed.

Thirty Northwesterners (25 youth, 5 adults) joined an equal number of Texans on Matagorda Island, which is a remote 38-mile long barrier island and part of the National Wildlife Refuge System, for a intensive wilderness and coastal ecology camp in mid-June 1991. In August 1991, 42 Texas 4-H members ventured to Port Townsend, Washington for a week-long investigation of the environment, enterprise, and culture of the Puget Sound area.

This focused learning program generated a greater appreciation and understanding of the ecology, industry, and people of two far-differing coastal regions while fulfilling the goals of both groups. Thus, the principle objective of developing a global perspective of the marine environment was advanced by this multi-disciplinary approach. Likewise, the groups from both states were enriched by this educational travel experience, measured by the following factors:

- Confidence -to venture out of the comforts of home, to meet, with enthusiasm, new people in unfamiliar surroundings; to take responsibility for the future; to learn;
- Ownership -derived from their work to design and fund the trip's activities; in the future of both states by sensing that, as the Indians taught, "all things have a life spirit which is to be revered;"
- Respect -for differing cultures and lifestyles of others; for the influence man's actions have on the environment and the fate of humanity; for the future;
- Tolerance -for the thoughts and actions of those with contrasting backgrounds and experiences; for nature's harsh realities and stringent demands which hold the planet in balance; to allow man and nature to exist in harmony;
- Teamwork -refinement of the skills to work, play, and learn together for the overall benefit of the group, society, and humanity as a whole;
- Leadership -the opportunity to guide the actions of others through example; the establishment of a knowledge-paved pathway for better social, economic, and environmental stewardship for our planet through mutual understanding; and

- Friendship -a bonding of souls transcending the breadth of a continent, capturing the spirit of kinship among the family of MAN, and the creation of a common vision of environmental and social balance between man and nature.

Just as this exchange adventure created an excitement to learn and a renewed commitment to sharing, it is hoped this presentation will generate enthusiasm in professional marine educators across the country to embrace exchange programs as an alluring means of equipping youth and youth educators to meet the future.

This pilot effort proved so successful, it encouraged its Sea Grant sponsors to consider developing a global marine education exchange network to promote and foster national and international travel opportunities (particularly with Mexico and Canada).

A suggested approach includes:

- Marketing this program through educational associations and the Sea Grant Programs to solicit the enrollment of prospective exchange partners,
- Developing and distributing to NETWORK members a directory of exchange opportunities listing and describing travel options and an exchange manual providing detailed guidance on functions necessary for a successful event (fundraising, risk and liability management, agenda planning, budget development), and
- Training select audiences on how to promote exchanges as an effective educational vehicle and, ultimately, to conduct successful exchange trips.

Until final plans are formulated, anyone desiring more information on the GLOBAL MARINE EDUCATION EXCHANGE NETWORK possibilities, or wishing to offer suggestions on the design and development of this proposed program, should contact: William R. Younger, Extension Marine Agent, 2200 7th Street - 4th Floor, Bay City, TX 77414, Phone (409) 245-4100, Fax (409) 245-5661.

Global Environmental Education: A Summer Opportunity For Middle School Teachers

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The Global Environmental Education Program is sponsored by the National Science Foundation in cooperation with the Gulf Coast Research Laboratory and the Sea Grant College programs of Mississippi-Alabama, Louisiana, Florida, Georgia, Maine-New Hampshire, and Oregon. Middle-school teachers in Alabama, Florida, Louisiana, and Mississippi may apply for full scholarships to a three-week, four semester-hour course on global environmental issues. Scholarships include full tuition, room and board, travel allotment, and a $300 per week stipend. This course was offered twice during the summer of 1992, and it will be offered twice during the summer of 1993 and once in June 1994. During the three-week, intensive course, participants acquire the knowledge, teaching techniques, resource materials, activities, and hands-on experiences needed to bridge the gap between their students and the latest scientific research on environmental questions of global magnitude. The course also includes sessions with nationally recognized scientists who are currently conducting global environmental research. The four major topics covered include climatic change (ozone depletion, acid rain, greenhouse gases, desertification/deforestation, and sea level rise), marine and estuarine pollution, overpopulation, and declines in biodiversity.

Participant selection is based in part on the commitment of the participating teachers to (with the school districts' support):

- develop at least one program for teacher-training or staff development in their school district,
- use Global Environmental Education support materials in the classroom and introduce the support materials to other classrooms through staff development efforts,
- submit an article to a national teacher's journal or present a paper or demonstration at a state, regional, or national teachers' conference on specific teaching techniques, concepts, or activities incorporated in classroom instruction, laboratory experiments, or field work that resulted from the workshop, and

- attending all three weeks of the Global Environmental Education Course.

The Global Environmental Education course is conducted at the Gulf Coast Research Laboratory's J. L. Scott Marine Education Center and Aquarium in Biloxi, Mississippi. The course is demanding, both intellectually and physically. Field work, including a one-half mile hike across a barrier island, occurs in the intense heat and humidity one finds in Mississippi. Other outdoor activities are interspersed among lectures. Participants also encounter homework, reading assignments, group projects, a dynamic teaching staff, motivational hands-on activities, and exciting interactive sessions with scientists.

The 26 participants in June and 29 in July 1992 earned the following grades: 47 A's, 6 B's, and 2 C's. The pre-test/post-test analyses reflected statistically significant increases in content knowledge for both workshops ($T=6.927$, $df=25$, $P<.05$; $T=8.35$, $df=28$, $P<.05$). Evaluation data collected at the conclusion of each course concerning the attitude of the participants toward the scientist-presenters indicate that, for the first course, 95% of the teachers believed the materials presented were valuable or very valuable. For the second course, at least 90% of the teachers rated the materials as either valuable or very valuable. These data may be interpreted as indicating the timeliness and importance of the selected global issues to these groups of teachers. A post-course survey was conducted in late fall for the participants to monitor their commitment to the criteria.

As of this symposium, 37 of the 55 1992 participants conducted workshops. The workshops were attended by 685 teachers who indicated a willingness to infuse the global, environmental materials in their respective classrooms. Further, the teachers are collectively responsible for classroom instruction of approximately 26,000 middle-school students. The data reflects the significant appropriation of the multiplier effect model of teacher inservice -- a small core of Gulf States teachers reaches out to a larger group of teachers, impacting thousands of students.

Additionally, the first year's courses resulted in the development of 440 instructional activities on the eight topics. These activities are presently being reviewed internally, with the goal of publishing a collection of the best for broad dissemination. Many of the first year participants continue to contact the Principal Investigator with needs for additional information, requests for networking assistance, and to relay new ideas discovered and/or tried in their classrooms. Such active participation following the period of formal project involvement is viewed as significant and a potential area for complementary course development and/or teaching the same course to elementary teachers.

Middle school teachers are currently being recruited from the four-state area to participate in the two 1993 summer courses. The final three-week course will be taught in the summer of 1994. Approximately 3,000 application packets have been distributed during the last two months; the completed applications are being processed for review by the Selection Committee.

A Global Model For Environmental Education

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Children's Alliance for Protection of the Environment (CAPE)
Austin, Texas

The Children's Alliance for Protection of the Environment (CAPE) is an international, non-profit organization initiated in 1988 to help children and youth see their place in the global ecosystem, appreciate the interdependence of the natural world and human societies, and realize their ability to conserve resources. Working with individual children, families, schools, public organizations, and governments in 49 states in the U.S. and 35 countries abroad, CAPE provides resources and information to help children create their own protected forests, animal habitats, recycling centers, and conservation and clean-up projects.

CAPE is environmental action, but CAPE also facilitates communication and cooperation, provides forums where future leaders can learn vital diplomatic skills, and promotes an ideal of global caring among children -- not just for the environment, but for people and children with different customs and concerns. CAPE is a unique, children's environmental organization. Its mission goes beyond environmental action to foster and teach important community values through local projects. Education, caring, and communication are integral parts of every CAPE effort.

The philosophy behind CAPE's mission is the belief that only when children and youth see themselves as members of a global family and accept responsibility for one another's welfare will the planet have hope for revival and survival. CAPE is based on the premise that the ultimate success of efforts to reverse the destruction of the environment and create sustainable communities for the future will depend upon society's ability to shape an environmentally conscious and responsible population of young people. CAPE's belief is that environmental education must be holistic, that is global in perspective and interdisciplinary.

Children learn best by doing. They develop a sense of what is possible by coming together, sharing their dreams and visions, and engaging in creative problem-solving with their peers. CAPE children and youths are encouraged to participate in innovative projects that benefit their neighborhoods and communities; around the world, they are cleaning coastlines, preserving rainforests and animal habitats, composting, recycling, and supporting their counterparts. Every quarter,

thousands of children look forward to sharing their ideas, dreams, and practical plans for improving our environment through *Many Hands*, the newspaper published by CAPE and sent free of charge to children in developing and industrialized nations.

The international office of CAPE is located in Austin, Texas, and it receives dozens of letters from children every day asking what they can do for the environment in their state or country. In response, CAPE publishes an action-packed environmental curriculum, suitable for use in classrooms, clubs, and youth organizations. The *Program Guide* was developed with input from children, educators, scientists, writers, volunteers, and environmental organizations. This comprehensive guide for teachers and youth leaders stresses hands-on experience and provides ideas and guidelines for many age-appropriate environmental action and communication projects. These action projects provide an excellent supplement to science, social studies, or language arts curricula already in place. Curricula and educational material for in-class use are provided along with special sections developed to familiarize students and teachers with current environmental issues, such as tropical rainforest destruction, ocean pollution, hazardous waste, endangered species, and global warming. CAPE is developing supplements on various environmental issues which will be sent to its charter members.

The CAPE Program Guide has received endorsements and commendations from the Gulf of Mexico Program, the United Nations Environmental Programme, Tufts University Environmental Programs, and the Office of Environmental Awareness of the Smithsonian Institution.

G. Society, Economics, And Environmental Education: People, Money And Power

Studing The Human Dimension Of Environmental Problems: Critical Missing Component To Environmental Education And Environmental Problem Solving

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A recent article in *Omni* magazine posed the question, "What would the world's environment be like if humans were to suddenly disappear?" The author described how he had asked a variety of scientists and scholars to respond to the question. He found some willing to speculate, especially ecologists who specialize in ecological restoration. One respondent provided a memorable image in which the person envisioned the national interstate highway system becoming "green highways" for species dispersal.

Rather than enthusiasm, however, the author of the article mostly encountered reluctance to consider the question. One scientist from Yale University responded, "It isn't interesting to consider the question."

The consensus of respondents was that it is more interesting to examine the human/environment (ecosystem) relationship. Given this conclusion, it is interesting to note that specialists who study the human/environment relationship with an emphasis on the human are found in all of the social sciences -- anthropology, geography, history, political science, psychology, and sociology. Biophysical scientists and others concerned with the environment are, however, only becoming aware of their existence. This lack of awareness is evidenced by the number of conferences in which there is only one, or very few, social scientists asked to participate. This was the case at a recent international marine debris conference. As far as the author knows, humans are the only species which "litters".

The Environmental Social Science Research Institute at the University of New Orleans, which the author directs, had a booth at this conference. Most people who walked by the exhibit paused as they read the title of the Institute and looked puzzled. When the Institute's work was explained to them, it was fun to observe their reaction as they considered the idea. They were told, "Humans cause most environmental problems, and humans are key to solving them. The Institute studies the relationship between humans, their groups and organizations, and the environment." Invariably, the visitors would respond, "This is important. We should be doing this. Good luck." Thus, social scientists are beginning to introduce their work to the environmental community.

The following questions are being used to guide some of the research being conducted at the Institute, and some of the findings may be useful to many people's work to improve the environment:

- Why is marine "littering" such a difficult habit to break?

- How do coastal residents and public officials respond to coastal erosion?
- Why did the TEDs (turtle excluder device) become so controversial?
- How do people respond to media reports of natural hazards?

The social and economic impact of off-shore oil and gas production is also being studied, and other projects include studying the way in which communities respond to technological and natural hazards.

As with other sciences, the various studies contribute to the support or rejection of beliefs about some phenomenon, in this case a component of human behavior. The understanding is refined with more and more studies. While social scientists do not discover rigid laws as do some other scientists, they do find norms -- patterns expected under similar conditions.

Some of the findings from this research which have received considerable confirmation and are useful for environmental education are as follows:

- if a person believes something is real, it is "real" because they act accordingly,
- once a person establishes a firm opinion about an issue, additional information is simply "processed" to support this opinion, rarely to change their opinion,
- people process information either heuristically -- that is finding easy ways to make decisions -- or systematically -- that is collecting a wide array of information and thinking things through carefully,
- different communication media facilitate one or the other style,
- for the public to become environmentally sophisticated, they must learn how to learn in order to process the needed information,
- people respond to problems in an "holistic" fashion,
- People come to one issue often with much "baggage" from previous problems. They become "captives" of these earlier conflicts and unresolved issues,
- "vested interests" shape people's interpretations, and are based on group memberships such as social class, occupation, race, gender, age,
- different groups have differential power to push their interests,
- people interpret the environment, then they deal with it,
- interpretation comes from the "world view" (paradigm) which the person holds,
- a person can hold conflicting views about different aspects of life, and
- a paradigm shift is occurring vis a vis the environment from a technological to an ecological emphasis.

Environmental social science has utility both for facilitating environmental education and assisting other means of solving problems such as learning more about how volunteer groups and governmental and corporate bureaucracies can function effectively to address environmental problems. It is important to be a part of this challenge -- learning about the human/environment relationship and how to improve the human impact on the environment.

The Complementary Nature Of Environmental And Economic Systems

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Job creation and economic development are frequently viewed as issues independent of, or contradictory to, environmental and resource conservation. In reality, economic systems function within a larger ecosystem context. Economic development will be forced to be consistent with the nature of a region's ecosystem over the long-term unless ecosystem services can be imported.

The direction, speed, and scale of development will ultimately be constrained by ecosystems. Rapid mining of ores in rainy, mountainous regions creates immediate jobs, but mine pollution will inhibit future replacement industries, such as silvaculture, recreation, or fishing. Industrial discharges in excess of the assimilative capacity of the ecosystem only inhibit the economic potential of a region as the ecosystem base is destroyed.

The traditional view is that enhancing environmental conditions is costly to economic development. In other words, environmental and economic risks are inversely related. However, this perspective denies a more plausible relation between ecosystems and economies. Rather, the loss of an ecosystem base, or increased environmental risk and reduced economic carrying capacity of the ecosystem, reduces the long-term economic welfare secured from the ecosystem. Hence, environmental and economic risks are complementary.

This study focuses on how environmental and economic risks complement each other over the long-term. The study uses one of many possible indicators of relative environmental

and economic risks, the ratio of toxic chemical emissions and jobs (E/J) to test whether relative risks are consistently related to traditional welfare measures, such as income and employment across the U.S.

Environmental risk is a vaguely measurable concept. Unfortunately, we cannot determine easily the end effects of environmental processes or exposures to risks. Without these relevant measures, risks can be measured by potentially risky activities, such as pollution discharge levels or destruction of ecosystems. In this study, the risk measure is primarily discharges of toxic chemicals. These are releases reported by the Toxic Release Inventory (TRI) data base, which measures releases of major dischargers. Relative environmental risk is measured as the ratio of these discharges to jobs created in the discharging sectors.

The U.S. national average of TRI emissions-to-manufacturing jobs ratios for manufacturing sectors (SIC 20-39) is shown in Figure 1. The nature of these production processes define, to a large extent, their inherent relative environmental risks. For example, the chemical industry has considerably higher E/J ratios than the apparel industry. The comparative economic advantages of different states results in different mixes of these industries thus, different relative environmental risks in the various states. This is clear from Figure 2, where emissions-to jobs ratios for all manufacturing within the fifty states are much higher for Louisiana, where high risk industries such as chemicals and petroleum dominate, than Vermont.

The study demonstrates that environmental risk and economic risk are complementary. Toxic discharge rates, hazardous waste rates, and energy usage rates, all measured on a per job basis, are significantly related to poor economic conditions. The higher the rates, the poorer the economic conditions. Broader indices of environmental quality also show significant direct relations between environmental and economic risks. Measures of the strength of state environmental policies also show that weaker policies are positively related to economic risks.

In general, as E/J is reduced, environmental and economic indicators improve and energy use decreases. The connection to sustainability appears evident but remains to be demonstrated. The E/J ratio may be useful for local or national short-term goals and incentives consistent with long-term global sustainability.

A state, region, or society can improve its general welfare by enacting policies which decreases E/J by recruiting an appropriate mix of industries to achieve a certain E/J objective. The focus is on improving energy and material efficiencies as cost cutting measures rather than job reducing labor productivity, organizing its environmental protection and economic inducement functions through a common E/J goal, and evaluating its progress in the development transition and, if necessary, taking corrective action.

Figure 1

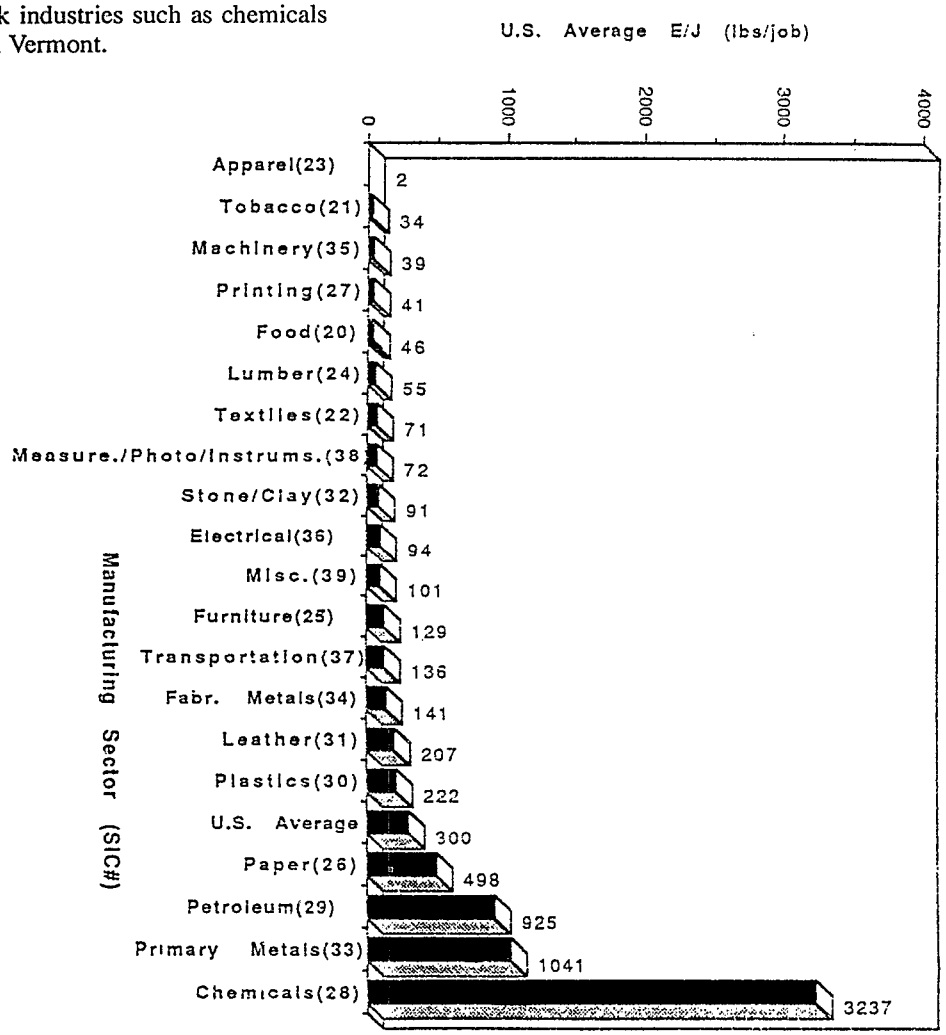

Figure 2

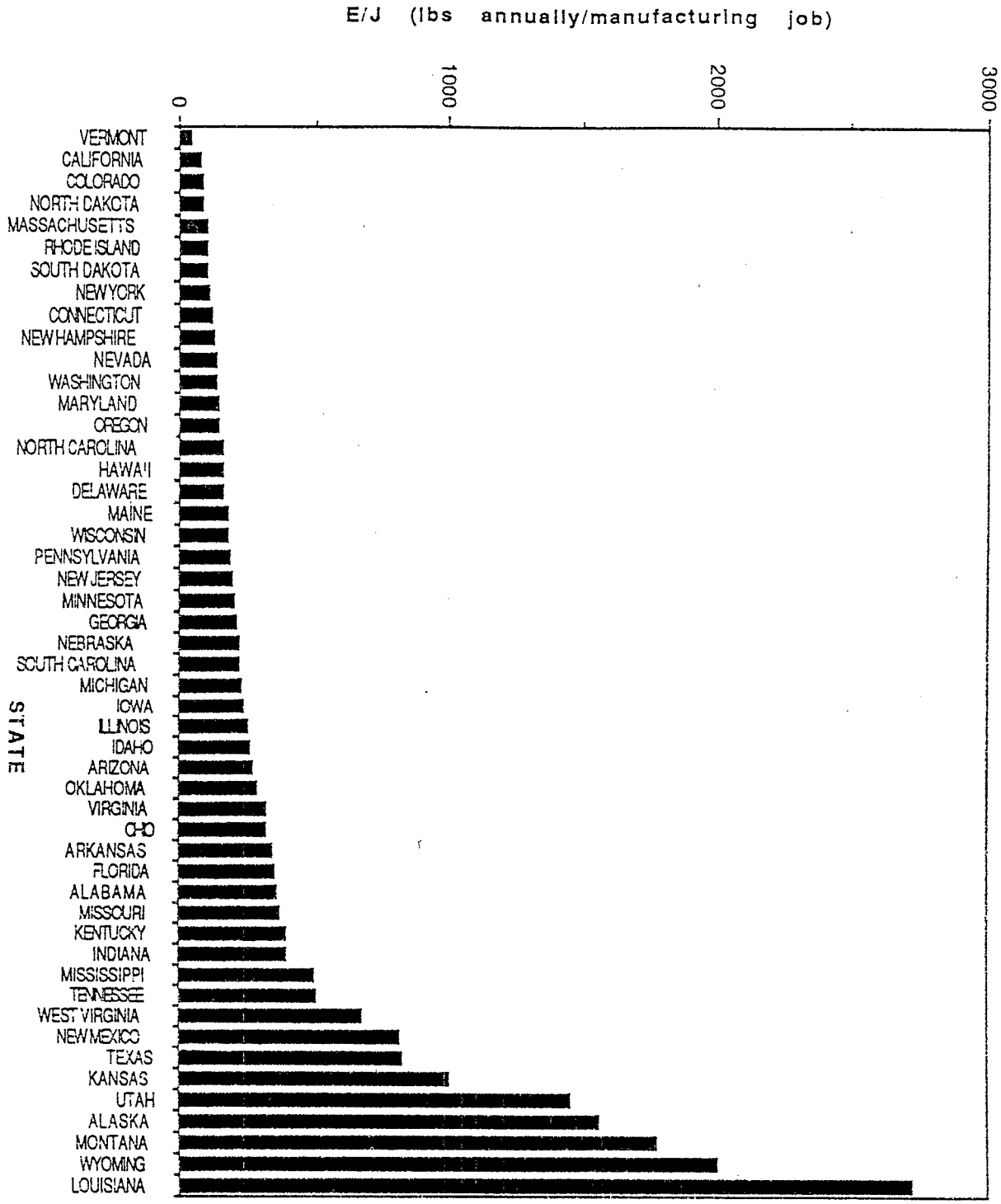

Figure 2; The Annual Emissions to Manufacturing Job Ratio by State

Project Ceed: Coastal Education For Economic Development

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Project CEED is a multidimensional educational effort taking place in coastal Louisiana focused on accomplishing its acronym, Coastal Education for Economic Development. Its concept is to motivate stewardship of the environment in citizens who understand that their livelihood is dependent on a healthy coastal ecosystem. In Louisiana, as in all coastal states, children who drop out of school are likely to seek employment in the coastal zone, usually in a fisheries related field. As a consequence, Project CEED is directed toward that group that is most likely to drop out of school -- middle school at-risk students.

Project CEED is a collaborative effort of the Society for Environmental Education (operator of the Louisiana Nature & Science Center) the University of New Orleans Department of Special Education and Habilitative Services. Project CEED's educational approach combines the talents and expertise of hands-on environmental educators (who know what to teach) and special educators (who know **how** to teach atypical learners).

A wide variety of materials has been developed to accomplish the objectives of Project CEED. Many local teachers participated as members of the writing team. Business involvement guarantees that the economic perspective is maintained (the first program in this area of Project CEED is under development).

Project activities are teacher friendly; they don't require massive preparation time for use, and the teacher does not have to be science-oriented. The activities are designed for use in several different disciplines, such as English, math, art, and history. Teaching elements include concept mapping, decision making, asking provocative questions, Bloom's taxonomy, Taylor's Multiple Talent Model, poetry (syntu, cinquains), scamper, synectics, and more. A video tape (Wetlands Blues) with accompanying teacher's guide and a MacIntosh computer game that models a wetland are available. Several independent teacher's guides have been developed, each of which focuses on a wetlands related topic (beaches, wetlands values, etc.) and a specific student-generated product (designing a bumper sticker or t-shirts, etc.).

Project CEED is a continuing program, with many new phases being considered. For information about acquiring the program products, write: Society for Environmental Education, P.O. Box 870610, New Orleans, LA 70187-0610.

Horror Stories Sell More Than Newspapers: Weaving Tales Of Social And Economic Issues As A Teaching Method

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A calamity, or near calamity, holds appeal to the public. Children at play, ministers in the pulpit, parents instructing children -- all use horror stories to emphasize a point. Weaving stories into presentations can increase audience involvement. Building a repertoire of stories is not simple unless one knows where and how to look for and when to use them.

Know Your Audience

Some stories are appropriate for adults but not children, and vice versa. Children have an affinity for "gross" topics which adults may view as crude. But, both groups want to know more about some topics, such as syringes and grass cuttings washed from street drains onto bay beaches because that indicates an environmental health risk around which they can rally.

Use Humor Effectively

Humor should never be abusive, pointless, or offensive. For instance, the punch line of the following story, illustrating the need for everyone in a city to understand shoreline processes, is not appropriate for all groups.

Sunfish Island, a migratory spoil island in the Corpus Christi Yacht Basin, is frequently suggested as a site for a statue of Christ, in honor of the City's name. However, because the island erodes rapidly, within a short time, the statue will be "walking on water."

Personalize Your Stories

When introducing your story, use phrases like, "When I was doing research for EPA," "Recently, at the beach, I saw," "When I was a child," "My colleague said," "Last week, I read."

Recent news stories have identified clusters of infants born with neurological birth defects in three isolated regions of Texas - the Rio Grande Delta, the Beaumont Coastal Prairie, and the Lampasas Cut-Plain.

The problem is real. The author knows due to her own niece giving birth to such a child last year. Does anyone have an explanation or solution? It must be found.

Involve The Audience

When discussing the impact of herbicides and pesticides, ask if anyone in the audience has a family member or close friend who was affected by Agent Orange. Chances are someone will. Let them describe the situation. Their personal tragedy will engender sympathy. Then, explain the implications of spraying an entire nation and its water supply. Bring the problem home by addressing the impact of continued use of similar chemicals on local water bodies and supplies. They won't soon forget.

Investigate Leads

Don't take someone else's word for it -- check it out! Then it becomes one's own story. Read; read; read! Write to authors. Go to seminars. Keep a file. Take photographs. Walk around, but never trespass. Sit and contemplate.

Talk to laborers who work daily with a problem, but, first, identify oneself so they feel they can talk freely. Never endanger a source's job by divulging names.

Keep A Journal

During spare time, make dated observational notes about subjects, such as the presence of litter, quips, news bits, sky color, beach width, or quotes, such as the following from Raymond Carver, "I think a little menace is fine to have in a story. For one thing, it's good for the circulation."

Know Local Regulations

Each locale has different land use regulations and methods of enforcement. For instance, in Aransas County, Texas, few regulations control sewage disposal on private property, unless there is a demonstrable impact on public surface or ground water. A case in point is a house on stilts with sewage lines ending before they reach the ground. Fifty feet from the house was recognizable commode waste, interlaced by tracks made by a child's toy car. No regulations prohibited this menace. If you know the regulations, you can affect change through education.

Illustrate A Point

A few years ago, during a class discussion, one student requested that the group investigate his uncle's problem. The main sewage trunk line in his uncle's hilly neighborhood ran up- and down-slope to the wastewater plant. The line often clogged.

The city cut a manhole in the line to unclog it, but a geyser erupted from the hole during heavy rains. The city was called immediately, but nothing was done. A cone of human waste built up, Uncle's horses and sheep contracted diseases, and his wife was persistently ill. Antibiotics could not provide relief. Then, the city dug a 200-foot long ditch from the manhole to the river for the raw sewage overflow.

This continued for more than a year when the author's class investigated and wrote a friend in the city government. A four-foot high concrete chimney was built over the manhole to absorb the water pressure. However, during heavy rains, the geyser returns and the mound grows.

After six years of perpetual health problems, exacerbated by bureaucratic stalemate and threats of losing his retirement benefits if he files a lawsuit, Uncle is trying to sell his restful retreat with the beautiful view, numerous songbirds, and backyard fishing in the river.

Tell The Truth

Your audience will quote you, which is the ultimate compliment.

H. Curriculum Development: You Can Get There From Here

USS My School

Linda Maraniss
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The Center for Marine Conservation (CMC) has been working on a special project funded by the United States Navy to educate students about marine debris. Phase One involved pairing Navy personnel with local school children during annual beach cleanups held around the U.S. each September. Phase Two involved creating a marine debris curriculum to teach children about the way the Navy is working to comply with legislation that bans dumping plastic and other trash into the sea.

During the September 1991 International Beach Cleanups, Navy personnel in Virginia and Texas worked with students from local schools cleaning beaches and collecting data on the trash found.

The Marine Debris Education and Outreach Program began in the summer of 1991. The result was a 14 lesson, three week curriculum known as USS MY SCHOOL, designed for upper level elementary school children. It was first tested in October 1991 in Austin, Texas and taught in October 1992 in Hampton, Virginia. It will be ready for national distribution in January 1993, and in April 1993, CMC will teach it in Florida. During the summer of 1992, teacher workshops to explain the project were conducted in Corpus Christi and South Padre Island, Texas.

The multi-disciplinary curriculum teaches students about the marine debris problem, its impact on the health of the oceans and marine wildlife, and about legislation making it illegal to dump plastic trash at sea. During the three week unit, students are involved with lessons in language arts, math, marine science, geography, reading, and public speaking. A letter from the Navy discussing the difficulties of holding trash on a ship with thousands of crew members is included in the curriculum. Maps showing the locations of Navy bases and countries party to the MARPOL Treaty are also included.

Students learn about marine debris from a slide program and video produced by CMC. A video produced by the Navy gives the students a first hand look at how it complies with no-dumping rules.

The USS MY SCHOOL curriculum has students working, just as the Navy does, to educate the "crew" about new shipboard waste handling procedures. Plastic trash from the cafeteria is now kept in storage for three days. The students learn about three different pieces of equipment being developed by the Navy to compact, grind, and process trash. During this unit, students become problem solvers, and they know they are working to solve a real life environmental problem. How will vessels handle trash at sea?

Students learn that the Navy is recycling. Plastic from Navy ships has been made into plastic lumber for benches and floating piers. During this project, the class also creates a display of household items, substituting plastic with non-plastic. The students learn that the Navy is reducing the amount of plastic taken on board ships. No more plastic dry cleaning bags, foam coffee cups, individual ketchup packets, or plastic coffee stir sticks.

The students become experts on the marine debris topic. After educating the "crew" about no dumping laws, they begin to store cafeteria trash. Soon, they learn just how hard it is to store trash for several days. These new procedures provide students with real life situations and a chance to learn how the Navy is solving its complex problems of managing shipboard solid waste. In a very hands-on way, the students learn that trash takes up space, starts to smell, and piles up quickly.

Also, the students produce brochures, posters, plays, and speeches to educate the crew about marine debris and ship board waste management. Another follow up exercise requires students to inventory the supplies used in their school's cafeteria to see how much plastic is thrown away daily and determine what changes they would make in purchasing supplies.

Several newspaper stories have been written about the project in Texas, and students in Virginia were treated to a tour of a Navy ship as part of the project. Navy personnel in both states have visited classrooms to teach students about marine debris and the Navy's research and development plans.

Students participating in this project feel special because they work together on teams, visit and interview the school cafeteria staff, teach other classes about the project, and complete a USS MY SCHOOL notebook, full of new information, from graphs and vocabulary lists to MARPOL stickers and maps. Lessons also include several enrichment activities to help with vocabulary development.

Environmental Curriculum: An Overview Of Classroom Development And Evaluation Of Existing Materials

Bonnie Holub
Panacea, Florida

This paper explains how evaluation and curriculum development go hand-in hand, or why evaluation is the first step in the curriculum development process.

When thinking of curriculum development, ask four main questions:

- What does one want to teach?
- Who will one teach?
- How will one teach?
- Did the students learn?

In education jargon, the answers to these questions translate into:

- educational objectives,
- target audience,
- methods, and
- evaluation.

Evaluation is usually considered as the last of the four steps. Evaluation has its place at the end of the process, but it also has a very important place in the beginning of the process.

In order to have a successful curriculum development model, one must start and end with evaluation. Take, for instance, the first question, "What does one want to teach?" By asking this question, the evaluation process has already begun, because what is really being asked is "What is it that one wants students to learn."

Curriculum development begins by developing evaluation questions first. Identify what students are expected to learn, and build the curriculum around these objectives.

For instance, if students will be taught about wetlands, one must identify what it is about wetlands the students should know.

In this example, the students should learn the characteristics of a wetland, the types of wetlands found in their state, why over 50% of the country's original wetlands have been lost, and most importantly, what actions students can take to prevent the future destruction of wetlands.

These four educational objectives translate into the following final evaluation items:

- List the main characteristics of a wetland,
- Name the types of wetlands found in Florida,
- Discuss the two main reasons why we have lost over 50% of our original wetlands in Florida, and
- Discuss three actions one can take prevent the destruction of wetlands.

Once the evaluation items have been defined, one should be ready to develop creative and varied ways to teach these things. Other background information can be taught along the way, but the focus should be directed to ensuring that the students know the main points when the lesson is over. Choose materials that are appropriate for the students' age group, level of previous knowledge, and consider the amount of time and other resources available to devote to this unit or topic.

After the unit has been taught, test the students to see the teaching success one has had using the evaluation questions developed before the lessons.

Curriculum development starts with evaluation, is built around evaluation, and ends with evaluation. That is how evaluation and curriculum development go hand-in-hand.

References

Marine Ecology, a middle school text, developed for the Wakulla County School Board

Project Estuary, a week long unit on estuarine ecology for middle and high school students, developed for the Apalachicola National Estuarine Research Reserve

Saving Wetlands: A Citizens' Guide for Action in Florida, developed for the National Audubon Society**A Citizens' Guide for Saving Wetlands in Mississippi**, developed for the Mississippi Bureau of Marine Resources and the National Audubon Society

Developing Regionally-Based Environmental Science Activities

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The rationale for using regionally-based examples in science instruction to illustrate universal environmental concepts can be attributed, in part, to the idea of meaningful learning. Learning theorists generally concur that it is easier for an individual to learn something new when it is linked to something with which they are already familiar. Secondly, they state that it is easier to capture one's attention in a new topic of study when that topic is personally meaningful to the learner.

Some critics of how science is presently taught in America feel that science instruction is not relevant to the majority of students. They feel that teachers are merely preparing students to take the next science course, not preparing the majority of students to be scientifically literate. They state that few graduates understand the interrelationships of science and technology in a social context; fewer still have the scientific knowledge or process skills to judge knowledge claims and make responsible decisions about public issues. These critics feel that the confluence of the science-technology-society theme can be an effective organizer for science education. They believe that the success of the individual, and, ultimately, society, is tied to their decisions on issues related to the social uses of science and technology.

Whichever rationale you prefer, it remains that students are usually more interested when teachers present instruction using familiar topics. Louisiana students may be more likely to remember an earth science discussion of erosion if examples deal with wetland loss rather than glaciers. They may be more likely to recall discussions of endangered species if examples of the brown pelican or the Louisiana black bear are used, rather than jaguars or snail darters. This is not to suggest that the usual textbook examples are not important or that local phenomena should be studied in isolation from worldwide issues. It does suggest, however, that a strong rationale exists for using the local examples to illustrate universal problems to students. In fact, educational researchers have found that the use of real world examples and situations can be more readily understood if the impact of those examples and situations can be internalized through regional, or personal, experience.

This is especially true for students in states bordering the Gulf of Mexico. Many of those states' economies are strongly tied to the environmental health and well being of the Gulf. Effective management and conservation of coastal wildlife and natural resources demands local emphasis in science education. If the Gulf States are to manage, use, and conserve our rich coastal resources wisely, our educational systems must produce citizens who understand certain concepts -- that coastal wetlands are fragile, that a healthy functioning whole depends on complex relationships among many natural processes and species and that careless exploitation and lack of balanced management will lead to a severe reduction in coastal resources, the finfish, shellfish, and wildlife on which many livelihoods depend.

To address these issues and to provide teachers with supplemental enrichment materials, several modules of science activities and video programs were developed at the LSU Sea Grant College Program. Exemplary science teachers, together with university scientists, developed a series of regionally-based environmental science materials that use current research, local biological phenomena, and social situations to teach environmental concepts. The program is entitled *Wild Louisiana* and is presented in such a way as to address the different learning styles of students. Hands-on activities, games, simulations, and role playing are designed to meet the needs of higher level students, while interactive video lessons help other students. Also included is background information that brings teachers up to date on current research and other related information. The program is linked to the learning objectives that are in the state-adopted curriculum, as well as to exit exam requirements necessary for students to graduate.

The program was evaluated in over 60 schools statewide and was shown to be effective in comparison to a lecture method of instruction. One other finding of interest in this study was that the highest level of students performed poorest in the lecture method of instruction compared to all other groups. This suggests that the instructional method used by the majority of teachers may be failing to meet the needs of our best students.

Wild Louisiana has been adopted by the Louisiana Department of Wildlife and Fisheries as part of its aquatic education program and instruction in this course is presently being given to Louisiana science teachers in a three hour workshop. Three modules presently exist with the completion of two more due this spring.

A second group of activities has also been developed for middle school science students. These activities are based on a wetlands poster published by the National Audubon Society and features both a typical freshwater swamp and a salt marsh. These activities provide teachers with background information about general marsh ecology and discuss the important functions that wetlands provide. The poster serves as a backdrop to teach food chains, food webs, and energy flow.

III. Citizens' Action And Community Involvement Forum

A. Shore And Coastal Erosion: Proactive Measures To Prevent Beach And Shoreline Erosion

Dunes Day In Brazoria County

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The science involved in dune construction and stabilization is basic. Whatever moves water moves sand. This could be wind, current, or tide. On the beach, sand is moved by wind, little people with spoons and pails, and big people with shovels and heavy equipment.

In the midst of this obedience to the laws of physics, the beach seems to breathe in and out like a living organism, eroding and accreting with the season, severely accelerated by storms. The trick is to make the sand stop in place, pile up, and stay put.

Here, science is less functional than art and magic -- the art of politics and the magic of salesmanship.

Philosophy precedes politics. Why have sand dunes? Because, they are possible. Because, they exist in their own right.

Aesthetically, they are beauty in the eye of the beholder and relief from the monotony of flatness. Functionally, they are life giving to a complex array of plants and animals. They are the land's first line of defense in the eternal struggle between sea and shore. They have a right to be here.

The citizens of Brazoria County have walked on flattened beaches and looked landward for surviving vegetation following destructive storms.

In 1978, the concept of rebuilding destroyed dunes was demonstrated by the Texas Agricultural Extension Service and the Soil Conservation Service, Waters Davis District. This demonstration consisted of placing ten yards of discarded Christmas trees in a row on the beach and tying them down with stakes. It was a prophecy of possibility.

Additionally, the Corps of Engineers has a history of erosion control projects, from stacking old car bodies on the beach to building sand fences for beach grass propagation. These projects are very interesting, and the Corps of Engineers is a good resource for information.

Enter politics. In Texas, according to State law, beaches belong to the citizens, up to the vegetation line, and access to the beaches shall not be denied. This is known as the "Open Beaches Act," which is administered by the Texas General Land Office and enforced by the Texas Attorney General.

The ten yard demonstration dune was easily forgiven, but how to get permission to work on nineteen miles of beach crossing several jurisdictions? For instance, the Texas Parks and Wildlife Department administers a state recreation area with frontage on the Gulf of Mexico.

The local county judge and commissioner's court are the key to gaining permission in each jurisdiction. The local County Commissioner and County Judge should be informed and updated throughout the planning process. Because their support will open agency doors, it is important to include each official with jurisdiction in the decision making process.

Enter salesmanship. The Pearland Action 4-H Club's Sea & Shore Project Group collected and installed the Christmas trees in the first demonstration dune. The media was interested in a story about boys and girls performing community service projects. The recycling cause was not yet popular, but saving landfill space appealed to city administrators. It was a winning proposition.

Each year, the Dunes Day event grew under the leadership of the Save Our Beach Association and volunteers like Dow Chemical-Texas Operation's "Beach Buddies", scout organizations, church groups, and people who just turned out.

Four major storms have taken away the dunes they built. Each time the people built them back, but subsidence has cut away sections that once supported dunes, exposing old trees laid down in the early 80's. Those old trees are stark memorials that the sand could be held in place for awhile, but all things change.

In 1993, Dunes Day volunteers will begin construction a little further back from the shore and in fewer areas. The dunes of '79 and '80 are gone, but the sand is not. Neither are people who love the beach and are willing to make the most of it.

Measures For Stabilizing Coastal Dunes In Alabama And Georgia

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Introduction

Dunes are reservoirs of sand formed by waves and wind that help keep a seashore intact. They provide a flexible barrier to the movement of high tides and waves in low lying areas behind a beach, reducing erosion.

Vegetation on the coastal dunes in Alabama and Georgia is inadequate to prevent rapid erosion. Where this condition occurs, the dunes are extremely vulnerable to the forces of wind and water and are causing them to disappear. They can be stabilized with vegetative and structural measures, including grasses and woody plants adapted to a coastal environment. Structures such as cross-walks and sand-fences also catch and hold sand.

A project demonstrating that sand dunes can be protected from erosion caused by both people and natural forces was implemented by local, State, and Federal agencies and a private developer in Gulf Shores, Alabama. The information obtained from the evaluation of plant materials adapted for coastal dune stabilization and the structural measures, such as cross walks and sand fencing, helped to plan larger projects on Tybee and St. Simons islands in Georgia.

Study Areas

Gulf Shores, Alabama

This project was undertaken with the cooperation of Gene Brett, developer of the Phoenix Condominiums where this project took place. In addition to participating in the project, Mr. Brett agreed to share in its cost. Technical assistance was provided by Soil Conservation Service plant materials specialists and the district conservationist. Also, the Baldwin County Soil and Water Conservation District cosponsored the project with the Coastal Area Program Office and arranged for Boy Scouts to do the planting.

The Soil Conservation Service Plant Materials Centers in Georgia and Florida provided most of the plant materials for the dune stabilization project. The SCS plant materials centers were involved in active projects to collect, assemble, and test plant materials for dune stabilization.

As a first step, SCS personnel prepared a dune stabilization plan that included plant materials, cross walks, sand fences, and an irrigation system for the 450 feet of beachfront.

Tybee Island, Georgia

The information obtained from the Gulf Shores, Alabama project was used to establish a larger project at Tybee Island, Georgia. In 1989, a beach renourishment project covering more than two miles entailed the establishment of cross walks, sand fencing, a temporary irrigation system, and adapted vegetation. The plant materials selected were sea oats, bitter panicum, and marshhay cordgrass. Cross walks were constructed at strategic points to provide pedestrian access to the beach, thereby protecting the dunes and vegetation.

SCS provided six kinds of plants from those developed in its Plant Materials Program that underwent extensive testing at SCS plant materials centers in Americus, Georgia and Brooksville, Florida. This project provided the opportunity to evaluate the plants under natural and, often, inhospitable field conditions.

Discussion And Results

Gulf Shore Alabama

On February 1987, Boy Scouts from Gulf Shores Troup 49 planted 9,000 plants. The plant materials consisted of 3,000 bitter panicum, 3,000 marshhay cordgrass plants provided by SCS, and 3,000 sea oat plants bought by the developer of the Phoenix Condominiums. They spaced the plants 18 inches apart in 18 inch rows and placed one ounce of slow-release fertilizer in each hole before planting. For the scouts, the project was an educational exercise in conservation and a chance to learn about the role that dunes play in coastal ecology.

The dunes are beginning to grow as the plants are established and trap blowing sand. The sand fences also catch blowing sand and allow the dunes to form. During the first year, the plants were irrigated twice daily and fertilized three times a year with 100 pounds of 13-13-13. The water added by irrigation and the new plant materials have encouraged the growth of native beach plants.

Conclusion

The dune stabilization system used in the Phoenix Condominiums project can be used to enhance dunes all along the Atlantic and Gulf coasts. The plants and technology are readily available, making it possible for individual homeowners to undertake their own dune preservation efforts. Essential to the success of any such effort is selecting the right location and plants and, then, irrigating and protecting the plants until they are established. An irrigation system is required on all dune plantings to provide adequate moisture during the initial establishment period. Well established dunes will not remain that way without following a reasonable maintenance program. Major considerations include maintaining the dune line and vegetation and controlling pedestrian and vehicular traffic.

Note:

The Americus, Georgia and the Brooksville, Florida Plant Materials Centers have released the following new plant materials varieties for dune stabilization:

'Flageo' Marshhay cordgrass (Spartina patens) 'Northpa' Bitter panicum (Panicum amarum) 'Southpa' Bitter panicum (Panicum amarum) 'Atlantic' Coastal panicgrass (Panicum amarum var. amarulum).

B. Restoration And Construction Of Coastal Wetlands

The Christmas Tree Marsh Restoration Project -- Jefferson Parish, Louisiana

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Metairie, Louisiana

The idea was born in Holland. The tiny Dutch nation, in its constant battle with the sea, builds land by trapping sediment in brush fences. During a visit to Holland, Dr. John Day, of Louisiana State University's Center for Wetlands Resources, wondered whether the Dutch technique would work in Louisiana.

In 1987, using a native plant, roseau cane, and approximately 2,000 Christmas trees, the Center demonstrated this technique on a site in the LaBranche Wetlands, a badly damaged area in St. Charles parish. Measurements showed that some land accretion occurred due to this experiment.

In 1989, the citizens of Louisiana voted to create a Wetlands Trust Fund to restore wetlands by approving an amendment to the Louisiana State Constitution. Suddenly, money was available for the long-overdue battle against the loss of Louisiana's coastal wetlands. In 1990-91, grants of $10,000 were offered to coastal zone parishes wishing to conduct sediment-trapping projects. The Coalition to Restore Coastal Louisiana offered to help by providing training on all aspects of the program. The Coalition further offered to recruit a Volunteer Coordinator in each parish.

The project in Jefferson Parish was, by far, the most ambitious. This is appropriate because Jefferson Parish is the second most populous parish, and it is part of the Barataria Basin, which is the fastest-eroding part of Louisiana's coast.

Site selection

Christmas tree projects are still experimental in a real sense. It is believed that suitable areas are shallow and have low-energy water movement. The site selected in this case has four intersecting bayous and receives current from the Mississippi River via the Intracoastal Canal. There is oil production and commercial fishing in the area, and most available sediment is resuspended sediment from boat wakes.

Project design

"Cribs" were built by driving 2"x 4"x 8' posts into the soft mud. Cribs were modular -- nearly all were 72'x4' and used 29 posts. A gap was left in each fence to provide access for fishing. It was discovered that posts could be emplaced simply by leaning on them, and that they could not be removed, even by a strong man.

The project was designed and sites selected by a parish Wetland Specialist. Volunteers are involved in most other aspects of the program, so it is a public-private partnership in every sense.

Labor

Jefferson's project uses volunteer labor almost entirely. Citizens are recruited by a Volunteer Coordinating Committee (VCC) composed of members of five organizations, La. Wildlife Federation, League of Women Voters, Sierra Club, Women for a Better La., and Young Leadership Council. Volunteers build the cribs, tie the Christmas trees into bundles, provide many small boats to transport trees to the project site, place the trees in the cribs, and tie them to the posts.

Publicity and public education

The VCC designs and prints a flyer and insert for the Parish water bills. It creates and distributes a Public Service Announcement, presents a slide show at various meetings, has members who frequently appear on radio and television talk shows, places exhibits at fairs, and distributes articles for newsletters. In 1992, a donation made it possible to put notices in the local newspapers.

Recruitment of volunteers

This is done by the VCC. Letters are sent to companies, government agencies, and other groups likely to be interested in participating. The VCC follows up the letters with telephone calls. Volunteers must be at least twelve years old to tie trees together and sixteen or older to work on the water.

Training, directing, and deploying volunteers

Planning is done by the VCC and Parish personnel. Because of the large number of volunteers, actual workday direction and deployment is largely a VCC activity. Radios are used to direct work on the boats from shore.

Safety and comfort of volunteer workers

Providing portable toilets and cordoning off work stations from areas where vehicles will be moving is largely done by Parish personnel. The VCC plans for a place to wash hands or get a drink of water and arranges to provide lunch each day by soliciting donations of food or money to buy food.

Volunteer workers must wear long pants, long sleeves, gloves, and leather shoes, and life jackets when on the water. The VCC also provides a first aid station. It is important to plan for volunteer safety and, to avoid potential liability, to be seen doing so.

Appreciation of volunteers

The VCC recognizes that volunteers cannot be appreciated

too much. Letters of thanks are sent to each individual volunteer, and certificates are sent to each organization. Also, the Parish president has a ceremony of appreciation for the VCC members.

What the Jefferson Christmas Tree Project has accomplished so far:

The first year (1991) of the project, 300 volunteers built 11,170 linear feet of cribs and tied and emplaced 24,000 trees, working an estimated 3,800 hours. In 1992, 700 volunteers tied and emplaced 60,000 trees. It is estimated that VCC spent 219 hours on administration, training, and public relations for the project, but that may be too low.

Using Christmas trees in these projects is perfect. People who did not feel good about destroying a tree for holiday decoration have a way to assure a continued beneficial use. The public loves the connection with Christmas gift giving - they can give their tree, making it is easy to get publicity tying into this theme. Also, a large and highly suitable mass of material becomes available at one time, and the trees do not go into increasingly precious landfill space.

Evaluating The Created And Restored Intertidal Wetlands At The Chevron Refinery, Pascagoula, Mississippi

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Coastal salt marshes are among the most productive natural ecosystems known. Besides their ability to convert large amounts of carbon dioxide into living tissue, they typically perform a number of other ecological functions - - some of which man values highly. Salt marshes along the northern Gulf of Mexico, for example, buffer adjacent uplands from storm damage, provide habitat for a variety of migratory water birds, furbearers, and reptiles, and they serve as nurseries and feeding grounds for finfish and shellfish harvested in nearshore waters. In fact, the importance and abundance of the estuarine wetlands which reach from Alabama to northern Texas, and their associated fisheries, led one scientist to label that region the Fertile Fisheries Crescent. Within that crescent, near Pascagoula, Mississippi, Chevron operates a major oil refinery.

The availability of the world's known crude oil reserves raised serious concerns about America's energy security through the 1970's. In a move to help stabilize energy production, Chevron began a project in 1980 to modify Pascagoula Refinery to allow it to operate efficiently on virtually any grade of crude oil which might become available anywhere in the world. Project design constraints, however, required that some nontidal and small, isolated wetlands within the existing refinery be filled, which was done in compliance with state and federal permit conditions. A number of measures were taken to mitigate adverse effects on wetlands. Project plans were changed to avoid some areas while impacts to others were minimized by relocating and redesigning equipment. Any remaining, unavoidable impacts would be offset by the construction of replacement habitat.

Working with state and federal resource agencies, Chevron devised a plan to construct a 25-acre intertidal marsh adjacent to nearby Bang's Lake estuary. The new marsh was excavated from a planted pine forest to a range of grades and elevations comparable to those found on the natural marsh. A simulated creek was constructed through the center of the site to ensure that tidal circulation would be adequate to sustain the vegetation and improve access to fish, invertebrates and plant propagules. Smooth cordgrass and black rush, the dominant species of the estuary, were then collected from wild stock in the estuary and replanted at the new site on three-foot centers.

Survey data was collected from transects on the natural marsh to determine the elevation zones preferred by each species. Plantings were then made at three-foot intervals with the cordgrass occupying lower elevations and the black rush in the higher intertidal zone. To encourage colonization of the site by species best adapted to site conditions, no effort was made to remove incidental growth from transplant plugs. A small amount of common 8-8-8 fertilizer, averaging one teaspoon/set, was incorporated during planting to accelerate establishment and coverage.

To further enhance the value of the site to wildlife, the spoils excavated from the marsh site were stacked and graded to form a dune. Dolomitic lime was added at four tons/acre to counteract acids formed by oxidation of sulfides and other materials and displace sodium from seawater which had saturated the spoils during excavation. Grasses were then planted to stabilize the soils against erosion. Native live oak and slash pine from a local nursery were planted along the seaward slope of the berm to provide a habitat type occurring only at a scattering of other locations around the estuary. When this site matures, the effect will mimic the maritime forest or coastal hammock habitat which has long been under development pressure along most of the coast.

Work at the site was completed in November, 1985; by the following May, the planted grasses had begun to spread and a number of volunteer species were observed, including salt grass, three pickleweeds or salt worts, *Spartina spartinae*, and additional smooth cordgrass. By the end of the first growing season, the site was being used or inhabited by a variety of vertebrates (fish, birds, mammals, reptiles) and invertebrates (blue crabs, fiddler crabs, periwinkles, ribbed mussels, etc.) despite the incomplete plant cover.

During the second growing season, the vegetation growth

accelerated significantly; by the third year, the black rush zone was completely covered by rush and salt grass. The cordgrass zone was well-established, except in localized patches where the plantings had failed. A salt panne, or upper high marsh, had also developed between the black rush/salt grass and the upland hammock by the end of the third year, colonized largely by the pickleweeds, *Spartina spartinae*, algal mats, and interstitial diatoms. The hammock area continued to mature with invasion of an increasing variety of early-successional species, such as morning glory, groundsel tree, pine seedlings, and *Iva imbricata*.

Further study of the site was initiated recently to compare it quantitatively with the nearby natural marsh. The study, which is being conducted by the Mississippi State University Coastal Research & Extension Center, will evaluate sedimentation, vegetation structure, macroinvertebrate assemblages, and use of the site by birds, mammals, finfish, and shellfish. This study will continue for three years under funding from the U.S. Army Corps of Engineers.

What once had been a few isolated pockets of mostly inadvertently-created wetlands within a heavy-industrial environment has successfully been replaced by a new sanctuary for fish and wildlife. Common visitors and inhabitants range from fish, shrimp, crabs, and mussels to a variety of birds and reptiles to raccoons, deer, and other mammals. As the project continues to mature -- especially the oak/pine upland -- its utility and attractiveness to wildlife will likely continue to grow as well.

Cooperative Habitat Creation Efforts In Galveston Bay, Texas

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The Galveston Bay system is not unlike many of our nation's coastal bays and estuaries in that wetland habitat has been declining over recent decades as human uses of the Bay's resources have taken their toll. Over 25,000 acres of wetlands were lost around Galveston Bay between 1956 and 1979 alone. Erosion, subsidence, coastal development, and dredging are some of the physical forces that have played a role in changing the face of the Bay system. Furthermore, Galveston Bay is home to 4,000,000 people and the nation's largest petrochemical complex, all contributing municipal and industrial wastes and non-point source pollution.

Also, like much of the nation, the socioeconomic and political history of Galveston Bay centered around use of the region's natural resources -- timber, oyster shell, fisheries, and oil and gas. Recently, however, there has been a growing awareness of the need to restore balance. The Galveston Bay Foundation (GBF) is a citizens' organization formed in 1987 to preserve and enhance Galveston Bay for multiple uses, through education, conservation, research, and advocacy. Its Board of Trustees is composed of individuals and groups representing the diverse users of the Bay.

It is through the diversity represented in the Galveston Bay Foundation that some of the solutions to the Bay's problems are found. Three years ago, a cooperative effort was begun to plant smooth cordgrass marsh for habitat creation and shoreline erosion protection. Smooth cordgrass, *Spartina alterniflora*, is the plant that grows without competition in the intertidal zone. Its marshes provide the habitat so essential for marine life, while at the same time absorbing wave energy that would otherwise erode the shoreline.

The project has been guided from the beginning by two GBF Advisory Trustees, Edward Seidensticker, of the Soil Conservation Service (SCS), and Robert Nailon, formerly of the Marine Advisory Service. From their early efforts, procedures were established for transplanting the cordgrass and providing suitable protection for the young transplants. Each brought his particular expertise, the flora and the fauna, in a combination of irrepressible energy and commitment to the project.

In 1989, an agreement was signed between the Galveston Bay Foundation and the Port of Houston Authority to plant cordgrass on islands owned by the Port in the San Jacinto River. In 1990, planting began, with the Port providing funding for equipment and supplies used for the project that year. The joint effort of local, State, and Federal agencies was supplemented by volunteer labor provided through the Galveston Bay Foundation. Twenty volunteers from the individual and organization members of the Foundation participated, representing conservation (Houston Sierra Club), recreation (Houston Canoe Club), and college service organizations. The two plantings were also assisted by volunteers from the Saltwater Anglers League of Texas (SALT), who provided their boats for transportation to the islands.

The second year of planting, 1991, brought an expanded array of volunteer organizations, an expanded role for SCS, and an additional site. In addition to the individual and organization members of GBF, new participants were recruited from agencies and local corporations, including the Texas Water Commission, Exxon Chemical, Exxon Refinery, and Tenneco. A cooperative agreement between GBF and SCS provided insurance for the volunteers who became part of the SCS Earth Team program. A new cooperative agreement with the U.S. Fish and Wildlife Service provided fencing materials and supplies to support a planting project to protect the shoreline of the Anahuac National Wildlife Refuge. With coordination by GBF volunteers and staff, seven plantings

were completed that year, five at the refuge (not requiring boat transportation) and two on the San Jacinto River. A total of 92 volunteers participated.

For 1992, the project received two additional boosts. The Texas Waterway Operators Association -- the barge industry -- funded the construction and operation of a boat for GBF. The Bay Ranger, with capacity for 16 volunteer workers, was christened in the fall of 1991. The availability of regular, safe boat transportation enhanced the opportunities. In addition, the Wray Trust, a local, charitable foundation, funded a part-time conservation intern for GBF to coordinate the effort, build in an educational component, and develop documentation on the progress of the project. Continued funding from the Port allowed for the purchase of additional scientific equipment, as well as materials and supplies. In 1992, approximately 200 volunteers participated in 16 plantings at 6 sites, with over 20,000 square feet of marsh successfully planted.

Each site brings its own unique challenges, mostly in methods to protect the new, young transplants, whether from wave action or from a variety of non-native predators. In each case, however, the end of the day brings an overwhelmingly positive response from volunteers, with the wealth of new knowledge they have gained from the experience and the satisfaction from knowing that they have contributed to an improved ecosystem for Galveston Bay.

C. Living Resources: Protecting Wildlife In The Water And Along The Coast

Participation Of Recreational Anglers In Tag And Release Studies: Cobia Study As An Example

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In ever growing numbers and for a variety of reasons, recreational anglers are choosing to release the fish they catch. Tag and release is becoming an important part of the fishing experience for many Gulf Coast anglers. Not only is tag and release tangible proof that a particular fish was caught, it also gives that fish an identity, providing useful information.

Data recorded on individual fish, such as how, when, and where caught, length, etc., become part of that fish's recorded history. When combined with other data, it can be used extensively to delineate stocks, document seasonal patterns of movement, estimate population size, understand growth and survival, determine life span, and examine behavior (Grimes et al., 1983; Wydoski and Emery, 1985; Scott et al., 1990).

In 1954, Frank Mather of the Woods Hole Oceanographic Institute initiated "cooperative" tagging programs involving public participation. Since then, numerous programs sponsored by scientific groups, and programs of sport fishing organizations which provide their data to fisheries agencies, have been established throughout the U.S. and around the world. More than 25 cooperative tag and release programs exist along the Gulf Coast.

Recreational anglers are the largest direct-user group of marine fisheries. They are concerned about fish resources and recognize that more information is needed to reverse declining trends. Understanding and incorporating the needs of anglers into research and management decisions is essential. Anglers are becoming increasingly involved in cooperative tagging efforts.

The success of cooperative tag and release studies is dependent, in great part, upon the accuracy of anglers in reporting tagging activities and recaptures of tagged fish. If tagging is to be used as a management tool, it is important to have quality tagging and tag returns. Consequently, biologists and program coordinators spend considerable time promoting their programs and, importantly, explaining proper tagging techniques and reporting procedures.

Tagging programs must expound upon the benefits of program participation, the value of tagging data, and the use of tag return data, as well as focus on expanded publicity on program results. Long-term educational involvement and information exchange should involve, not only anglers, but, opinion-makers and writers as well. These are the people who can help make tagging and reporting tag returns a routine part of the angling world. Getting the right people involved is a key ingredient to success; then, keep them involved, informed, and motivated (Lucy et al., 1991).

In response to a growing need for life history information on cobia, a prized sport fish, the Gulf Coast Research Laboratory initiated the cooperative Cobia Tag and Release Program in 1989. The study is a joint research effort by biologists and volunteer anglers funded by the U.S. Fish &

Wildlife Service Sport Fish Restoration Program (Wallop-Breaux), through the Mississippi Department of Wildlife, Fisheries, and Parks Bureau of Marine Resources. By November 1992, over 4,200 cobia had been tagged and released by more than 800 anglers. A core group of approximately 100 people tagged many of the fish. The majority of cobia were tagged in the northern Gulf of Mexico; however, cobia were tagged off all Gulf states. The recapture rate approximates 5.0 %.

This study provided significant insight into the biology and seasonal movement of cobia in the Gulf. The following are examples of information developed by the study:

- verification of seasonal movement from the northern the southern Gulf during late fall, and a reverse migration in the spring,
- first documentation of long-distance movement from northern Gulf waters into the Atlantic off the U.S. East Coast (Georgia), as well as movement from the East Coast of Florida to the northwestern Gulf,
- fish returning to exact tagging locations several seasons following tag-release, and
- recaptures, including some greater that 2.5 years after tag-release, which are providing insight into cobia growth (approximately 5.0 cm./month for juveniles and young adults).

The results of the work are available to fisheries managers. Updates are routinely provided to the media, and a newsletter keeps interested parties briefed on study activities. Angler participation and cooperation are key to the program's success, and public recognition provides an incentive for future cooperation.

Some people have questioned the value of angler tagging programs. In some circumstances, it is the only way fish can be tagged cost-effectively, but, most importantly, when well-planned and executed, a cooperative study can provide valuable information that is difficult to obtain by other methods. As anglers, biologists, and fisheries managers realize the significant information that can be acquired through tagging, the value of these programs will grow. In an era of ever-tightening budgets, efficiently-run volunteer tagging efforts can pay important dividends to marine fisheries research and management.

Fishery resources have suffered from a lack of the public's knowledge about resource issues, and a misinformed public will result in losing the battle for a high-quality aquatic environment. The long-term well-being of these resources depends upon public support for scientific research and direct participation where possible. Due to the intense public interest in fisheries status, the scientific community will continue to benefit from interaction with the public through tag and release. Cooperative tag and release programs expand the knowledge of the species involved and provide something to concerned recreational anglers few other options hold...they have impact. The bottom line is that cooperative tag and release programs work!

Bibliography

C. Grimes, S. Turner, and K. Able, "A Technique for Tagging Deepwater Fish," Fishery Bulletin, Vol. 81, No. 3, pp. 663-666. (1983).

J. Lucy, J. Tiedemann, M. Donnelly, M. Voiland, M. Malchoff, B. Doyle, and J. Vaske, "Increasing Angler Participation in Marine Catch/Tag-and-Release Fishing Programs: Workshop Summary, Program Outlines, and Angler Survey Results," Virginia Sea Grant Program, V.I.M.S., Gloucester Point, Virginia, 82 pp. (1991).

E. Scott, E. Prince, and C. Goodyear, "History of the Cooperative Game Fish Tagging Program in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea, 1954-1987," American Fisheries Society Symposium, 7:841-853. (1990).

R. Wydoski and L. Emery, "Tagging and Marking," In: L. Nielsen and D. Johnson (eds.), Fisheries Techniques, American Fisheries Society, Bethesda, MD. (1985).

Protecting Nesting Habitat For Coastal Birds

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The barrier islands, coastal bays, and wetlands bordering the Gulf of Mexico provide habitat for a dazzling array of North American birds. Each year, millions of migrant songbirds cross the Gulf. In autumn, they stop over to build fat reserves before heading south, and they rest and renew themselves after the northward flight in the spring.

Hawk and shorebird migrations occur along the barrier islands and coastal lowlands, while Louisiana and East Texas provide important winter habitat to waterfowl. A few rare species also make their winter home on the Gulf, including the world's only wild flock of whooping cranes which inhabit parts of the Central Texas Coast.

Equally important, the Gulf Coast provides nesting habitat for over 30 species of pelicans, cormorants, herons, egrets, ibises, spoonbills, gulls, terns, skimmers, and related species totalling *one million* birds. These birds are also known as colonial waterbirds since most of them nest in large aggregations and feed in wetlands or open coastal waters. Most breed on islands, in mixed-species colonies, with up to 60,000 birds, in the largest colonies. Most are smaller, with 100-1,000 birds.

The birds require habitat providing food, cover and isolated

nesting and roosting sites protected from predators. During the 1900's, important habitats have been lost and colony sites destroyed due to human population growth and development. Even recreational activities have caused population losses through disturbances of breeding birds. Some species have such narrow habitat requirements and are so vulnerable that their numbers have declined to critically low levels. At current rates of population loss, only active policies will ensure their survival into the next century.

Fortunately, where large groups of birds gather to breed in dense formations, a specific set of needs can be met readily. The opportunity is illustrated through the program at the National Audubon Society's Tampa Bay Sanctuaries. Our primary mission is "the protection of the large breeding bird colonies of the Tampa Bay region, and the natural systems that support them." To accomplish this task, the Society must:

- lease or acquire, post, patrol, and monitor the major sites,
- work cooperatively with state and federal agencies to ensure that important colonies are identified and protected,
- design specific habitat creation/restoration projects,
- create local media events featuring citizens or businesses involved in colony protection and habitat creation,
- serve on local committees working to protect and restore natural systems which support bird colonies,
- talk to local groups, explain the significance of the colonies, the problems they face, and what can be done, and
- prepare summaries of annual nesting populations, breeding success, and environmental problems that affect nesting.

With a small staff, the Society cannot undertake all activities by itself. Therefore, volunteers are an essential part of this program. For instance, volunteers help post, patrol, monitor and improve sites through activities such as planting cordgrass and raking tern nesting sites. They also provide publicity through speeches, committee service, and interviews.

Approximately 50,000 breeding pairs of 25 species are protected by Audubon efforts in the Tampa Bay area. However, only 20% of these birds inhabit Audubon Sanctuary islands. The others are protected by outreach to other agencies, and through the efforts of local volunteers.

Two good examples are found at Shell Key, located at Pass-a-Grille (St. Petersburg), and Three Rooker Bar, near Clearwater. Both are small sand bars, prized destinations for beachgoers. They are also sites used by nesting birds, including some listed by the State of Florida as Threatened or Species of Special Concern. During 1991 and 1992, observations confirmed that the colonies were disturbed often, resulting in poor nesting success. A long list of impacts was compiled, such as chasing chicks, camping in colony areas, and dogs catching young birds.

At privately-owned Shell Key, volunteers obtained permission to post warning signs in the colony area, obtained donated signs from the State of Florida and private parties, and publicized their work. They maintained the signs and monitored the colony throughout the nesting season. At Three Rooker Bay, a boating club initially opposed the planned closure of the island by the state park staff, but, later, joined and spearheaded efforts protect nesting sites.

Some highly specialized species, like snowy plovers and american oystercatchers, nest outside protected areas and are difficult to protect. People and pets continue to violate posted areas. However, these efforts represent a promising start due to local volunteers who perceived a problem and resolved to correct it.

Citizen action is the touchstone of the National Audubon Society's approach to solving environmental problems. A small staff can make a dent, but thousands of informed, committed citizen volunteers can make a huge difference. These efforts will be more important in the years to come as, perhaps, the world stands on the brink of the largest "extinction event" of its history. The collective response to problems and challenges along the Gulf of Mexico will determine the future of this system and its wildlife.

References

American Ornithologists' Union, "Check-list of North American Birds," 6th edition, American Ornithologists' Union: Washington, D.C., 877 pp. (1983).

Gaston, G. R., and P. G. Johnson, "Nesting Success and Mortality of Nestlings in a Coastal Alabama Heron-Egret Colony, 1976," Northeast Gulf Science 1: 14-22 (1977).

Howell, A. H, "Florida Bird Life," Coward-McCann, Inc.: New York, 579 pp. (1932).

Imhof, T. A., "Alabama Birds," Univ. of Alabama Press: Birmingham, 591 pp. (1962).

Lowery, G. H., Jr, "Louisiana Birds," Louisiana State University Press: Baton Rouge, 651 pp. (1974).

Martin, R. P., and G. D. Lester, "Atlas and Census of Wading Bird and Seabird Nesting Colonies in Louisiana: 1990," Louisiana Department of Wildlife and Fisheries and Louisiana Natural Heritage Program Special Publication No. 3, 182 pp. (1991).

Meyers, J. M., "Colonial Shorebird and Seabird Nesting on Gaillard Island, Mobile Bay, Alabama, 1988," Alabama Game and Fish Division unpubl. report, 14 pp. (1988).

Oberholser, H. C., and E. B. Kincaid, Jr., "The Bird Life of Texas," University of Texas Press: Austin, 1070 pp. (1974).

Paul, R. T., and T. H. Below, "Populations, Distribution, Habitats, and Migration of Gulls, Terns and Shorebirds in Coastal Florida: An Overview," in D. P. Jennings Compiler pp. 66-78, Proceedings of the Coastal Nongame Workshop, U. S. Fish and Wildlife Service, Region 4, and Florida Game and Fresh Water Fish Commission (1991).

Spendelow, J. A., and S. R. Patton, "National Atlas of Coastal Waterbird Colonies in the Contiguous United States: 1976-82," U. S. Fish and Wildlife Service, Biological Report 88(5). x + 326 pp. (1988).

Texas Colonial Waterbird Society, "An Atlas and Census of Texas Waterbird Colonies, 1973-1980," Caesar Kleberg Wldl. Res. Inst., Kingsville, TX., 357 pp. (1982).

Toups, J. A., and J. A. Jackson, "Birds and Birding on the Mississippi Coast," University Press of Mississippi: Jackson, MI, 303 pp. (1987).

Table 1. **Colonial Waterbirds Nesting along the Gulf of Mexico, and their Status as Endangered or Threatened.**

	Federal and State Listings					
Species	USFWS	TX	LA	MS	AL	FL
American White Pelican		✓				
Brown Pelican*	E (TX-LA)	E	E		✓	SSC
Double-crested Cormorant*						✓
Olivaceous Cormorant		✓	✓			
Anhinga*		✓	✓	✓		✓
Magnificent Frigatebird**						✓
Least Bittern		✓	✓	✓	✓	✓
Great Blue Heron*		✓	✓	✓	?	✓
Great Egret*		✓	✓	✓	✓	✓
Snowy Egret*		✓	✓	✓	✓	SSC
Little Blue Heron*		✓	✓	✓	✓	SSC
Tricolored Heron*		✓	✓	✓	✓	SSC
Reddish Egret*	C 2	T	✓		✓	SSC
Cattle Egret*		✓	✓	✓	✓	✓
Green-backed Heron*		✓	✓	✓	✓	✓
Black-crowned Night Heron*		✓	✓		✓	✓
Yellow-crowned Night Heron*		✓	✓	✓	✓	✓
White Ibis*		✓	✓		✓	✓
Glossy Ibis*			✓		✓	✓
White faced Ibis		T	✓		✓	
Roseate Spoonbill*		✓	✓			SSC
Laughing Gull*		✓	✓	✓	✓	✓
Gull-billed Tern*		✓	✓	✓	✓	✓
Caspian Tern*		✓	✓	✓	✓	✓
Royal Tern*		✓	✓	✓	✓	✓
Sandwich Tern*		✓	✓	✓	✓	✓
Roseate Tern	T					T
Common Tern				✓	✓	
Forster's Tern		✓	✓			
Least Tern	T	✓	✓	✓	✓	T
Sooty Tern		T	✓			✓
Brown Noddy						✓
Black Skimmer*		✓	✓	✓	✓	✓

✓ = Confirmed nesting
E = Nesting, and classified as Endangered
T = Nesting, and classified as Threatened
SSC = Nesting, and classified as Species of Special Concern
C2 = Candidate for listing, with some evidence of vulnerability, but for which not enough data exist to support listing

* Nesting species protected at Tampa Bay Sanctuaries
** Roosting population protected at Tampa Bay Sanctuaries

Ecotourism And Human Effects On Marine Species: Dolphin Feeding Cruises In The Gulf And Other Marine Mammal Issues

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Ecotourism is tourism resulting from, and focused on, a particular ecologically-sensitive or interesting portion of the natural environment. In the Gulf of Mexico, marine mammals are considered a particularly interesting portion of the environment.

The Marine Mammal Protection Act of 1972 (MMPA) recognizes that marine mammals are a source of international significance, aesthetic and recreational, as well as economic. Congress imposed a moratorium on "taking" marine mammals, which is defined as harassing, hunting, capturing, or killing any marine mammal. While the meanings of the words hunt, capture, and kill are seldom disputed, the term harass is subject to interpretation.

National Marine Fisheries Service (NMFS) regulations limit the approach distance to humpback whales in Hawaii to reduce behavioral changes caused by closely approaching

vessels. Unfortunately, some ecotourist activities, such as dolphin watching and feeding, may be less benign than they appear, and in certain cases, may constitute harassment.

In the Southeast, the aesthetic significance of marine mammals in the wild, especially bottlenose dolphins, has developed into an economic enterprise. There are approximately 10 large commercial cruise operations and a number of smaller ones featuring dolphin watching or feeding. If properly conducted, dolphin watching trips may help the public to better appreciate these animals and the delicacy of their environment.

However, NMFS and numerous marine mammal scientists believe that feeding wild dolphins may have a serious, detrimental impact on the populations affected by this practice. In 1989, partially in response to recommendations from a whale watching workshop, NMFS prepared a briefing paper which detailed dolphin feeding practices in the Gulf of Mexico and along the Southeast Coast. The report contained scientific opinions from noted marine mammal biologists, both federal and non-federal.

In these experts' opinions, the practice of feeding dolphins in the wild was detrimental for a number of reasons. There were concerns that dolphins could be fed inappropriate or harmful food items, or they could be lured to boats where they could be harmed. The overwhelming concern expressed by all the marine mammal experts was that feeding dolphins in the wild could habituate these animals to humans and vessels, altering their natural behavior, particularly their feeding behavior.

There have been no scientific studies that have examined a population of human-fed dolphins versus a population feeding in the wild. However, there are a number of anecdotal accounts that demonstrate some of the possible results of habitual dolphin feeding.

In 1990, NMFS drafted regulations to prohibit feeding all marine mammals in the wild. In the Southeast U.S., there was considerable opposition, especially in Panama City, Florida where 4 commercial feeding tour boats operate, and in Corpus Christi, Texas where a feeding operation operated for several years. Although there were negative comments on the proposed regulations, there was, in general, strong support, especially from conservation organizations.

The final regulations were published in 1991, but the Corpus Christi operators obtained a temporary injunction prohibiting the enforcement of the feeding ban. In October 1992, the U.S. District Court for the Southern District of Texas ruled in favor of the dolphin feeding cruise operators. The judge's decision disagreed with expert opinion and partially based his opinion on the fact that there were no scientific studies to support the government's actions. The ruling enjoins the Secretary of Commerce from enforcing the regulation as they relate to dolphins.

The Department of Justice is appealing the ruling, and a decision should be made by late 1993. At the present time, dolphin feeding remains legal.

Another tourist oriented activity dealing with marine mammals is dolphin and whale watching cruises. There are a number of dolphin watching vessels in the Gulf and the Florida Keys that have never featured dolphin feeding, but bring people out to observe closely these animals in their natural environment. There are also thousands of people with private boats out on the Gulf all the time.

Unfortunately, when it comes to viewing dolphins, some people cannot get too close. Extremely close encounters with dolphins, or most wild animals for that matter, may alter the animal's behavior. This may be especially serious during feeding or mating, or when a mother and calf are approached. Again, relying on the recommendations of the whale watching workshop, NMFS proposed regulations in the fall of 1992, establishing approach limits on cetaceans.

Activities such as dolphin watching can be educational as well as enjoyable. However, anyone who participates in this activity should keep in mind the possible harm they may do by getting just a little closer.

The last ecotourist activity regarding marine mammals is swimming with dolphins in the wild. There are several places in Gulf coastal waters where this occurs. It normally occurs where dolphins have become habituated to vessels and humans. While the first two tourist activities have real possibilities for harming animals but present little danger to humans, this activity poses dangers to both animal and humans. Most dolphins act in a benign manner towards humans, but any threat perceived by the dolphin, whether real or imagined, could elicit a flight response or an aggressive response.

Dolphins are an integral part of the marine environment. They are fascinating to watch and beautiful to behold. However, like the rest of what makes up the Gulf of Mexico, they must be treated with care and understanding. NMFS promotes the conservation and wise management of living marine resources so that future generations may also enjoy a healthy, productive, and diverse environment.

D. Development And Land Use Planning: Uniting Citizens, Communities, And Industry For Protecting The Environment While Planning For The Future

How Farmers Manage Wetlands For Wildlife Habitat

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The Mississippi Delta is an alluvial plane comprising approximately four million acres in northwest Mississippi. Three million of those acres are productive farm land.

The Delta was once one of North America's best wildlife areas, and, now, farmers and private land owners are restoring some of the habitat in that area that was lost or degraded.

Farmers use filter strips, grass waterways, overfall pipes, no-till or reduced tillage farming, and other soil conservation practices. Also, farmers improved their pesticide handling techniques to improve water quality. The "New Chemistry" now available to farmers means using smaller quantities of more specific pesticides which degrade into harmless substances.

The result has been an 4 to 6-fold increase in fish populations in lakes and streams.

The Delta Wildlife Foundation, a grassroots organization of farmers, sportsmen, and agri-business, is obtaining solid support for its program to improve and expand wildlife habitat in the Mississippi Delta.

Delta Wildlife has a broad range of activities, including providing nesting structures for wood ducks and improving habitat for deer and small game. Delta Wildlife has an active education and promotion program, and its winter waterfowl habitat program has been very successful.

A public education program has been undertaken to make Delta farmers aware of the many Federal and State agencies and other organizations which offer technical and, sometimes, financial assistance for conservation and habitat programs.

Farmers throughout the Delta are providing new leadership for practicing conservation measures and accepting responsibility to be good stewards of the land.

E. Citizen Monitoring: Citizen And Community Efforts To Monitor The Environment Around The Gulf

Citizen Efforts To Reduce Marine Debris

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The Center for Marine Conservation (CMC) is a private, non-profit organization dedicated to the health of coastal and marine environments and their living resources. For the past seven years, CMC has led the fight to stem the tide of unsightly and harmful marine debris. Much of CMC's efforts focused on educating marine user groups and the general public about this global problem and making them aware of the international agreements and U.S. laws restricting overboard garbage disposal. Additionally, CMC has enlisted volunteers to monitor marine debris in each part of the world and identify violations of the laws.

Since 1988, CMC coordinated the International Coastal Cleanup each fall, attracting over 160,000 volunteers worldwide in 1992. The volunteers record the number and types of debris collected on standardized data cards and list items traceable to passenger cruise ships, the military, offshore oil and gas operations, fishermen, and shipping.

To increase and improve data collection during the cleanup, CMC's Florida Regional Office holds regional meetings for the Zone Captains and lead volunteers who organize local beach cleanups. While sharing suggestions on how to improve data collection and increase participation, CMC also emphasizes how the data is used.

This unique data base provides information on the trends

of the amount and type of debris found and its sources, and it led to Special Area designation for the Gulf of Mexico and Wider Caribbean Region under the MARPOL Agreement, Annex V. Once ports in the region have facilities for handling waste, overboard disposal of all debris other than ground food waste will be prohibited. Currently, this ban only applies to plastic trash.

States and cities use the data to support new laws related to marine debris. The data was also used in CMC testimony, along with that from government agencies and the cruise industry, during recent congressional hearings evaluating the effectiveness of the Marine Plastic Pollution and Research and Control Act (MPPRCA) of 1987, which ratified the MARPOL Treaty by the U.S.

With the increased need for statistical data regarding marine debris, the U.S. Environmental Protection Agency (EPA) provided CMC with a contract to conduct a marine debris statistical sampling study determining the effectiveness of MARPOL Annex V. The survey seeks to answer two questions -- is there a decreasing trend in the amount of marine debris accumulating on beaches and is the debris coming directly from the ocean or other areas of the beach? To answer these questions, volunteers must collect and categorize debris in a 500 meter section of beach and mark it in the two sections on either side of it. The surveys are done every 28 days and must be conducted for 5 years for statistical analysis.

Pilot studies were conducted at Island Beach State Park in New Jersey and Assateague Island National Seashore in Maryland. Both were successful, and studies continue in both states. A new group of volunteers has been selected to survey Sea Rim State Park in Texas, and CMC will soon expand the project in each Gulf State.

In order to educate citizens that the storm drain on their street often leads directly to a body of water, CMC recently began a campaign entitled "Million Points of Blight." Communities and volunteers are enlisted nationwide to stencil one million storm drains with a message not to dump waste into the drain. The program serves as a national network for existing stenciling programs and guide for individuals and groups who want to stencil in their communities. CMC supplies an initial information packet to interested groups, outlining the non-point source pollution problems of storm drains and how to initiate the project. The stencils can be borrowed, if necessary. Often, municipal public works or parks departments are the organizing entity. Volunteers also collect data on the type of pollutants found in the vicinity of the drain being stenciled, like motor oil or street litter, and provide the information to CMC's data base.

A major goal of CMC's efforts is to educate the public and marine user groups of the specific points in MARPOL Annex V and MPPRCA so they know how to behave correctly and what constitutes a violation. Once armed with this knowledge, individuals witnessing vessels dumping trash will know whether it is legal or a violation. Unfortunately, once 25 miles from shore, it *is legal* to dump all materials from a vessel except plastic trash.

Placards to display on vessels were designed and distributed by CMC that outline the restrictions for within 3 miles, 3 to 12, 12 to 25, and outside 25 miles from shore, as well as an easy to follow *Citizen's Report Form* outlining the information needed to file a report with the Coast Guard.

To educate boaters and individuals likely to see a violation, CMC developed a Citizen Pollution Patrol program sponsored by EPA. It was initiated in Maryland and New Jersey and is now the model for an expanded boater education program in Santa Barbara, California. Once educated and armed with the information, boaters are more encouraged to report violations they witness.

Cruise ship passengers are another group upon which CMC has focused education initiatives. A media campaign which exposed the chronic problem of illegal dumping by the cruise industry was based on reports from passengers and crew members and Coast Guard cases brought against cruise ships. CMC developed a fact sheet on the cruise industry and what individuals can look for if they are planning to take cruises.

Due in part to the citizen interest in the issue of illegal dumping, the Coast Guard has taken a stronger enforcement posture. For instance, they will now act upon violations within 200 miles of the U.S. coast (previously it was 12 miles), and fines have increased to $500,000 for a criminal violation.

In closing, these combined efforts, in particular the involvement of hundreds of thousands of citizens in the cleanup, data collection and monitoring, are demonstrating the concern there is for the global problem of marine debris in the ocean.

Coordinating Volunteer Marine Mammal Stranding Networks

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The Texas Marine Mammal Stranding Network is a non-profit volunteer organization dedicated to the conservation and preservation of marine mammals that become stranded along the Texas coast. Since stranding phenomenon provides one of the few sources of information about marine mammals, it is essential that the events be dealt with quickly and efficiently. To acquire the greatest amount of useful data and tissue samples, volunteers are involved in all aspects of the Network. They are responsible for many aspects of the stranding network, including reporting and recovering individual strandings as well as data and tissue collection and dissemination. Properly coordinating the activity of the many volunteers is vital to the success of the Texas Marine Mammal Stranding Network.

Monitoring Of Hutton Branch, Carrollton, Texas

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Carrollton, Texas

The stream known as Hutton Branch in the Dallas suburb of Carrollton is a tributary of the Elm Fork of the Trinity River. From the 1920's until 1970, a part of this stream meandered through property of the summer ranch of former Dallas Park Board Chairman Ray Hubbard. This rolling blackland prairie area included stock tanks built by Hubbard along the creek banks of land he called his Country Place.

Like much of the area, development of the Hutton Branch watershed occurred rapidly, resulting in occasional fish-kills and frequent flooding and sedimentation.

With the "recession" of the mid-80's, the watershed became fallow and more stable, but urbanization had continuing effects on flooding. Questions regarding water quality arose frequently, but, generally, they were unanswered. In 1988, the citizens of Carrollton passed a bond issue to address some of the major flood and sedimentation issues, particularly on Hutton Branch.

After noting that the Texas Water Commission (TWC) received funds under the U.S. EPA. Clean Lakes program to utilize volunteers to monitor the water quality of Texas streams and lakes, the author proposed a volunteer citizens monitoring program on Hutton Branch as part of the TEXAS WATCH program.

TEXAS WATCH was formed to protect the surface and ground-water quality of the state and monitor other environmental information on air, soil, biological, and human resources data through citizen activities. The program offers training and equipment so that citizens can identify objectives and locate sampling sites, and it provides a repository for the gathered data. Citizens groups must meet certain criteria, including identifying volunteer coordinators, having clear, unbiased environmental information objectives, completing training sessions on monitoring procedures, taking responsibility for equipment, and submitting monthly sample data and other documentation.

Citizen monitoring of streams for water pollution has taken place since 1927, and the information collected augments that of Federal, State, and local agencies. There are now over 5,000 stream monitoring organizations in 34 states. This information is used to determine the stream's well-being, assess management practices, or see changes signalling problems.

Hutton Branch Citizen Monitoring Program, Carrollton, Texas

The segment of Hutton Branch sampled includes two locations on the stream and two in ponds within the 2.6 square mile watershed study area. The objectives include establishing a base-line of the stream's water quality, evaluating the impacts of urbanization and industrialization, and comparing the region's water quality to Wilson Creek, the TWC's minimum impact eco-region.

The study area watershed is approximately 60% developed with all of the land zoned for either single or multi-family residential, light industrial, small commercial, or airport uses. In the mid-1980's, many roadways and utilities were installed in anticipation of rapid growth. With the recession and slow-down in building in the late 1980's and early 1990's, the majority of the land disturbed for development has become grass covered. Thus, it is presently in a stable condition, and base-line monitoring should provide meaningful data to assess changing conditions.

There are several ponds in the study area, one of which is stocked with large-mouth bass and inhabited by additional wildlife, including a resident heron and egret population. The pools along the stream segment are active with ducks and migratory geese.

Measuring and sampling is done at small weirs along the stream to estimate discharge and clarity. Testing equipment provided by the TWC includes pH and TDS meters with calibration solutions, a secchi disk, thermometer, dissolved oxygen sampling kit, and some personnel protective equipment (goggles and rubber gloves). Training sessions were held on-site. Samples are taken monthly at mid-month, and the results mailed to the TWC.

Sampling Results Summary 1991-92

Some of the fluctuations seem to follow predictable patterns; when it rains the pH and TDS drop, or as temperature rises the dissolved oxygen follows a standard saturation curve. At other times, they are confusing; for example, the Lob Lake sample pH has been rising, while the incoming waters have had a relatively constant pH. Dave Buzan, of the TWC, indicated that a plankton bloom was the culprit due to a probable increase in nutrients from recent construction activity and rising seasonal temperatures.

Overall, it appears the Hutton Branch is relatively healthy, although in the short period of sampling, signs of spills have been observed and reported to both the TWC and the City of Carrollton. A fish kill was observed during the May sample event.

Construction activities quickly show up with sediment and wash-down of workers' equipment. The lakes seem to react more slowly to changes. Plots of temperature, flow, TDS, pH, and dissolved oxygen have been made in an attempt to look for patterns and correlations. As data accumulates, these may be more useful in identifying trouble as well as trends.

Why Citizen Monitoring Of Small Lakes And Streams?

The rewarding part of citizen sampling and monitoring is the fascinating diversity one sees in a stream during repeated observation. The smallest fluctuations that once went unnoticed by the participants become wondrous. Additionally, there are insufficient resources to obtain the

data needed to assess water quality throughout the nation. Carefully controlled citizens monitoring programs will continue to provide this information to government so that it can utilize its limited resources on other important endeavors.

Oscar Bray, former president of the American Society of Civil Engineers, stated "The engineer's responsibility to the public may be expressed succinctly in two words from the French, *noblesse oblige*. Roughly translated, it describes the moral obligation of those who understand, or have abilities, to contribute their knowledge and abilities for the general good of all."

F. Water Quality I: Preventing Nutrients From Reaching Surface Waters

Using A Constructed Wetland To Improve Catfish Production

Truman Roberts
Hattiesburg, Mississippi

The overall objective of the proposed work is a continuing evaluation of an intensive culture system involving the utilization of circulating surface water through a constructed wetlands for reuse. The benefits are an increase in catfish production and the creation of wildlife habitat.

NASA Space Research, which produced velcro and the microwave oven, is now improving water quality and catfish production in Mississippi. Research on waste water treatment for long-term space travel is determining the feasibility of using plant roots to filter water. Now, several towns in Mississippi and catfish farmer Truman Roberts have adapted this research to their needs.

This presentation deals with, and discusses, the details of using various plants and constructed wetlands to filter Mr. Roberts' catfish ponds and improve water quality. It also discusses the cost of this type of operation compared to the conventional method of raising catfish in the Mississippi Delta.

The location of these experiments is southeastern Mississippi, in the lower coastal plains. The local water supply is very limited and the cost of drilling a deep well is cost prohibitive. Therefore, constructed wetlands are being used to filter various nutrients, and the same water is recycled through catfish ponds to improve water quality.

Mr. Roberts is almost doubling the pounds of fish raised, compared to the conventional systems in the Mississippi Delta. The cost of raising the fish is also less expensive.

The artificial wetlands not only improves water quality, but increases certain wildlife species drastically, such as wood duck, blue and green wing teal, and many types of non-game birds. Also, many species of fur bearing animals use these constructed wetlands for habitat.

Florida Neighborhoods: Neighborhood Involvement In Local Environmental Protection

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Florida Neighborhoods is a program that pairs residents committed to improving the environmental quality of their homes and yards with experts trained to advise and assist. It's a hands-on course in environmental stewardship that brings the classroom to the backyard; residents receive instruction in ways to reduce pollution from stormwater runoff, conserve water, and restore native habitats.

The program was developed to empower citizens by providing tools to improve the quality of the environment in their community. Special emphasis is placed on landscape design and maintenance. Most residents overdose their yards with fertilizers and pesticides, which are a key source of pollution from stormwater runoff. By reducing fertilizers and pesticides used in yards and by encouraging native and other water-conserving plants, residents can help protect area bays and rivers and improve the quality of their local environment.

The program begins with a two part environmental checkup -- a survey of residents to determine landscaping and homecare practices and an on-site inspection by a team of experts to identify environmental opportunities and problems. After completing the assessment, the Florida Neighborhoods team prepares a 12 month action plan for participating neighborhoods with recommendations for improving landscape care, conserving water and energy, and recycling waste. Workshops and information provided by the Florida Neighborhoods team assist residents in completing their plan.

Residents meeting goals established in the neighborhood plan help their neighborhood win official designation as a Florida Neighborhood, *an award of distinction granted to* residential communities in which a majority of homes practice recommended conservation techniques.

Florida Neighborhoods is administered by the Bay Area County Cooperative Extension Services, with funding from the Tampa Bay National Estuary Program. Partners in the program include the cities of Tampa, St. Petersburg, and Clearwater, Pinellas, Hillsborough, and Manatee counties, the Florida Native Plant Society, the Southwest Florida Water Management District, Florida Department of Natural Resources, Florida Power Corporation, and Tampa Electric Company.

Consumer Awareness of Phosphorus And Phosphate/Non-Phosphate Detergents

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The two most common forms of nutrient contamination in surface waters are nitrogen and phosphorus. Phosphorus is usually the limiting nutrient in fresh water systems. Too much phosphorous can cause excessive algal growth and result in oxygen deprivation and the death of animals living in the system. Phosphorus can enter a water body by soil erosion, fertilizer runoff, animal wastes, and detergents containing phosphorus.

The Louisiana Cooperative Extension Service has developed a program with the purpose of empowering consumers with knowledge and skills in decision-making to select detergents that are safe for the environment and effectively clean the family laundry.

Phosphates enhance the performance of the cleaning agents in detergents by softening water, dispersing dirt, emulsifying grease and oil, and cleaning in water with a high iron content. Two recent research studies compared the performance of detergent types. Under similar situations in home laundry, the phosphate detergent of the same brand matched or outperformed the non-phosphate detergent in overall laundering. Yet the non-phosphate detergent worked equally well when combined with recommended stain removal procedures.

The Louisiana Cooperative Extension Service has developed teaching plans, visual aids, and support material, undertaken a consumer survey of local markets for phosphorus content of detergents, surveyed consumer knowledge of laundry detergents, and conducted two lessons at 4-H Clothing Camp.

The pilot parish surveys questionnaire results are as follows:

Table 1. What Do You Know About Detergents?

Detergent Statements	Answer	Percent
1. There is not much difference between soaps and detergents.	False	57
2. All detergents work equally well in all types of washers.	False	100
3. Phosphates added to the water stream assist in algae growth.	True	71
4. Most detergents clean better than soap in hard water.	True	71
5. Clothes can become dingy if too little detergent is used.	True	86
6. You need to use more detergent in soft water than in hard water.	False	100
7. High phosphate detergents do not harm the environment.	False	100
8. Most detergents work well in cool, warm or hot water.	True	100
9. Liquid and granular laundering detergents both work well.	True	71
10. Liquid detergents are all the same.	False	86

When asked which factors influenced the homemaker most when buying detergents, the following were ranked as follows (the ranking is from 1-most important to 14-least important):

Table 2. Factors That Influence Me To Buy....

1 price	6 its environmental safety	11 a friend or relative's advice
2 discount or special coupon	7 aroma or smell	12 advertising
3 my own experience with it	8 convenience of use	13 safety of product
4 faith in the brand name	9 a free sample was provided	14 appearance
5 manufacturer's reputation	10 size of container	

The consumer felt she was informed about detergent ingredients as indicated in Table 3.

Table 3. Consumer Evaluation Of Self

How would you describe yourself as a buyer of laundry products?

14% well informed	43% very interested
57% as informed as others	43% as interested as others
29% not well informed	14% not interested at all

Two educational videos are being developed for LA. CES Agent and Leader training and for Leaders to use with consumer lessons.

Homemaker club meetings will be conducted on consequences of phosphorus in the environment, how to read labels for phosphate content in laundry detergents, the purpose of phosphates and other components in the laundry, and wise decision-making.

Media information and publication(s) with phosphorus and laundry facts are being developed. Information will be available following the evaluation of the three parish pilot project.

G. Water Quality II: Industry And Community Involvement For Reducing Or Eliminating Toxics And Pesticides From Ground Or Surface Waters

Dow Chemical's Waste Reduction Programs And Community Advisory Panel

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Waste reduction is the cornerstone of the Dow Chemical Company's waste management policy. It is an old concept revisited for Dow because waste reduction efforts began in the 1960's. The Waste Reduction Always Pays, or WRAP program, which began in 1986, reemphasized and formalized the company's environmental priority for waste reduction. This program places the responsibility of waste reduction on our experts, the generating facilities.

Waste minimization is defined as any practice or process which minimizes or eliminates wastes before they are generated; the treatment, reuse, or recycle of any material

which minimizes the volume and or toxicity of a waste prior to its final disposition.

When establishing a program, it is important to set goals. A key goal of the **WRAP** program at Dow is to reduce waste to all media, namely air, water, and land. A multi-media approach ensures that solving a problem in one area does not create a new problem in another area.

The program must provide incentives and recognition to encourage the development of ideas and projects to reduce waste. Dow wants to create a "waste reduction mentality" in its employees. This means that environmental awareness is a part of every job.

A good waste reduction program will also lessen future liability because the use of treatment and disposal facilities will be reduced. This type of program will gain the confidence of the public because the efforts of companies which reduce waste will be noted.

The practices used to minimize or reduce waste are those that permit efficient operation of the company's plants. Improved raw material purity provides for less by-products, reducing the amount of waste which must be destroyed. Improved computer control and instrumentation also ensures that less off-specification material having to be re-worked or disposed of is produced. On-stream analysis allows manufacturing plants to maintain control over processes and minimize product variation. Improved sampling techniques reduce the amount of material collected for sampling and allows it to be returned to the process, eliminating workplace and environmental exposure. Preventive maintenance programs provide for efficient operating equipment and fewer leaks.

At the Louisiana Division, one of the ways projects are identified is through a contest. During the early eighties, an Energy projects contest was started to encourage the development of methods to reduce energy which would, in turn, lower production costs. The contest was successful in identifying energy cost savings at a time when energy prices were very high. The winners were recognized, and the projects were funded.

A few years later, yield savings projects were included in the contest. In 1988, **WRAP** projects were added to the contest. Over 200 waste reduction projects have been identified through the contest.

Once projects are defined, they must be implemented based on priorities in order to work on the right projects. Both the quantity and impact of the reduction are evaluated to prioritize funding.

One project implemented at the Louisiana Division was designed to recover hydrocarbon vapors released into the atmosphere when products are loaded in low pressure barges. When a barge is loaded, the vapor space is displaced by incoming liquid products, and the displaced nitrogen and hydrocarbon vapors escape to the atmosphere through vents to prevent the barge from being over-pressured.

The barge vent recovery system consists of a new vapor collection system and recovery unit. The collection system gathers the vapors and discharges them into the vapor recovery unit, absorbing the hydrocarbon vapors and returning them back to the original production process for reuse. The vapor recovery unit operates at a recovery rate greater than 98 percent, eliminating the discharge of more than 100,000 pounds of hydrocarbons per year into the atmosphere.

Waste reduction is part of an integrated waste management philosophy at Dow. This means that methods to eliminate generating wastes must be developed. Approaches must be developed that recycle or reuse wastes that are created, turning them into raw materials that can be used in manufacturing processes. Then, remaining wastes must be treated or destroyed to reduce their volume and toxicity. At Dow, remaining wastes are destroyed through high temperature incineration and the ash is deposited in a secure landfill. Dow has a goal of internal disposal, and at the Louisiana Division, over 99% of the waste generated is treated or destroyed.

Managing Pesticides For Crop Production And Water Quality Protection

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Pesticides should be used with an understanding of their environmental consequences. However, until recently, such data was not available to pesticide users from either the U.S. Environmental Protection Agency or the manufacturer, despite the requirement of such data in registering them with the EPA. The data is useful in reducing potential impacts on humans, aquatic life, or other concerns.

Typically, farmers choose pesticides on the perceived effectiveness and cost of a product, and they are unlikely to experiment with different products once a favorite is chosen. Selection criteria for effective, cost-efficient, environmentally-benign products are emerging (Hoag & Hornsby, 1992). This will help agricultural and urban pesticide users and aid regulatory agencies in understanding the more subtle issues of pesticide use, resulting, hopefully, in better public policy.

Practical Grower Guides For Pesticide Selection

Both the USDA Soil Conservation Service (USDA/SCS) (Goss and Wauchope, 1990) and the Florida Cooperative Extension Service (CES) (Hornsby, et al., 1991, Hornsby, 1992) developed decision aids to help their clients select pesticides that avoid or reduce adverse impacts on water quality. The aids vary slightly in their approach but provide a much-needed methodology that includes environmental concerns in determining the appropriate pesticide. Both consider the environmental fate of pesticides and soil properties of the application site.

The CES methodology uses a two-tier approach that considers the potential for leaching and/or runoff and toxicological impacts. The criteria match soil properties to the environmental fate and toxicological parameters of the pesticides which include two derived indices (for leaching and runoff) and two toxicological parameters (U.S. EPA lifetime health advisory levels and aquatic toxicology).

A "Pesticide Selection Worksheet" (Figure 1) is used to organize the information necessary to consider the alternatives and make an informed decision. While this approach does not explicitly mention efficacy or differences in application amounts and costs of alternative products, the user is reminded of these aspects in the Extension Circular (Hornsby, et al., 1991) containing the procedure, which has been developed for 55 different crops.

Pesticide parameters. The Relative Leaching Potential Index, RLPI, defines the relative attenuation (reduction in mass as it moves through the soil) of each pesticide in soil, and its potential to leach to groundwater. The index is calculated by multiplying the ratio of the organic carbon sorption coefficient and the degradation half-life by 10. The index is integer. Values greater than 2,000 are assigned a value "2,000". Values between 1,000 and 2,000 are rounded to three significant digits. This ratio defines the relative attenuation of pesticides over a wide range of soils. Pesticides that are very mobile, for example, K_{oc} values less than 100 in sandy soils, or 50 or less in fine-textured soils, should be used with caution. There is some uncertainty in the data used to calculate this index. However, since the values are relative, they can still be used. The smaller the RLPI value of a pesticide, the greater is its potential to leach.

The Relative Runoff Potential Index, RRPI, defines the relative immobility of each pesticide in soil, and, therefore, its potential to remain near the soil surface and be subject to loss in runoff either sorbed to eroded sediment or in the aqueous phase. This index represents the combined sediment and aqueous phase runoff potential and is calculated as follows:

A. If K_{oc} is 1,000 or greater, then the RRPI is the ratio of 1,000,000 and the product of the sorption coefficient times the degradation half-life.

B. If the K_{oc} is less than 1,000, then the RRPI is the smaller of the values calculated in A or the RLPI.

This index is integer and values greater than 1,000 are assigned the value "1,000". There is some uncertainty in the data used to calculate this index. However, since the values are relative, they can still be used. The smaller the RRPI value of a pesticide, the greater is its potential to be lost in runoff.

Both the leaching and runoff indices were developed by evaluating the results of long-term (30-50 years) simulations using validated pesticide fate models to predict the probability of leaching or runoff of pesticides for a range of soil and pesticide properties (Leonard and Knisel, 1988). In order to reduce confusion on the part of the user of the pesticide selection procedure, the leaching and runoff indices were constructed such that a smaller value represents a greater hazard in the same sense as the health advisory level and the aquatic toxicity.

The Lifetime Health Advisory Level or Equivalent, HALEQ, provides a measure of pesticide toxicity to humans. The lifetime health advisory level as defined by U.S. EPA is the concentration of a chemical in drinking water that is not expected to cause any adverse health effects over a lifetime of exposure (70 years), with a margin of safety. The values used are the USEPA lifetime health advisory level, HAL, or an equivalent value, HALEQ (denoted by a superscripted asterisk), calculated using the same formula used by the USEPA (HALEQ = RfD x 7,000), where RfD is the reference dose determined by the USEPA. For non-carcinogenic pesticides, the calculated HALEQ should not differ by more than a factor of 10 from the values forthcoming from the USEPA. HAL and HALEQ have units of micrograms per liter (g/l, or ppb). The smaller the value, the greater is the toxicity to humans.

The Aquatic Toxicity provides a measure of pesticide toxicity to aquatic species. The values used are the lethal concentration at which 50% of the test species die (LC_{50}). Unless otherwise noted by a lower case letter following the value, the test species was rainbow trout. The smaller the value, the greater is the toxicity to aquatic species.

Data for K_{oc}, RLPI, RRPI, HALEQ, and aquatic toxicity are given for the active ingredient of a product as shown in an abbreviated form in Table 1. Data corresponding to the pesticides identified to control a pest is transferred to the "Pesticide Selection Worksheet". When using a product that is a mixture of two or more active ingredients, use the RLPI, RRPI, HALEQ, and Aquatic Toxicity value for the most restrictive active ingredient in the mixture.

Soil parameters. The following criteria were developed by the Florida USDA/SCS in collaboration with the Florida CES to rate soils for leaching and runoff:

Leaching. Factors that determine the soil leaching rating are the soil permeability and the occurrence of mucky layers in the upper 2m of the soil, as follows:

RATING	CRITERIA
HIGHS	lowest permeability is 15.2 cm/hr or more.
MEDIUMS	lowest permeability is between 1.5 and 15.2 cm/hr.
LOWS	lowest permeability is 1.5 cm/hr or less.

Exceptions:

- Soils with a muck or peat layer are rated LOW.
- Soils with a mucky layer are rated MEDIUM unless the soil has a slowest permeability of less than 1.6 cm/hr; then the soil is rated LOW.

Runoff. The factors that determine the soil runoff rating are hydrologic group, permeability, and slope, as follows:

RATING	CRITERIA
HIGH	Soils in hydrologic group D in their natural, undrained state.
MEDIUM	Soils in hydrologic group C; and any soils in hydrologic group B (in their natural undrained state) that have a permeability of less than 15.2 cm/hr within 51cm of the soil surface.
LOW	Soils in hydrologic class A; and any soils in hydrologic group B (in their natural, undrained state) that have a permeability of 15.20 cm/hr or greater in all of the upper 51 cm of the soil profile.

Exceptions:

- Soils that are frequently flooded during the growing season are rated HIGH.
- Soils rated LOW are changed to a rating of MEDIUM where the slope is greaterthan 12 percent.
- Soils rated MEDIUM are changed to a rating of HIGH where the slope is more than 8 percent.

These criteria were used by the Florida SCS and CES to rate soils in each county that has a published or interim soil survey (Brown, et al., 1991). Table 2 is an abbreviated example of soil ratings for Manatee County, Florida (Hurt, et al., 1991). The pesticide user need only locate the pesticide application site on the county soil survey map to identify the soil map unit(s) (MUSYM) that constitute the field or area being treated then find corresponding MUSYM(s) in Table 2 to obtain the soil ratings for pesticide leaching and runoff for the application site. These ratings are then transferred to the "Pesticide Selection Worksheet" (Figure 1). These criteria for rating soils for leaching and runoff of pesticides may need to be modified for use in other states where soil characterization data does not extend to 2-m depth. The USDA/SCS National Water Quality Staff has developed ratings for all states with slightly different criteria.

Pesticide selection criteria. After the chemical data and soil ratings have been transferred to the "Pesticide Selection Worksheet", criteria presented in Table 3 can then be used to select pesticides that are relevant to the water quality considerations needed at the application site. By first looking at the soil ratings, selection is made by matching the appropriate criteria in Table 3.

The "Selection Criteria" encourages the user to "move away" from the "worst case", as defined by the smallest RLPI/RRPI and HAL/Aquatic Toxicity values, rather than defining the "best choice". The philosophy of the CES is to provide information for the user to make an informed decision, but not to make the decision for the user. For some combinations of crops and pests there are few alternative selections. In this case, the user may not be able to select a product using these criteria. Nevertheless, the user is apprised of the likely consequences of their use and can proceed with cautious use of these products. One should note that use of this procedure in no way preempts requirements set forth on the product label.

The methodology set forth in this section has been published in a series of Extension Fact Sheets and Circulars by the Florida CES for joint use by the SCS in conservation plans and by the CES with agricultural and urban pesticide users.

References

Brown, R.B., A.G. Hornsby, and G.W. Hurt. 1991. Soil ratings for selecting pesticides for water quality goals. Circular 959. Florida Cooperative Extension Service. Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. 4 pages.

Goss, D.W. and R.D. Wauchope. 1990. The SCS/ARS/CES pesticide properties database: Combining it with soils property data for first-tier comparative water pollution risk analysis. pp 471-493. In Weigman, D.L. (Ed) Pesticides in the Next Decade: The Challenges Ahead. Proc. Third National Research Conference on Pesticides. Richmond Va. November 8-9. Virginia Water Resources Research Center, 617 N. Main St. Blacksburg, VA. 881 pages.

Hoag, D. L. and A.G. Hornsby. 1991. Linking Economics to Groundwater Contamination from Farm Pesticide Applications. J.Environ. Qual. 21: 579-586.

Hornsby, A.G. 1992. Site-Specific Pesticide Recommendations: The final step in environmental impact prevention. Weed Technol. 6:736-742.

Hornsby, A.G., T.M. Buttler, D.L. Colvin, F.A. Johnson, R.A. Dunn, and T.A. Kucharck. 1991. Soybeans: Managing pesticides for crop production and water quality production. Circular 1003. Florida Cooperative Extension Service. Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. 12 pages.

Hurt, G.W., A.G. Hornsby, and R.B. Brown. 1991. Manatee County: Soil ratings for selecting pesticides. Soil Science Fact Sheet, SL-86. Florida Cooperative Extension Service. Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. 4 pages

Leonard, R.A. and W.G. Knisel. 1988. Evaluating groundwater contamination potential from herbicide use. Weed Technology 2:207-216.

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Table 1. Abbreviated soybean pesticide parameter matrix for selecting pesticides to minimize water quality problems.

Table 2. Abbreviated Example of Soil Ratings for Manatee County (see footnotes for explanations of column headings). Abridged from Hurt et al., 1991.

Table 3. Pesticide Selection Criteria.

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Figure 1. Pesticide selection worksheet for organizing information needed for selection process.

TABLE 1. Abbreviated Soybean Pesticide Parameter Matrix for Selecting Pesticides to Minimize Water Quality Problems. Abridged from Hornsby, et al., 1991.

Trade-Name[1]	Common Name	Application Type[2]		Sorption Coefficient[3]		Relative Losses		Toxicity		
		Soil	Foliar	K_{oc} (ml/g)		Leaching RLPI[4]	Runoff RRPI[5]	HAL or HALEQ[6] (ppb)		Aquatic LC_{50}[7] (ppm)
Herbicide										
Actor	diquat		x	1,000,000		>2,000	1	20	*	10
Alanap	naptalam	PRE		20	E (pH7)	14	14	300	*	76
Amiben	chloramben	x		15	E	11	11	100		non toxic
Assure	quizalofop-ethyl		x	510		85	33	60	*	18c
Banvel	dicamba		x	2		1	1	200		28
Basagran	bentazon		x	34		17	17	20		635
Blazer	acifluorfen		x	113	E	81	81	1		54
Bronco (M)	glyphosate	x	x	24,000	E	>2,000	1	700		8.3
Bronco (M)	alachlor	x	x	170		113	113	0.4		1.4
Butoxone	2,4-DB salt		x	20	E	20	20	70	*	4
Butyrac 200	2,4-DB salt		x	20		20	20	70	*	4
Canopy (M)	chlorimuron-ethyl	INC,PRE		110	(pH7)	28	28	100		950a
Canopy (M)	metribuzin	INC,PRE		60		15	15	200		76
Classic	chlorimuron-ethyl		x	110	(pH7)	28	28	100		950a
Cobra	lactofen		x	10,000	E	>2,000	33	10	*	nd
Command	clomazone	x		300		125	125	300	*	nd
Dual	metolachlor	INC,PRE		200		22	22	100		2
Fusilade 2000	fluazifop-butyl		x	5,700		>2,000	12	70	*	1.6
Gemini(M)	chlorimuron-ethyl	x		110	(pH7)	28	28	100		950a
Genini(M)	linuron	x		400		67	42	10	*	16
Goal	oxyfluorfen		x	100,000	E	>2,000	1	20	*	0.2b
Gramoxone Super	paraquat		x	1,000,000	E	>2,000	1	30		15
Hoelon	diclofop-methyl		x	16,000		>2,000	2	10	*	0.35
Lasso	alachlor	PRE		170		113	113	0.4		1.4
Lexone	metribuzin	x		60		15	15	200		76
Linex	linuron	x		400		67	42	10	*	16
Poast	sethoxydim		x	100	E (pH7)	200	200	600	*	170
Prowl	pendimethalin	x		5,000		556	2	300	*	0.199b
Reflex	fomesafen sodium salt		x	60		6	6	nd		680
Rescue(M)	naptalam		x	20	E (pH7)	14	14	300	*	76
Rescue(M)	2,4 DB		x	20	E	20	20	70	*	4

HAL or HALEQ[6]: Lifetime Health Advisory Level or Lifetime Health Advisory Level Equivalent.

Continued---

TABLE 1. Soybeans - Pesticide Parameter Matrix---Continued:

Trade-Name[1]	Common Name	Application Type[2] Soil	Application Type[2] Foliar	Sorption Coefficient[3] K_{oc} (ml/g)		Relative Losses Leaching RLPI[4]	Relative Losses Runoff RRPI[5]	Toxicity HAL or HALEQ[6] (ppb)		Toxicity Aquatic LC_{50}[7] (ppm)
Herbicide										
Reward	vernolate	INC		260		217	217	7	*	4.3
Round-Up	glyphosate		x	24,000	E	>2,000	1	700		8.3
Salute(M)	metribuzin	x		60		15	15	200		76
Salute(M)	trifluralin	x		8,000		1,330	2	5		0.041
Scepter	imazaquin	INC,PRE		20	f(pH)	3	3	2,000	*	>100
Sencor	metribuzin	x		60		15	15	200		76
Sonalan	ethalfluralin	x		4,000		667	4	300	*	0.0075
Squadron(M)	imazaquin	x		20	f(pH)	3	3	2,000	*	>100
Squadron(M)	pendimethalin	x		5,000		556	2	300	*	0.199b
Storm(M)	acifluorfen		x	113	E	81	81	1		54
Storm(M)	bentazon		x	34		17	17	20		635
Surflan	oryzalin	x		600		300	83	400	*	3.26
Tackle	aciflurofen		x	113	E	81	81	1		54
Treflan	trifluralin	x		8,000		1,333	2	5		0.041
Tri-Scept(M)	imazaquin	INC		20	f(pH)	3	3	2,000	*	>100
Tri-Scept(M)	trifluralin	INC		8,000		1,330	2	5		0.041
Turbo EC(M)	metribuzin	x		60		15	15	200		76
Turbo EC(M)	metolachlor	x		200		22	22	100		2
Vernam	vernolate	x		260		217	217	7	*	4.3
Whip	fenoxaprop-ethyl		x	9,490		>2,000	12	20	*	0.48
Zorial	norflurazon	x		700		233	48	300	*	6

[1]Trade-Name: (M) indicates that the product is a mixture of two or more active ingredients.
[2]Application Type: INC: incorporated INJ: injected PRE: preemergence x: applied to soil surface or foliage

[3]Sorption Coefficient: E: estimated G: educated guess
[4]Relative Leaching Potential Index (RLPI): Smaller number indicates greater leaching hazard.
[5]Relative Runoff Potential Index (RRPI): Smaller number indicates greater runoff hazard.
[6]HAL or HALEQ: Lifetime Health Advisory Level or Lifetime Health Advisory Level Equivalent.
*: Lifetime Health Advisory Equivalent

[7]Aquatic Toxicity LC_{50}: value is for rainbow trout 48 or 96 hr exposure time, unless otherwise specified
a=channel catfish b=bluegill c=carp j=fat head minnow

nd: no data available.

Table 2. Abbreviated Example of Soil Ratings for Manatee County, (see footnotes) *Abridged from Hurt et al., 1991.*

MUID[a]	NUM[b]	MUSYM[c]	SOIL NAME[d]	LEACH[e]	RUNOFF[f]
81001	1	1	ADAMSVILLE VARIANT	High	Medium
81002	1	2	BEACHES	High	High
81003	1	3	BRADEN	Medium	Medium
81004	1	4	BRADENTON	Low	High
81005	1	5	BRADENTON	Low	High
81006	1	6	BROWARD VARIANT	High	High
81007	1	7	CANOVA	Low	High
81007	2	7	ANCLOTE	Medium	High
81007	3	7	OKEELANTA	Low	High
81008	1	8	CANAVERAL	High	Medium
81009	1	9	CANAVERAL	High	Medium
81010	1	10	CANAVERAL	High	Medium
81011	1	11	CASSIA	High	Low
81012	1	12	CASSIA	High	Low
81013	1	13	CHOBEE	Low	High
81014	1	14	CHOBEE VARIANT	Low	High
81015	1	15	DELRAY	Low	High
81016	1	16	DELRAY	Low	High
81017	1	17	DELRAY	Low	High
81017	2	17	EAUGALLIE	Low	High

Footnotes:

[a]**MUID** = Soil Conservation Service's map unit identifier.

[b]**SEQ NUM** = Sequence Number, indicating a particular soil name among one or more names constituting a map unit name.

[c]**MUSYM** = Map Unit Symbol from the soil map and legend in the Soil Survey of Manatee County, Florida. Note that if a MUSYM appears more than once in this list it signifies that two or more soils are co-dominant in that map unit, and each such soil is rated separately here.

[d]**SOIL NAME** = Name of soil or other landscape component (urban land, pits, dumps, water, etc.).

[e]**SOIL LEACH** = The rating of the soil for leaching of pesticides through the soil profile.

[f]**SOIL RUNOFF** = The rating of the soil for runoff of pesticides from the soil surface.

Table 3. Pesticide Selection Criteria.

If Soil Ratings Are:		Select Pesticide With: Leach		Runoff
High	Low	Larger RLPI value,	AND	Larger HALEQ value.
Medium	Low	Larger RLPI value,	AND	Larger HALEQ value.
Low	Low	Larger RLPI and RRPI values,	AND	Larger HALEQ and Aquatic Toxicity values.
High	Medium	Larger RLPI and RRPI values,	AND	Larger HALEQ and Aquatic Toxicity values.
Medium	Medium	Larger RLPI and RRPI values,	AND	Larger HALEQ and Aquatic Toxicity values.
Low	Medium	Larger RRPI value,	AND	Larger Aquatic Toxicity value.
High	High	Larger RLPI and RRPI values,	AND	Larger HALEQ and Aquatic Toxicity values.
Medium	High	Larger RRPI and RLPI values,	AND	Larger Aquatic Toxicity and HALEQ values.
Low	High	Larger RRPI value,	AND	Larger Aquatic Toxicity value.

PESTICIDE SELECTION WORKSHEET

Landowner/Operator Name:_____ County:_____ Date:_____

Crop:_____ Farm ID:_____ Field ID_____ Sheet___of_____

Target Pest (1)	IFAS Recommended Pesticides (2)	K_{oc} Value (3)	Realitive Losses: Leaching RLPI (4)	Realitive Losses: Runoff RRPI (5)	Toxicity: Lifetime HALEQ* (6)	Toxicity: Aquatic Toxcity (7)	Soil Type (8)	Soil Leaching Rating (9)	Soil Runoff Level (10)	Selected Pesticide (11)	Comments (12)

If the K_{oc} value is 100 or less or if the RLPI value is 10 or less and the soil leach rating is high, then the pesticide has a high potential for leaching and should be used with extreme caution. Alternative pesticides and reduced rates should be considered if possible. Apply pesticide during periods with low potential for rainfall if possible.

H. Building A Gulf Constituency: Encouraging Individuals And Organizations To Make A Difference For The Gulf Of Mexico

Grassroots Organizing: Reaching Out To Minorities And People Of Color

Scott Douglas
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Birmingham, Alabama

What constitutes the Gulf Coast constituency? With the Mississippi River draining more than 40% of the 48 contiguous states into the Gulf of Mexico and ½ of U.S. export/import tonnage passing through Gulf waters, most of the U.S. population has a vested interest in the Gulf. The viability of hundreds of species, the heritage of unique ecosystems, and the quality of life of millions of people depend upon the mobilization of an expanded, inclusive Gulf constituency. Therefore, it is necessary to make the public more aware of these issues and enlist it to act on behalf of a sustainable economic, social, and political relationship with the Gulf, its wetlands, and its watershed.

The ecological problems of the Gulf Coast can no longer be considered apart from the economic and social problems which characterize the region. After all, there is the historical pattern of disempowered peoples, ecological abuse, and grossly unsustainable development in the states bordering the Gulf. Of those states, only Texas finds itself above the fourth (lowest) quartile in factors affecting the quality of children's lives (KIDS Count Data Book, Center for the Study of Social Policy). If the children are indeed the future, one must seek to build a Gulf constituency among the least healthy and educated populations of the country.

It is important to remember that voiceless communities of the past have achieved numerous gains in Congress and the state legislatures through increased representation due to redistricting and reapportionment. For instance, approximately one-half of the Congressional Black Caucus is from the South. In fact, 13 of its 16 new members are from the South.

The newly elected U.S. Senator from Colorado, Mr. Ben Nighthorse Campbell, joins Sen. Daniel Inouye of Hawaii as the only Native Americans in the U.S. Senate. The addition of Mr. Nighthorse Campbell is expected to amplify the concerns of Native Americans fighting environmental problems across the country and focus new light on indigenous peoples in the Americas.

Without increased citizen empowerment, the goal of an expanded Gulf Coast constituency will remain elusive. Obviously, the basic elements of a broad outreach are not in place. Those seriously interested in casting a wider net for a new coastal constituency will apply investments of resources, reasoning powers, and attention to detail to comprehensive outreach across barriers of race and economic status similar to those applied to other worthy research and development projects.

What are the elements of minority outreach for an inclusive coastal constituency? First, one must be mindful that the coastal constituency cannot be built successfully only from residents of coastal communities. Industry, when building its constituencies, understands this well. Second, one must assess all the resources of communities of color that have any tie, whether actual or potential, to sustainable Gulf policies. Third, one must design, through truly collaborative processes, mechanisms of inclusion that translate effective dialogue into effective policies.

Extending minority outreach on and beyond the Gulf Coast could be initiated by establishing a coastal education, preservation, and restoration network utilizing the contributions of existing voluntary associations and non-profit organizations. The point of communicating to these groups, however, is not to have them sign on to some 21st Century blueprint for the Gulf, but for them to participate in its development.

Primary participants include the relevant issues committees from hierarchical churches/associations of independent churches, people of color in the non-profit sector, and Historically Black Colleges and Universities (HBCU). To accomplish this, a multicultural entity with state affiliates could be built and empowered to initiate, facilitate, and channel the comprehensive issues bound to emerge from the expansive dialogue. Such a multi-state, multicultural entity could disseminate information, investigate alternative models of economic development, incorporate the rich historical legacy of the Gulf, and provide Gulf consciousness far upstream.

Building such an entity requires taking bold steps. One must be prepared to expect perceptions of what is realistic to vary by class, race, and location. This is only an affirmation that experience affects perception. One should also be prepared to address substantive issues of great consequence, such as a superfund for displaced workers and/or communities, tightened and enforced waste measures, and various moratoria on coastal and near coastal development. But, if one is not willing to consider these steps, building broader constituencies may be useless.

Building A Gulf Constituency: Creating Environmental Projects With Punch

Heidi Smith
Sarasota Bay National Estuary Program
Anita Hocker
Sarasota County Schools
Ingrid McClellan
Honey Rand
Mote Marine Laboratory
Sarasota, Florida

It's one thing to have a great idea for educating and involving the public in protecting bays and the Gulf of Mexico. It's quite another to put all the pieces together to create a project with punch, one that really makes a difference in changing the way people interact with coastal resources.

A successful education and action project basically requires four elements: Management, Money, Manpower, and Media. Management denotes the leadership, money management, buck-stops-here role that must be effectively filled, regardless of how many helpers are involved. Money is, well, money. Most projects require it or donations of time, equipment, or supplies. Manpower takes two forms -- the helpers who put the project together, and the citizens who take part in the event or program. Finally, media means promotion. Getting the word out helps support the money and manpower elements of the project and, ultimately, makes or breaks the project's effectiveness as a vehicle for change in the community.

Management

The person who takes responsibility for an environmental project can expect to invest time and energy in proportion to the scale of the project. The larger or more comprehensive the project, the more money, manpower, and media the manager will require. A close-knit, coordinated team of leaders can be a real asset.

The manager is the end of the line for all problems and disputes, so a clearly defined objective and project strategy are essential to maximize positive results and minimize difficulties. The project strategy should start with clearly stated objectives keeping with the natural resource's needs but also meeting the community's priorities. For example, a project related to preventing stormwater pollution would help a bay or the Gulf and could also incorporate a local government's needs to respond to Federal mandates. Thus, the assistance of the local government could be assured, enhancing opportunities for generating funding and community involvement.

Be certain of not only what is to be accomplished by the project but also which audience(s) will be targeted. This will be essential in the other aspects of the project, and focusing efforts on achieving specific results will make the project team's efforts pay off as true environmental benefits result.

Money

Cash is only one method of funding a project. Donations of food, supplies, products, equipment, or time may be just as valuable, depending on the project. Because cash is generally more difficult to come by, strategies for securing it are the focus here.

Consider all likely sources of money, including both public and private organizations. Some examples are government agencies, private foundations, businesses, civic organizations, or fundraising projects by volunteers.

Regardless of the funding source, a good prospectus or proposal is a necessary promotional tool. An effective proposal includes clearly defined objectives targeted to the funding source, a method of evaluating the project's effectiveness, a plan of action including a reasonable time frame, and a budget with as much detail as possible. Funding sources expect that promises will be kept, so follow-through is essential. Also, funding sources expect positive exposure from their involvement. Generating positive media coverage will "thank the bank" and help ensure an open door for the next funding request.

Media

The news media, including newspapers, radio, and television, are excellent partners for projects that benefit the community. They can help generate volunteers, attendance, and funding, while carrying the project's environmental education message throughout the community.

Develop a constructive working relationship with local reporters by providing crisp, well-written news releases and being willing to work with their schedules. Pitch the story of the project using an angle that will appeal to a newsperson, i.e. show the reporter or editor how the project relates to a hot topic in the community or benefits local residents. The ability to supply information tying the project to a state or national effort also can be effective.

Don't forget about newsletters of civic groups, conservation organizations, colleges, and universities. These are excellent vehicles for reaching grassroots constituents for volunteers or participants.

Manpower

The project manager who has no help also has no project. Recruiting volunteers involves many of the same sales skills as fundraising and media relations. Volunteers need to understand why their efforts are essential to the project, and they must be rewarded or recognized when they come through. Volunteers can be found through the media, from civic groups seeking a community service project, from schools, local governments, or by word-of-mouth.

When recruiting participants in a hands-on project, decide which audiences would be most appropriate and develop a letter and/or phone conversation for each audience. The sales pitch should explain how the project will benefit both the participant and the community.

Organizing For Community Involvement In Difficult Situations

Joy Towles Cummings
Salem, Florida

The purpose of this paper is to explain how to organize a community with an environmental crisis which is largely unknown and difficult to get residents to do something about!

Taylor County, Florida is home to a paper pulp plant that is currently owned by Proctor & Gamble on the Fenholloway River, which was made a Class 5 industrial river in 1947. An industrial river is one with very few, if any, restrictions placed on industry so that it can dump its toxic effluent into the river. Many consumer products, paper products, and bleached white cellulose products that society used to live happily without are produced at this chlorine-using cellulose pulp mill.

The plant is responsible for a great deal of environmental degradation. For 38 years, the plant contaminated the water and the environment. Also, a huge inland bay and a wetlands area was drained to plant pine trees for pulpwood in the headwaters for the Fenholloway and other rivers and creeks in the county. Now, the river is nearly all pulp mill effluent, 50,000,000 gallons a day, except for a few springs. Also, twenty-five square miles of sea grass is dead where the Fenholloway flows into the Gulf of Mexico.

There is, however, an important political problem. P&G is the largest employer in this rural county of 17,000 people, dominating the county's economy. The company owns 85 percent of the land in the county, pays half the taxes, and employs about a thousand hard-working people. P&G has sold all of its pulp mills around the U.S. except this one, but what company is going to buy itself that headache? Threats of closing the mill have fueled job blackmail, and that fear grips the community. However, how will this mess get cleaned up if the company leaves? Will it become a Superfund site?

A change in consumer attitudes needs to occur. Will it make any difference if disposable diapers are a light tan color rather than white, knowing how they are used?

In order to convince the local citizens that their help was needed, the problem was related to them through everyday events. Hunters and anglers knew that the local deer population was producing smaller horns and that female fish were producing male sex characteristics.

Rather than merely contacting EPA and local politicians and attending hearings as one normally does, local residents provided dramatic demonstrations of the problems in Taylor County. Baby formula was made with local water and dioxin-contaminated mullet dinners and noxious well water were served to regulators after they'd said nothing was wrong with the water. Signs were placed on the river with all of the information about it; people spoke at the company's annual meeting; chlorine shipments were prevented from arriving, and lawsuits were filed in federal court.

In renewing P&G's 1984 NPDES permit that expired in 1989, EPA should impose some meaningful restrictions. Without them, the permitting process is just that -- the process which permits industries to pollute.

There are many things that one can do to get the community involved in, be aware of, and educated about local environmental problems. First, however, one must understand the problem completely. Research must be done constantly. Helpful persons must be identified, and a group must be formed and meetings held. Work should be delegated among the members, and media attention should be obtained whenever possible.

At this point, give up all other activities, one won't have time for anything else. Make the hard work fun, and socialize with new friends made through environmental activism. They may take the place of one's family members, because by this time, the environmental problem will have totally taken over one's life. Therefore, it is important to show the members that they are appreciated.

Snoop on the environmental problem-causer. Find out what they're doing, and remember the cockroach theory -- when a light is shined on them, they scurry away from the light. Always tell the truth; it is not necessary to lie about polluters, they tell enough lies for everyone.

Keep track of accomplishments and failures, and congratulate oneself occasionally. Move forward constantly, and don't ever look back. Expect the unexpected, but never do what the polluter expects. Be prepared for the worst. Be brave. Be vigilant.

Write, call, write, call, write, call, and get media attention. Protest, raise Cain, make demands. Be willing to negotiate, but don't give an inch. Take a stand and don't ever back down. Write more letters.

Identify those people in the federal and state agencies who are helpful. There are lots of good folks who want to help.

The two main things that work are lawsuits against the polluters and exposing the polluters in the media. So file a lawsuit and develop an effective public relations campaign.

The author's wish list includes: passing fishermen's right-to-know laws in every state, signs should be placed where people shouldn't eat the fish and shellfish, and real action should be taken so the signs can be taken down. Instead of just closing off fishing areas and restricting the number of fish a person can legally catch, the cause of the problem should be solved so that pollution does not continue.

Perhaps these words from Margaret Mead best encapsulate what is necessary, "Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed it's the only thing that ever has."

V. Students' Forum

A. Sea Grant Science Project Winners - The Best

Carbon Concentration By *Emiliania huxleyi*

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Debate continues to grow over the role of carbon fixation in the sea acting to remove CO_2 from the atmosphere. The influence of the marine unicellular alga, *Emiliania huxleyi*, one of the principal photosynthetic organisms globally, has figured prominently in major studies. However, it is debatable whether the net effect of *E. huxleyi* is removal of CO_2 by photosynthesis or creation of CO_2 by calcium carbonate deposition, summarized by the equation:

$$Ca^{2+} + 2HCO_3^- \text{------} CaCO_3 + CO_2 + H_2O.$$

Thus, for each carbon in carbonate deposits, a CO_2 molecule could be generated. In this study, a way to test directly whether *E. huxleyi* removes or adds to atmospheric CO_2 was devised. In addition, experimentation on the properties of carbon fixation by this organism was conducted.

Procedures

Cell cultures were grown in synthetic f/2 media, and transfers were done weekly in sterile conditions. Two methods were used to test whether *E. huxleyi* removes or adds to atmospheric CO_2. In the first approach, the amount of CO_2 that moved from the atmosphere to the media, in both the presence and the absence of cells, was measured. Experimental setup consisted of two glass vials with gas tight silicon tops through which samples could be taken with a syringe. Small Eppendorf tubes were suspended in the top of each vial with monofilament. Cells in media were pipetted into one of the gas tight vials. Media containing no cells was pipetted into the other. To begin measurement of the flux of CO_2 from the atmosphere to the media, $H^{14}CO_3^-$ was pipetted into the Eppendorf vial, along with HCl to convert the bicarbonate to CO_2. Triplicate samples of the medium were taken at half hour intervals. Each 0.1 ml sample was injected into a vial containing 10 ml of scintillation fluid, then radioactivity (carbon uptake) was measured with a liquid scintillation counter.

In the second approach, the amount of carbon released from the medium to the atmosphere was measured, again in both the presence and the absence of cells. The same type of gas tight vial was used, except there was no Eppendorf vial as ^{14}C was added directly to the media rather than to the air. The first vial contained media with cells; the second contained only media. To begin the experiment, ^{14}C was injected into the media of each vial. The amount of CO_2 that was released was measured by sampling the air with a gas tight syringe. The air samples were injected into a gas tight vial containing scintillation fluid. NaOH was added to raise the pH of the scintillation fluid, convert the $^{14}CO_2$ to $H^{14}CO_3^-$, and, therefore, trap the labeled carbon in the fluid so it could be counted in the liquid scintillation counter.

The ability of *E. huxleyi* to accumulate inorganic carbon inside the cells was evaluated by a series of carbon concentration experiments. The technique is called the Silicon Oil Assay, and it is based on the fact that liquids with different densities can be layered and do not mix. The cells were separated into two groups, one at twenty degrees Celsius, and, the other, at two degrees Celsius. In plastic centrifuge tubes, 200 l of 10% NaOH (1.11 g/ml) was pipetted, followed by 200 l of less dense silicon oil (1.05 g/ml). To measure the amount of inorganic carbon inside the cell, a 200 l sample of the *E. huxleyi* culture (1.02 g/ml) at 20 degrees was layered on top of the silicon oil, and 2 Ci of $H^{14}CO_3^-$ was added. The cells were exposed to light for one minute and allowed to perform photosynthesis, then centrifuged at 14,000 rpm. The cells were spun through the silicon oil into the NaOH layer. The centrifuge tube was then placed into a bath of methanol and dry ice and frozen. The NaOH layer of the cells was cut off using a small, handheld rotating saw and placed in a test tube containing scintillation fluid and counted.

The resulting radioactivity represented total carbon associated with the cells, organic and inorganic. Since only the amount of inorganic carbon was being sought, the amount of organic carbon was found so that it could be subtracted from the total carbon measurement. This was done by adding 100 l of 5 M HCl to the remaining sample in the test tube and leaving it overnight. The next day, a half milliliter of the sample was put in scintillation fluid and counted. The remaining counts represented acid stable carbon, or organic carbon. Except for the acid treatment, the same sampling procedure was used for the *E. huxleyi* cultures at two degrees Celsius. The resulting number after the samples had been counted represented any C^{14} that was not inside the cells, but had been carried with the cells through the oil. This is because, at two degrees, all processes of *E. huxleyi* are thought, essentially, to shut down. To find internal inorganic carbon in the cell, the number of acid stable counts at twenty degrees

and the number of counts at two degrees were subtracted from the total counts per minute at twenty degrees Celsius.

Results and Discussion

The studies reported herein all showed that the effect of carbon fixation by *E. huxleyi* is to remove inorganic carbon from the medium which sets up an influx of CO_2 from the atmosphere. This is supported by direct measurement of $^{14}CO_2$ influx from the air and CO_2 outflux from the medium. In the presence of cells, more CO_2 was taken in from the atmosphere than in the absence of cells. In the presence of cells, less CO_2 was released from the media than in the absence of cells.

While it is true that calcification may generate CO_2 within the cells, this extra CO_2, evidently, is immediately converted by photosynthesis to organic carbon and not released to the sea as free CO_2. The simple inorganic equation shown above is not really applicable to biological calcification.

The experiments on carbon concentration by *E. huxleyi* showed that the cell does not concentrate inorganic carbon relative to what is available from the medium. Many modern algae can do this to an extent of 100 fold, or more. This fits with the assumption that coccolithophorids (a group of which *E. huxleyi* is a member) may be an old group of algae that lacks the mechanism.

The paradox is, that although *E. huxleyi* seems to lack an important carbon concentration mechanism, it is, nevertheless, among the most abundant and widely distributed of all photosynthetic organisms. It may be that *E. huxleyi* is good at concentrating some other nutrient that limits the growth of modern algae. This puzzle is currently under further study.

Tiny Toxic Tyrants Cleanup Man-Made Mishaps: A Study Of *Pseudomonas aeruginosa*

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There is an increasing problem in, not only the Gulf of Mexico, but every other ocean, sea, lake, and river in the United States and countries across the globe. The problem is oil pollution of waterbodies.

Every year, more than 400 billion gallons of oil are transported around the world, of which over 100 million gallons are spilled into the Earth's waters. Recently, in 1990, the Gulf of Mexico suffered a dramatic oil spill off the Texas coast when 4.5 million gallons of light Angola Crude were lost from the Mega Borg supertanker. *Newsweek* magazine called this "one of the largest tanker spills in American coastal waters." The Mega Borg was ignited during the routine, but dangerous process of lightering, or transferring part of a heavily laden ship's cargo of oil to smaller ships so that it can navigate in a shallow ship channel. "But, as the oil hit the sea, it turned into a floating inferno, sending thick black plumes twisting into the skies and crackling with a sound like rain on a thousand barbecue grills," also according to *Newsweek*. *Time* magazine stated that "The 30 mile long slick seemed likely to inflict some -- but not major -- damage ashore. It had been a close call."

How many close calls will we have to endure before some drastic action is taken? The Mega Borg incident is just one of several recent oil spills. One can't forget the Exxon Valdez oil spill in 1989, which was the largest in U.S. history covering over 3,000 square miles of water and 1,100 miles of beaches and shorelines. The last count of wildlife which died due to the oil spill identified 580,000 birds, 5,500 sea otters, and 22 whales.

Thus, the author decided to investigate and conduct experiments using an inexpensive, natural, and effective means to clean up oil spills, *Pseudomonas aeruginosa*, a bacteria that secretes a soap-like material which enhances the removal of oil from gravel and other surfaces. In the Exxon Valdez oil spill, according to *Science News*, *Pseudomonas aeruginosa* "removed three times the amount of oil washed away by plain warm water, commonly used by cleanup crews." The cleanup effort did more harm than good, considering that the principal method used to clean the beaches was to shoot water, at temperatures of 100 degrees Fahrenheit or hotter, out of high pressure hoses, essentially boiling the organisms in the lower food chain.

Bioremediation is defined as elimination by bacteria. Bioremediation costs between $50-100 to eliminate a ton of oil, which is cheap compared to the $1,000 cost of incinerating the same amount of oil.

Hence, using all of the collected data, the author hypothesized the effects of *Pseudomonas aeruginosa* on Castrol GTX motor oil. To begin, it was believed *Pseudomonas aeruginosa* would effectively deteriorate crude oil. Second, the ratio of *Pseudomonas aeruginosa* to oil concentrations ranging from 1 x 10 to 1 x 10 would determine the amount of oil broken down and the time it takes to dissolve. Third, the lysis of oil would prove the effectiveness of *Pseudomonas aeruginosa* in oil slicks.

Soon after reaching the hypotheses, the author wondered what was the purpose for the investigation. Determining if *Pseudomonas aeruginosa* would be an effective method of bacterial cleanup -- if the oil would actually be dissolved, how much time would be required to dissolve it, and exactly

what ratio would work best -- was the purpose. Then, procedures were developed for three experiments.

In Experiment #1, a serial dilution of *Pseudomonas aeruginosa* was prepared by inoculating the bacteria into separate test tubes filled with distilled water. The bacteria were then transferred to nutrient agar plates and allowed to incubate at 37 degrees Celsius for 24 hours. After the 24-hour period, each plate was covered with 1.5 ml. of Castrol GTX motor oil. The results were monitored daily for lysis of the oil.

In Experiment #2, a turbidity box was made to observe the turbidity of the test tubes. The interior was painted black, and a light was placed at one end. Holes were drilled in the blocks to hold the test tubes while they were analyzed. As the light passed through the test tube, it fell upon a photoelectric cell. A galvanometer, which measures current, was attached to the cell, and readings were taken according to the amount of light passing through the test tubes.

In Experiment #3, a 35% solution of salt water was prepared to simulate the sea. Twenty ml. of water was placed in test tubes. Bacteria from each of the dilutions was inoculated into the water. The tubes were covered in oil ranging from increments of 1-9 ml., and they were monitored daily by measuring the number of millimeters the bacteria had broken apart.

In conclusion, *Pseudomonas aeruginosa* proved to be a very effective, inexpensive, and natural way to clean up man-made disasters. Therefore, for the most part, *Pseudomonas aeruginosa* proved worthy as a clean up method for oil spills. It tightened the bond and shortened the gap between technology and the simpler world around us. However, it also proved that no matter how highly-advanced the technology, nature may be the best remedy. And a better remedy is what is truly needed to prevent oil spills in the Gulf of Mexico and around the world.

Nutrients Effect On *Codium* Algae

Paul Constant
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Algae, which are classified according to their color, belong to the kingdom Protista and are very important because they are the start of a food chain. Fish depend on algae for their food, and people eat the fish. In addition, many foods, such as gelatin, ice cream, chocolate milk, and beer, use ingredients derived from algae.

Codium isthmocladum blooms have been reported in all parts of the Caribbean and South Florida for the past five years, but the reason for their appearance is unknown. The blooms appear in early summer and start to die off in late October. The algae smother reefs and kill sponges, coral, sea fans, and other sea life. It appears that algae are fed by polluted water from storm runoff or sewage outfall pipes pumping nutrient-rich water into the ocean.

Some scientists believe that anthropogenic nutrient inputs have enhanced coastal reef productivity with subsequent impacts on reef habitat quality and resource yields.

The SEFLOE II study is being done in Southeast Florida to determine the destination and impacts of the existing outfall discharges. Some other causes or contributing factors may be upwellings from offshore or discharge from large canals draining agricultural areas.

About 350-400,000 gallons of sewage are discharged daily into the coastal waters offshore in Southeast Florida. During the height of the *Codium* algae bloom, approximately 80% of reefs are covered. During the past five years, there have been reports of *Codium isthmocladum* smothering the reefs from Key Biscayne to the Lake Worth inlet. The depth at which the algae is found ranges from showing up on the beaches to 600 feet. In the summer time, when the bloom is at the height of its cycle, approximately 85 million pounds of *Codium* algae can be found on the reefs of South Florida. Commercial net fishermen have a difficult time with the algae because it gets caught up in their nets.

Algae is the fastest growing plant life on earth and *Codium* is capable of very rapid growth. It reproduces by breaking apart and releasing spores. *Codium isthmocladum* has a certain type of pigment which allows it to live in deep water and thrive in limited light. Algae blooms are controlled by nutrients, pH, and temperature.

Research Paper

Recently, the water temperatures have been warmer than usual and may be linked to the bloom. When the corals are covered with *Codium*, they don't receive the proper amount of sunlight and cannot exchange gases with the water. Therefore, they die. The fish and crustaceans become displaced due to algae settling in cracks and holes which drives them out of their habitat.

When *Codium* algae drifts with the current, it seems to snag easily on soft corals and sponges, usually resulting in death. When the algae begins to disappear in the winter months, all that is left is the skeletal remains. These sections are usually overcome by something else which leaves no opportunity for it to regenerate. Masses of *Codium isthmocladum* have been known to accumulate in excess of four feet.

The fish population, appears to be affected by the *Codium* algae also. A large percentage of the casual fish population

has decreased since the blooms appeared on reefs. Some of the fish affected were angelfish, parrotfish, and surgeonfish. *Codium* could be the cause of the reduction in reef productivity. Tropical fish collectors believe that the loss of food source and environmental degradation are the major factors. These algae blooms could be the beginning of a serious problem from which it could take decades to recover.

Predicting Seasonal Hurricanes In The North Atlantic

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Since reading an article quoting Emmanuel and Schneider in which they claim the intensity of Hurricane Hugo would have increased greatly if the water temperature had been several degrees warmer, the author sought to predict the effects of climate upon the intensity and number of hurricanes. This paper presents a model predicting the number of hurricanes in the North Atlantic Ocean by using the Southern Oscillation Index, Caribbean sea temperatures, North Pacific sea temperatures, West African rainfall, and Quasi-biennial oscillations or 30-mb winds.

Factors Affecting Weather and Hurricane Formation

According to Golub and Brus, at irregular intervals about every 3 to 4 years, the normal pattern of the tropical Pacific Ocean area becomes disrupted because of a phenomenon known as El Nino. During El Nino years, the surface waters of the tropical Pacific become unusually warm in a region extending from the South American coast to the west, extending as far as the International Date Line. El Nino is not an isolated occurrence, but it is, instead, part of a pattern of changes in the global circulation of the oceans and atmospheres. Southern Oscillation causes the atmospheric pressure to rise in the normally low-pressure areas over Indonesia, while the pressure falls in normally high-pressure areas in the southeastern Pacific. When the warming ends, the reverse occurs, allowing the pressures to return to normal.

According to Gray, the tropical eastern and central Pacific sea-surface temperature warming events associated with El Nino reduce hurricane activity in the western Atlantic during the season following the onset of an El Nino event. The occurrence of such an El Nino-Atlantic hurricane activity relationship is associated with extra deep cumulus convection found in the Pacific during such warm water episodes. This enhanced convection is associated with strong westerly tropospheric wind patterns over the Caribbean and equatorial Atlantic. These enhanced westerly wind patterns are believed to reduce the number of hurricanes.

El Nino causes an enhancement of the westerly winds, or weaker easterly winds, over the Caribbean and western equatorial Atlantic regions and, thus, creates conditions different from non-El Nino years. These upper tropospheric westerly winds that occur during El Nino years lead to a situation in which the seasonal 200 mb wind flow is greatly reduced over the Caribbean basin, and in the western Atlantic, it is significantly reduced from conditions normally occurring in non-El Nino years.

The upper tropospheric westerly winds that occur during El Nino years lead to a situation in which the seasonal 200 mb wind flow is greatly reduced over the Caribbean basin and the western Atlantic. These westerly winds are significantly reduced in speed from normal conditions occurring in non-El Nino years. Hurricane activity is lessened by any process that suppresses seasonally averaged upper tropospheric wind patterns.

El Nino events are usually associated with low surface pressure values in the southeastern Pacific. When this occurs, it is expected that West Atlantic hurricane activity will also be below normal in years with a low Southern Oscillation Index.

The Quasi-biennial oscillation is a shift in the 50 mb winds, from East to West, occurring every 26 months. Seasonal hurricane activity occurring in non-El Nino years with easterly equatorial 30 mb winds has been studied and compared with seasonal hurricane activity in non-El Nino years when 30 mb winds were westerly. Gray found that when the westerly 30 mb winds are accompanied with increasing westerly wind speeds, hurricane activity is typically higher than during easterly 30 mb winds. Easterly winds and El Nino seems to have the same suppressing effect on hurricane activity. Other factors that share a part in the formation of hurricanes, according to Atkinson, are sufficiently large ocean areas with warm surface temperatures and weak vertical wind shear in the basic current.

It is the author's hypothesis that the seasonal number of hurricanes can be predicted with a statistical model based on regional climatic factors. If true, then this will lead to possible applications in forecasting seasonal hurricanes and changes in tropical storms due to global warming.

Using the regional climatic data and similar data from global warming model predictions, a statistical model was developed and tested. Regression and correlation analysis showed that the Southern Oscillation, sea surface temperatures, North Pacific temperatures, 30 mb winds, and West African temperatures for January and February were highly correlated. Physically, this model also had parameters that seemed likely to predict the number of tropical storms.

Although this experiment had good results, February precipitation was chosen, along with May sea surface temperature anomaly, June North Pacific temperatures, July Southern Oscillation, and March 30 mb winds for the forecast model. This model had parameters available for use in a

predictive model. The skill score was 19% with a root mean square of 1 and the prediction varied by one storm to the actual. According to this model, the forecast number of hurricanes for the 1992 hurricane season will be 2 to 3 events.

The Effects Of Cobalt-60 On The Germination Of *Spartina alterniflora*

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The purpose of this report was to determine the effects of Cobalt 60 on *Spartina alterniflora. Spartina* has a normal germination rate of 30% in the environment. In the control of the author's experiment, a 39% germination was achieved.

The author began with the null hypothesis that germination of *Spartina alterniflora* would not be effected by gamma irradiation. To prove this, seeds were obtained from Louisiana State University and radiated in the University's Nuclear Science Department. They were exposed to rads in multiples of five to determine the effects on germination. The largest positive effect was observed at the 20 rad dosage level. The germination for the control was 39%, while the germination rate for the irradiated seeds totaled 62%. There was a marked decrease in germination beginning at 50 rads. The seeds were also discolored as the doses increased.

Currently, *Spartina*, quart-sized plants are purchased at a cost of $2.85 per plant to restore the marsh area in the LaBranch Wetlands. At that rate of germination, the cost of plants should greatly decrease because of the supply produced.

The technique is not as complex as one might imagine. It is based on the fact that if, under safeguarded conditions, the gamma rays emitted from a radiation source are allowed to pass through seeds, the rays kill or reduce the number of bacteria and fungi reducing germination (the radioisotope most often used is Cobalt 60). In a previous experiment, the author discovered that radishes exposed to radiation produced larger leaves and fleshier roots. Therefore, this technique could be very beneficial for farmers.

The effects of germination were significant. Generally, *Spartina* is located in an area with brackish water (0.5 - 2.0% salt). *Spartina* is very important to the future of Louisiana for two reasons. First, *Spartina* has large binding roots which hold soil together and prevent erosion. Second, it has a high tolerance to salt dissolved in water.

Over the years, thousands of new channels and canals have been dug in the Louisiana marsh. Many of the channels provide ingress to saltwater from the Gulf of Mexico to fresh water areas where plants cannot live with increased salinity. The plants and grass die, exposing the fragile, rich soil to tidal action. Without the massive plant root system for protection, the marsh soil is carried away, creating new areas of open water. Every year, Louisiana loses about 50 square miles of marshland, or about 4 acres per hour.

The South Louisiana marshes containing *Spartina* provide hundreds of estuarine nutrients upon which many species depend during their life cycle. Many of these species are vital to Louisiana's economy. Each year, Louisiana produces about 90% of the nations alligators, 50% of the national crab harvest, 40% of the national oyster harvest, $90,000,000 of shrimp, $45,000,000 of menhaden (a bait fish), and $16,000,000 of fur. The marsh also provides habitat for about 3-5 million waterfowl each year, primarily ducks. Therefore, Louisiana faces severe economic consequences from increased saltwater intrusion, and measures must be taken to protect *Spartina alterniflora*, not only for the State's economy, but for the continued existence of the plant.

On Earth Day 1991, Mr. Milton Cambre planted the author's *Spartina* in the LaBranch Wetlands Project. A total of 29 plants were embedded in the sediment in a semi-circle as part of an attempt to build up the land. Also, 24 containers of grass were planted along the sandy areas.

On January 2, 1991, the number of plants remaining was recorded, and 18 *Spartina* and 11 individual grass plantings survived. Sediments were being trapped by the plants to build up the land, while the massive roots were binding soil to prevent erosion. One month later, 14 plants remained, and new roots had developed. The grasses were planted close together and formed ground cover on the sandy beach area.

Bibliography

Palmisano, Angelo Williams, "Plant Community-Soil Relationship in Louisiana Coastal Marshes," University Microfilms International, Ann Arbor, Michigan. (1981).

McDaniel, Donald, "Soil Survey of St. Charles Parish, Louisiana," United States Department of Agriculture. (1987).

Louisiana Association of Conservation Districts, "Coastal Erosion ... Everyone's Problem," New Orleans, Louisiana. (1987).

B. The Environment As An Outdoor Classroom

Wesson Elementary School PARKnership Program

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In 1989, educators at Leonard Wesson Elementary School embarked upon a quest to change the world, child by child. At Wesson, the mythological dragons about females and minorities versus science are being slain. This is being done, in part, through an environmental education program that encompasses summer programs using a specific ecosystem as the theme for teaching all academic subjects. This approach helped Wesson to be the only elementary school in Florida to be included in the PARKnership pilot program for 1992-1993, which is a joint effort of DOE and Florida DNR to provide environmental services for state parks and schools. In the PARKnership program, a state park provides an "outdoor classroom" and technical assistance, while the school provides a service for the park that would otherwise not be done. Wesson has completed one project for Wakulla Springs, and the students are excited about continuing this unique PARKnership with seven more projects this year.

A Constructed Wetland Model In A Recreational Park

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Four Bonnabel High School sophomores organized an intense effort to construct a model wetland area in a recreational park in Jefferson Parish, Louisiana. The Seiko Youth Challenge Team members, Aaron Jabes, Jeannie Pham, Miranda Sherbs and Long Pham, exhibited great interest and concern for the disappearing wetlands. The students conducted extensive research on the coastal wetlands, investigated attempts by agencies to reduce coastal erosion and wetland loss, examined some of Lake Pontchartrain's problems, and concluded that constructing a model wetland area could be a beneficial contribution to the research community.

After the lagoon area in Lafreniere Park was selected as the site, preparations were made for the project. Detailed measurements were made of the area, a plot plan was developed, plants were researched to develop a database of potential plants, the number and type of plants to be used was decided and calculated, and a trial run was conducted. Volunteers constructed over 1,200 nutria excluder devices (NED's) which were needed to protect newly planted vegetation from nutria and ducks. The NED's were constructed from chicken wire rolled into a cylindrical cage which was placed around the newly planted vegetation.

In early April, the Seiko Team organized over 100 students and faculty volunteers in Operation Marsh. One group went to Lake Catouatche to gather plants, while another group stayed at Lafreniere Park to organize the NED's. When the plant gatherers returned from the marsh, the plants were transplanted into their new home and protected with the NED's. The project was quite successful and provided a stable wetland area for research purposes, as well as visual and educational benefits to the lagoon area of Lafreniere Park.

The Natural Environmental Lab

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The Natural Environmental Lab is a restoration project to return an unused area of a school campus to its native wetland habitat. Students, which are the core of this project, have contributed countless hours of planning and manpower to develop it. In this hands-on learning experience, students planted native flora, introduced ground cover, mounted bird houses, and helped in a controlled burn. Fifteen to twenty acres of unused school property were an overgrown, swampy eyesore, but hard work by enthusiastic students and their dedicated teacher made this land the perfect natural laboratory. It offers a variety of habitats to study, from a natural bog to a bayou and a meadow. Numerous species of the animal kingdom, from invertebrates to vertebrates, are represented. Similarly, a wide variety of plant life, from simple algae to towering pines and deciduous trees, are present.

The initial plan was met with great enthusiasm; however, before the project could become reality, two years were spent in extensive planning and research. It was necessary to obtain permission from numerous sources, including neighboring homeowners and the school board. Funding was obtained from corporate sponsors and individual donations through a series of multiple presentations to a wide variety of community groups and civic organizations. Help was sought on several levels, ranging from the P.T.A.-sponsored sale of individual boards in the viewing boardwalk to large scale land shaping by members of the nearby naval construction battalion. It was a slow process since all labor was provided purely on a voluntary basis. The project became reality and the initial phase was accomplished over a four year period.

Currently, the lab is available to all school classes, as well as individuals in the community. The lab is used for a wide variety of purposes, from detailed study of plant and animal life to an alternative location for leisure activities, such as walking, jogging, and bird watching. Future plans include restoring the natural habitat by reintroducing native plants and providing food sources and shelter for wildlife. This will enable interaction between students and the environment for years to come. The long term goals is to create a self-sustaining ecosystem for future generations.

Take A Class Outdoors (TACO)

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Many years ago in ancient sailing times, sailors mistakenly thought manatees were mythical mermaids, or women who lived under water. Eighteen young women from Booneville High School traveled to Crystal River, Florida, last December to swim with those mermaids and study the environment in which they live.

The students participated in the school's Take-A-Class-Outdoors (TACO) program. The program, designed to interest females in careers in science and mathematics, stimulates thinking about scientific and engineering careers, develops logical reasoning and problem solving skills, promotes positive attitudes toward science, and increases the student's interest and knowledge about scientific work. The program provides hands-on experiences in geology, astronomy, botany, entomology, ecology, meteorology, and marine science.

The first TACO program was implemented during the 1988-89 school year with Exemplary Programs in Mathematics, Science, Computer Learning, and Foreign Languages funding. The project served 50 young women each semester in the first year. Students in Biology I and Advanced Biology classes applied to participate in the program by writing essays on why they would like to participate in the outdoor classroom project.

Although funding for exemplary projects was not available during the 1989-90 school year, teachers and administrators saw the tremendous impact the program made on the students in past years and sought funding from the Mississippi-Alabama Sea Grant Consortium to provide the opportunity to study marine science on the Mississippi Gulf Coast. Students learned field techniques and studied salt marsh and barrier island plants, animals, and processes.

During the spring of 1991, 32 young ladies attended an advanced session mini-camp in marine science. The girls enjoyed dissecting sharks, studying the sea turtle, beachcombing, and fish printing. The mini-camp emphasized the importance of protecting the natural resources and preventing the extinction of animals and plants.

In February 1992, the students traveled to Crystal River, Florida to swim with the manatees. They received instruction

in snorkeling prior to the trip. During the six day excursion, students trawled in Mobile Bay, Alabama. Over 25 specimens were collected and identified for further use in the classroom. Students were introduced to estuarine habitats and the importance of preserving them as nursery grounds. The young women were ferried to a dredge spoil site where they were introduced to the plants and animals of this unique flood plain habitat, how the natural system works, and the basic ecology of the Apalachicola National Estuarine Research Reserve.

The highlight of the Crystal River trip was a two mile float-dive which allowed girls to view a variety of fish species, turtles, plant life, natural springs, caves, caverns, and rock formations to depths of up to 35 feet. The significance of this portion of the trip for the students was to experience this type of environment which does not exist near their school in Northeast Mississippi. Despite the chill of the 70 degree water, no one seemed anxious for the trip to end, and many young ladies left knowing they wanted to pursue a marine science-related career.

The benefits of Project TACO are far reaching and numerous. Students have shown increased interest in science courses -- enrollment is steadily increasing, graduates are choosing majors in a greater variety of science fields -- many of whom attribute their choice to past TACO experiences. The most positive feature of the program has been the enhancement of classroom learning, not only for the two hundred-plus students who have participated, but also for those with whom they share their experiences and increased knowledge.

C. Water Quality Activities And School

Bonita Imperial River Project (BIRP)

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In this time when new environmental threats are created every day yet are unnoticed, teachers at Bonita Springs Middle School decided they had to develop a plan of action to improve student awareness of these issues.

The concerned teachers took action in the 1991-92 school year by adopting the Imperial River as a water system to study. The project became known as the Bonita Imperial River Project, or B.I.R.P. The teachers designed a hands-on, interdisciplinary program to determine the Imperial River's health and its role in the community. The objective was to instill knowledge through cooperative participation.

Leading this proposal, Mr. Al Hegner and a team of fellow teachers formulated the B.I.R.P. plan. It was a time consuming process involving a multitude of red tape, and the teachers devoted a significant amount of time and effort to succeed in getting the project started. They decided to use a combined team of 40 sixth grade "At Risk" students, and 150 eighth grade students served as mentors for their younger peers. The students were grouped into eight learning teams, and each group was divided into five mini-cooperative teams.

The project was conducted for a full day, once a week, for four months. All activities were held outside, and each integrated fine arts, mathematics, natural and physical sciences, social issues, environmental awareness, and physical education. Teams rotated among activities for periods of 3 ½ hours. Every session opened with time to share feelings through creative journal writing and closed with a round-circle, student-teacher discussion of failures and successes.

Because of shipping problems, inadequate funding, and lack of time, sufficient scientific data to fulfill the objectives could not be gathered. The teachers formed a plan to complete the project the next school year. However, environmental awareness was heightened in participating students, who truly enjoyed the project.

As a participating eighth grader, the author felt this was a good opportunity for students to become environmentally-aware within a relaxed learning atmosphere. The teachers were very supportive, respectful of student ideas, and encouraged the students to get involved. The students felt secure about being honest with the teachers and developed a one-on-one relationship with group mentors and educators. To be given a voice in the round circle discussions of the negative and positive aspects of the day was something the students had not experienced before, and the author felt good expressing her views and being heard. The river project was fun for everyone involved, and the students looked forward to them. There was no better way to spend a Monday.

The Bonita Imperial River Project was a great activity to incorporate into the curriculum of Bonita Springs Middle School. It accomplished an often sought, but rarely achieved combination of sincere learning for all involved. It is the author's sincere belief that projects of this nature are necessary if the current generation of children is called upon to solve the ecological problems that besiege the environment.

Project F.U.R. (Fight Urban Runoff)

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Project F.U.R. (Fight Urban Runoff) is based on the belief that individuals are the basis of all environmental action.

Lake Pontchartrain, once a recreational haven for New Orleans area residents, has become increasingly polluted over the past three decades. Urban stormwater runoff has been identified as the most serious threat to the lake's ecosystem, but it is also the factor most responsive to individual action. Since many individuals see no connection between their daily activities and environmental degradation, PROJECT F.U.R. was organized to address that issue. Through a plan of environmental awareness and civic action, PROJECT F.U.R. interacts with the public and encourages local residents to do their part to clean up the Lake Pontchartrain Basin Ecosystem by reducing stormwater runoff pollutants.

The awareness phase was planned to educate the public regarding problems associated with improperly-disposed-of motor oil and its effects on the Lake Pontchartrain ecosystem, as well as the benefits of recycling used motor oil. Reduction of stormwater runoff was the major goal, with energy conservation a close second. Used oil is a neglected, but valuable resource that can be recycled and reused as a lubricant or fuel. Because New Orleans is "a city in a saucer," if used oil is not recycled and improperly disposed of, as is often the case, it enters the extensive system of drainage canals and pumping stations that empty into the Lake Pontchartrain Basin ecosystem.

EPA studies show that "do-it-yourself" mechanics mismanage at least 61% of the oil they handle, and publicity about recycling used oil is believed to triple do-it-yourselfer participation in recycling programs. Most citizens were not aware that collection sites were available in their neighborhoods at local quick-change oil service establishments, parish recycling centers, and other sites. PROJECT F.U.R. decided to publicize that fact!

Through a community outreach program, the members of PROJECT F.U.R. brought that message to as many people as possible. After educating the students of Holy Cross High School, arrangements were made to speak at other schools, civic meetings, and environmental fairs. Copies of EPA pamphlets on recycling used oil were obtained and distributed. Bumper stickers provided by the Lake Pontchartrain Basin Foundation and posters from the Louisiana Department of Environmental Quality were also given to the public. The team designed and distributed a flyer and information sheet on urban runoff and its effects on Lake Pontchartrain.

The vision of a volunteer "army" was realized in May 1991 with Phase I of the Stencil-A-Drain project. Organized in Jefferson Parish, the project involved a cooperative effort of the Louisiana DEQ, the Delta Chapter of the Sierra Club, local businesses, and civic organizations. PROJECT F.U.R. also played a significant role in the development and implementation of the Stencil-A-Drain project. Storm drain covers in the Bissonet area of Jefferson Parish were stenciled with the logo "Dump No Waste--Drains to Lake" to remind residents that carelessly disposed hazardous materials have a negative impact on the Lake Pontchartrain ecosystem.

One of the current goals is to have the project authorized in Orleans and St. Bernard parishes to increase public knowledge about stormwater runoff.

Another part of our civic action campaign involves an exciting example of recently developed technology -- the used oil filter "crusher!" Recycling used oil is important, but the used oil filters present another problem. Containing as much as a quart of oil, used filters are often left to drain into the ground or end up in landfills. Through the generosity of Custom Compactors, Inc. of Tampa, Florida and with the help of W.A. Offshore Co. of Kenner, Louisiana, PROJECT F.U.R. was provided with a "Crusher 1" used oil filter compactor. In less than ten seconds, the oil is drained from the filter as it is reduced to the size of a hockey puck. The recovered oil and the compacted filter can then be recycled. PROJECT F.U.R. is currently planning to collect used oil filters from Holy Cross High School students and from local mechanics.

In order to understand more fully the effects of pollutants in the Lake Pontchartrain Basin ecosystem, PROJECT F.U.R. conducts monthly water quality studies at several sites along the south shore of the Lake. Students collect plankton, record observations of other biota, and monitor water turbidity, temperature, dissolved oxygen, salinity, pH, nutrients, metals, and fecal coliform bacteria. Data is collected, evaluated, and kept for future study.

Begun in 1990, PROJECT F.U.R. has been highly successful. It has been recognized at the local, state, and national levels. The group was a regional winner of the prestigious President's Environmental Youth Award. More importantly, as students, members of PROJECT F.U.R. experienced the scientific, social, and political components of an environmental issue and had the opportunity to apply knowledge to a real-world situation.

A healthy Lake Pontchartrain will be a major recreational and economic asset to metropolitan New Orleans. Achieving that goal through public education and civic action is the objective of PROJECT F.U.R.

The Water Quality Event At The Science Olympiad

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Science Olympiad is a competition for junior high and high school students with 28 different events. Each event is scored separately, with the total of each team's event scores determining the overall team standing. There are three levels of competition -- regional, state, and national.

One event was Water Quality, which required testing water samples provided by the event judges for total hardness, salinity, and acidity. To accomplish this, each team was supplied a kit with the necessary equipment and chemicals. A written test with questions about the oceans, the water cycle, and how humans pollute water and the steps that have and will be taken to test and clean-up the earth's water was given. Some questions were about the salinity of the oceans, or the amount of dissolved salts in the water, including what are the appropriate methods for measuring salinity (measuring the water's conductivity, evaporating off the water and weighing the remaining solids, etc.) and the preferred unit of measure (usually, grams per kilogram).

The exam also covered the equipment to test and clean bodies of water. Some equipment used by water quality specialists are bottom dredges (or an Eckman dredge), secchi disks, and a cylinder-shaped device called a Kemmerer water sampler. The bottom dredge scoops up sediment from the bottom of a lake, or other body of water. The scoop is attached to a pole with a button on the top. After the dredge-scoop has been forcefully dropped into the sediment, the button is pushed, releasing the spring-loaded jaws that close around the trapped sediment. This allows the dredge-scoop to be lifted from the water with the sediment sample in place, and it is dumped into a bucket and examined. Water quality is measured indirectly by determining the diversity and number of living organisms in the sediment sample. Both numbers and diversity of organisms should be high if water quality is good; fewer organisms are present when water quality is poor or pollution is increased. Insects obtained can be checked in the laboratory for signs of pollution, such as for DDT, PCBs, or heavy metals.

To find the clarity of the water sample, a secchi disk is used. A secchi disk is a round, flat object with alternating sections of black and white on its surface. The disk is attached to a rope marked to indicate the length, and it is lowered into the water until the lines can no longer seen. The depth to which the disk has been lowered is then recorded. The further down the disk can be lowered before the lines disappear, the higher the clarity of the water.

The Kemmerer water sampler is a tube on a shaft with stoppers on each end that is attached to a rope and has a brass weight. At first, the ends of the tube are both open, so the tube can slide through the water as it is lowered without disturbing the water. When the sample depth has been reached, the weight is dropped, pulling the stoppers over the ends of the tube and trapping the water from the desired sample level. Then, the tube is raised to the surface, and the water sample is emptied to another container for testing later. This equipment enables scientists to sample water at a specific depth or location which can be tested for parameters such as specific pollutants, oxygen content, alkalinity, or hardness.

In the lab part of the Water Quality Event, the teams were given water samples to test. One test was the oxygen, or BOD (Biochemical Oxygen Demand), determination. Some of the sample is transferred to a test container, which must be done slowly to prevent more air from being added to or lost from the sample. The contents of a "powder pillow", which is a capsule containing pre-measured quantities of chemical reagents that change the form of oxygen, is added to the water sample. The new oxygen form is more stable, and it is ready for the addition of a chemical indicator. The indicator is added to the sample, drop by drop, and mixed into the sample. Each drop added to the sample until it turns completely pink is counted, and the number of drops is used to calculate the amount of oxygen present in the sample.

Another test was for pH, which determines the acidity of the water sample. This was tested in two ways. A piece of pH paper is dipped in the water sample, and the color to which it changes is compared to a chart corresponding to the pH of the water.

The other method uses a device to measure the pH. Some sample water is poured into two identical test tubes, and six drops of pH indicator is added to one of the test tubes, changing the color of that water sample. Nothing is added to the water in the other test tube. The test tubes are then placed in a rectangular box with two holes in the top for the test tubes. The test tube with the indicator added goes into the center hole. The untouched sample is placed in the outer hole, which has a color wheel on the inside, with each color representing an acidity level. The disk is turned until the color of both tubes is the same, and the pH is indicated by the color on the portion of the disk in front of clear sample when the tubes match. A dark green match might mean a pH of 7.5 (on the alkaline side of the pH scale), while a lighter green might mean an acidity of 7.0 (neutral). The device is called a colorimeter which measures pH colorimetrically.

In the Science Olympiad competition, the lab results were weighted as 50% of the grade (the results were matched to the known values for the samples), and the written test as the other 50%, with each question being of equal value. In case of a tie, the lab score was used as the tie-breaker.

The Weeks Bay Estuary Project

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The Weeks Bay Estuary Project was formed to give seventh and eighth grade students enrolled in Gulf Shore Middle School in Foley, Alabama the chance to learn in a different environment. The project provides seventh and eighth grade students with real-life situations, helps students with their math, science, and english skills, and teaches students with different learning styles.

The program has received numerous awards and recognition. For instance, it was awarded an $11,000 AmSouth Educational Grant in 1992. For the past two years, 1991 and 1992, the program has received the Alabama's Best Environmental Education Program Award sponsored by the Center for Environmental Research and Service. Alabama Governor Hunt issued a proclamation honoring the Gulf Shores School and the Weeks Bay Project, and the City of Gulf Shores and Orange Beach declared it an Outstanding Learning Project.

The activities of the Weeks Bay Estuary Project were coordinated with Baywatch, Weeks Bay Estuary Reserve, and the Baldwin County School System. In 1992, the project focused on water quality. Monitoring the quality of the Weeks Bay-Fish River water system is the principle focus. Students were taught how to sample, conduct water tests, and operate a calorimeter.

A typical day at the Weeks Bay Reserve is as follows. A group loads up on a bus at school, with either Mr. Valine, the science teacher, of Mr. Vest, the math teacher. Whichever teacher doesn't get on the bus will take Mr. Valine's jeep, with all the proper equipment, to the 150 year-old oak tree. The bus arrives with the students later at the reserve. The students, Mr. Valine, and Mr. Vest take the equipment out of the jeep and place it by the oak tree. Mr. Vest reads off the names of students in each group and in which research zone they will participate. There are six different research zones.

One group will go to the still photography research zone, at which one person is given a camera. Pictures are taken of animals, nests, bogs, plants, streams, etc. Another group learns how to forecast the weather. Humidity, temperature, the direction and speed of the wind, the type of clouds, the percent of cloud cover, the altitude of the clouds, and the time of day are recorded.

The next group gathers mollusks and analyzes parasites. At this research zone a group of students digs on the shore of Weeks Bay to collect clams, oysters, and snails. Then, using a microscope, they analyze the parasites on, and in, the mollusk.

The fourth research zone is estuary analysis. The student group in this zone maps the entire estuary. The map includes the deck, marsh, pier, and other discoveries made that day.

Water quality is the fifth, and most important, research zone. In that research zone, a group of students collect two water samples at three sites in Weeks Bay. The samples are tested for dissolved oxygen, Ph, dissolved carbon dioxide, total dissolved solids, turbidity, mercury, and temperature. Students are taught how to sample, conduct water tests, and operate a calorimeter.

Students in the final research zone are responsible for collecting raw data. They collect all the information gathered that day and enter it on a computer.

After each group works at their particular research zone for three hours, they have a 30-minute lunch break, although it is often cut short. At 2 o'clock, all of the equipment is packed up, and the students go back to school. The students must then write a 300 word essay on what they did that day.

With this information gathered, the teachers use things that happened at Weeks Bay as examples in their lessons on Thursdays and Fridays.

It is much easier to remember ideas learned from experiences at the Weeks Bay Reserve than from reading a book.

D. Addressing Broader Issues

Student Involvement In Local Environmental Politics

Jeremy Conner
LBJ High School
Austin, Texas

Students are the driving force of change in politics today and the educated voting force of the future. Although most students are too young to vote, they achieve political change through many means, such as testifying at local government meetings, picketing, organizing letter writing campaigns and boycotts, and educating other citizens. Since the youth of today will inherit the earth, it is our responsibility to make it worth inheriting.

The Austin City Council has been one area where students have been able to influence local politics. Students at LBJ High School influenced the Austin City Council's decision to ban detergents containing phosphates. To accomplish this, LBJ students collected water quality data and used the results in testimony presented to the Austin City Council.

The students' presentation was influential, and it was enhanced through the use of many visual aids. For example, the students used many charts for their data and demonstrated how they obtained their results. Since the City Council tries to televise its hearings, the testimony given by LBJ students was well publicized. Their presentation was still being shown on television several months after it occurred. City Council meetings are an excellent place to influence voters by showing them that students are serious about, and involved in, issues relevant to their communities.

Recently, the Austin City Council has been the battle ground over the Barton Creek Watershed. A new subdivision was being built in the area, but many critics were concerned over the level of environmental safeguards. Many feared that construction would damage the Barton Creek Watershed and Barton Springs, a very popular, spring-fed pool. Students from LBJ testified at and picketed City Council hearings on the issue. Four LBJ students testified, giving reasons why there should be stricter regulation of the subdivision. One student's testimony was so moving that the entire audience at the hearing gave a standing ovation. The speech was included on the evening news. Other students picketed outside City Hall. Some signs said "Honk if you support Barton Springs". This was effective because the noise from the cars could be heard inside the hearing room, demonstrating to the City Council Members that the community strongly supported protecting Barton Creek.

Several students from LBJ spent their summer in the Austin Youth RiverWatch Program. The Austin RiverWatch Program is a year long program in which students monitor local creeks and serve as peer tutors for At-Risk students. The program has a two fold purpose. One is to spread environmental knowledge to other high school students, the other is to keep At-Risk students in school. Students from LBJ have taken their proteges to environmental concerts, recreational events, and taught them to do water quality testing.

Student teams test various creeks once a week for nitrates, phosphates, dissolved oxygen, fecal matter, temperature, and pH levels. They also look for stream flow rates and record the many kinds of life present in and around the creeks. Then, the information is sent to the Lower Colorado River Association, enabling it to provide ample, valid data to other government agencies.

Schools play an important role in the education and organization of the student body so that students may influence local politics more effectively. As mentioned earlier, there is an Environmental Science class at LBJ High School that monitors local creeks. This class also spreads information throughout the community by making environmental comic books that appeal to other students. Also, students in a marine science class sent letters to their local Congressman to encourage stricter laws to eliminate the use of purse-seine nets that can hurt dolphins. The Environmental Protection Organization is a student club that has held training sessions in water quality testing. Other clubs, such as the Marine Science Club and the Science Club, are dedicated to helping students experience nature.

Students from many schools participate in the Gulf Coast Clean-up, which can target certain industries that are not environmentally responsible. Also, there have been many lake and stream clean-ups in Austin, some of which students helped organize. Many other activities like these often occur locally, and their perpetuation must be encouraged by a strong, well-organized student turnout.

Students can play an important role in environmental issues. However, they must work hard to demonstrate that they are an informed, organized, and dedicated group with legitimate concerns. Student activities in environmental projects are enhanced by their ability to collect and analyze data. By speaking directly to lawmakers and voters, students can positively direct government to take responsibility for the environment.

Project Hermit Crab: Helping Environmental Research Monitoring In The Coastal Regions And Beyond

Jennifer Franke
Kim Kennedy
LBJ High School
Austin, Texas

The Federal Water Pollution Control Act of 1972, or Clean Water Act, mandated that the U.S. Environmental Protection Agency establish standards for clean water, monitor the nation's water supply for contaminants, and prosecute polluters. However, EPA lacks the manpower to fully monitor the nation's rivers and estuaries, and, so, it relies on self-reporting by government and business on the amount of pollutants released into waterways.

In response to this need for personnel, citizen's groups have established water quality monitoring programs. In Texas, Clear, Clean Colorado initiated a student-citizen monitoring program on the Colorado River named RiverWatch.

The RiverWatch program was so successful that it was adopted by both the Lower Colorado River Authority and the Texas General Land Office. Additionally, the Texas Water Commission adopted the RiverWatch model for its Project 2000 program, which covers all Texas watersheds. Coastal citizen groups have established monitoring networks for estuaries following the RiverWatch model.

While the upsurge in citizen involvement in water quality monitoring is welcomed by the EPA, the impact of citizen action is limited for three reasons. First, there are no established standards for water quality monitoring common to both fresh and saltwater studies. Also, no one has correlated the data from citizen's groups with that of government agencies, such as EPA. Lastly, there is no central repository for data from these networks. Consequently, interested citizens and environmental groups have limited access to the data generated, which is of limited value to relate the health of freshwater bodies to estuaries. Thus, Project HERMIT CRAB was conceived by the board of the National Consortium of Specialized Secondary Schools in Math, Science, and Technology to work with government and citizens groups to establish water quality monitoring standards consistent for fresh and saltwater and develop a monitoring network with the Consortium schools in the states bordering the Gulf.

In the first phase, a core group of ten students will be selected to work with teachers, government officials, and citizen group representatives. They will collect information about water quality monitoring techniques from government and citizen groups already monitoring fresh and saltwater in the Gulf states. They will also obtain two data bases from the EPA -- the point emission data base for riversheds terminating in the Gulf and the corresponding database with marine pollution levels in the estuaries affected by these riversheds. Then, the students will analyze the EPA data sets for fields that can be readily correlated and for deficiencies that can be filled by simple monitoring methods.

After conducting a literature review, core students will recruit other students in consortium member schools in coastal states. These students will research citizen and government water quality efforts in their respective states and write preliminary reports of their findings. The information from the data bases and the preliminary reports will be combined into the final report that students and teachers will present to a committee of government agency and citizen group representatives. This committee will work with teachers and students to determine which techniques not used by all groups should be included and establish the standard tests for the monitoring network. The students will compile the standard water quality tests and associated protocols into a handbook.

In the second phase, EPA trainers will teach core students and teachers how to conduct the standard water quality tests, initially at the annual N.C.S.S.S.M.S.T. student conference, and, then, to students, teachers, and citizen volunteers along the Gulf.

In the third phase, EPA trainers will teach core students and teachers how to use the Geographic Information System database. The students in the consortium will receive basic instruction in research and statistical methods relevant to the data. They will then teach this to other students, teachers, and citizens. Data collected by the voluntary networks, from the tip of Texas to Miami Beach, will be entered in the GIS, to which they will have access.

The project goals are to:

Tier One

- Standardize the type of water quality tests used by citizen groups and government agencies,
- Teach students, teachers, and citizens how to conduct the water quality monitoring tests,
- Teach GIS to students, teachers, and citizens, and
- Teach students how to analyze water quality data with appropriate statistics.

Tier Two

- Increase student's feelings of personal responsibility,
- Make science more relevant to students, and
- Encourage student scientific research projects using the data.

Tier Three

- Create a student-run citizen monitoring network that provides accurate, reliable water quality data,
- Make water quality data available to government, educational, and citizen groups through computer networks, and
- Encourage presentation of student research at national conferences.

The first tier goals will be evaluated primarily from a decision orientation. The second tier goals will be evaluated from a research-orientation, and the third tier goals will be evaluated from a systems-orientation (does it work for governmental agencies and citizen's groups already involved in water quality monitoring?).

The Earth - Everyone's Responsibility (TEER)

Jessica Burton
Carrie Mewha
Bay Point Middle School
St. Petersburg, Florida

Two years ago, eight students got together at Bay Point Middle School in St. Petersburg, Florida and pondered what they could do to help the environment. The students formed the TEER Club, which stands for The Earth - Everyone's Responsibility. The first year of the club, which now has over 75 members, was a pioneering effort by the few charter members. They established Green Week to promote Earth Day throughout the school.

Green Week activities included distributing green ribbons to the entire student body to symbolize a pledge to improve the environment. TEER members were magically transformed into SCUM BUSTERS and SCUM FAIRIES, distributing candy to those students displaying their green ribbons. Door decorating and other contests were also held during the first annual Green Week celebration.

By the beginning of its second year, the TEER club had more than tripled in size. Because of the strong support Bay Point and TEER showed for the environment, the school was chosen to be the pilot program for NEED, the National Energy Education Development program. Additionally, TEER received much needed financial and moral support from Florida Power.

To teach the students about energy resources and issues, a pair of TEER members went to each homeroom class for three days. The first day was spent introducing the five renewable and five non-renewable energy resources and reenforcing that knowledge with chants. On the second day, the students played a unique game using their chants and fact sheets while forming into separate groups. A Pictionary-type game with energy related topics was played on the third day. Keeping these sessions short, only twenty minutes each day, held the students attention and kept them interested. Later, TEER members and members of other student groups were trained to run the games provided by NEED and introduce speakers. TEER sponsors contacted environmental agencies to line up the speakers, which culminated in one spectacular day when students attended no classes, but instead, learned about energy, environmental, and Gulf of Mexico issues.

During the second year, the second annual Green Week was organized. Green ribbons were again distributed, but instead of giving out candy, students were given TEER bucks that could be traded for prizes. During the week, food was collected for various animal shelters, and a sculpture contest was held. In the sculpture contest, the homeroom classes created new forms of art by using biodegradable, organic, and recyclable materials. In addition, Rascal, a ferret from the local science center was adopted by the students, as were Olympia the whale, and a section of Brazilian rainforest.

TEER members participate in several community events. One of their favorite was last year's beach clean-up at Weedon Island. They collected over 25 pounds of trash, excluding a set of tires.

In the past year, TEER has received several awards for its achievements, including The Green Thumb Award for environmental excellence. Also, the club was recognized by the national NEED office for its efforts. Members were sent to Washington D.C. to attend the annual NEED conference and receive awards. TEER's accomplishments also earned Bay Point Middle School the Florida School of the Year award.

This year, TEER has three main goals. One goal is to create a natural habitat on campus because it is important for students to learn about Florida's ecosystems, not just through text-books, but through hands-on experience as well. The habitat will serve as an outdoor classroom large enough to allow many species of plants and animals to survive.

Another goal is to establish recycling programs at Bay Point and in the community. The first step taken was encouraging paper recycling by placing boxes in each teacher's room. The paper placed in these boxes was collected monthly for recycling. The second step will be to place canisters around the school for encouraging aluminum can recycling.

The third goal is to continue with efforts in the NEED program. TEER currently conducts workshops in four counties to help establish NEED programs in other schools. This year's plans include bringing the NEED program to Bay

Point Elementary School and conducting another annual fair and TEER Day.

TEER's efforts cover many environmental issues -- recycling, energy and water conservation, and wildlife and wetland preservation. With the help of students, teachers, and community leaders, the club plans to continue the tradition of environmental awareness and education for many years to come.

E. Make It Happen In The Field

Bird Island Habitat Restoration Project

Paige Provenzano
Chamberlain High School
Tampa, Florida

Bird Island is a national marine bird sanctuary located in Tampa Bay at the mouth of the Alafia River. In the past, a hard freeze caused significant damage to mangroves and other shore line vegetation, resulting in the loss of nesting habitat for the numerous species which live there and erosion of the shore line.

Marine biology classes from Chamberlain High School began a restoration project in September of 1988 which has become an on-going project. Red, white, and black mangrove seeds are collected by the students after school and on weekends. They are potted in class, placed in the school's greenhouse, and fertilized and watered until May. The plants are then sent by school bus, along with students, to Gardinier Park on the Alafia River.

Several state and county agencies provide boats and representatives to supervise the planting of mangroves and marsh grass on the shore line. The Florida Audubon Society is joined by members of the Department of Natural Resources, Tampa Bay Regional Planning Council Agency on Bay Management, Southwest Florida Water Management District Surface Water Improvement and Management Program, Mangrove Systems, Inc., Hillsborough County Schools Environmental Science Supervisor, and employees of Gardinier Chemical Company. The students are ferried to the island and spend the entire day restoring vegetation and watching birds.

Bird Island, or Alafia Bank, is the largest of the Tampa Bay Sanctuaries. Depending on the year and the condition of the fresh water wetlands, 8,000-15,000 breeding pairs of some 16 species of birds nest at the Alafia. They include brown pelicans, double crested cormorants, anhinga, nine species of herons and egrets, white ibis, glossy ibis, and roseate spoonbills.

In 1974 and 1975, reddish egrets nested at Alafia Banks; in 1975, fifteen pairs of roseate spoonbills were observed nesting. These were the first such records since the turn of the century. Species diversity here is greater than any other colony in Florida and may exceed that of all other wading bird colonies in the U.S.

Chamberlain students want to protect the significant breeding bird colonies of Tampa Bay by restoring the natural systems that support them. In addition to Bird Island restoration, Chamberlain students started a Mangrove Adoption Program.

Booths are set up at beach clean-ups and other environmental activities to allow people to gain an appreciation for the value of mangroves. Students help the prospective "parent" select a seed, plant and water it, and name it. Then, they are given official adoption certificates, a brochure on mangroves, and a list of rules for raising the mangrove properly. The adoptive parents raise the it for a year and return it on Earth Day the following year to plant it on Bird Island as part of the restoration project.

Chamberlain students have also distributed mangroves to elementary schools as part of an educational program to help children gain environmental awareness. By educating others and working to improve Bird Island, the students hope to make a favorable impact on the environment.

Save Our Swamps (SOS)

Eric Oosting
Randolph Tully
Environmental Education
Lee County School District
Fort Myers, Florida

The students of Lee County School District's Monday Group, the Action Environmental Education Seminar Class, have served the community and the environment for more than two decades. The group, which got its name from meeting every other Monday, is composed of junior and senior high school students who are interested in the environment from schools throughout the county. Every year, the class chooses a project which it feels will improve the world in which the students live.

In 1974, the students became concerned about Six Mile Cypress, a 2,500 acre cypress strand that flows across the eastern boundary of the City of Fort Myers. The swamp was proposed for public acquisition, and if it were not purchased by the public, it would probably have become short term farm fields, another large-scale real estate development, and the source of poles for fencing, destroying the delicate ecosystem through changes to the system's drainage and general degradation. The impact of the change in discharge from the watershed would have been felt throughout Estero Bay, the estuary into which Six Mile Cypress empties.

The first year project involved compiling an extended knowledge base about Six Mile Cypress Swamp. Students conducted a biological survey, an ownership survey, a geological survey, a hydrological survey, and a land use survey. All of their information was compiled into a booklet on Six Mile Cypress.

Because many juniors from that first class chose to participate again during their senior year, the Class of 1975 had a running start on its project. It decided to try to get a public referendum allowing citizens to acquire Six Mile Cypress by raising local taxes. The students did their homework, and, after two attempts, they succeeded in gaining the support of all five county commissioners. The students were able to influence the wording of the ballot and determine the timing of the election.

The following year, the class chose to continue the project. They were left with the problem of convincing the public that the cypress swamp was worth a $500,000 tax increase. From September to November, when the vote on the referendum took place, the students campaigned with no budget. However, on election day, the voters overwhelmingly approved the referendum with the highest plurality ever given to a tax issue in Lee County.

The next year's class took a look at the work of its two predecessors and decided that all work was not done. They found that no one in Lee County's Park and Recreation Department was trained in park planning. So, in the fourth year of the Six Mile Cypress Swamp project, the students made it their goal to create a Park Master Plan, which included a regional bike path system.

These early efforts are continued today by a group organized by students named Save Our Swamps (SOS). SOS is designed to be a public voice to encourage the preservation and appropriate management of wetlands in Lee County.

The class has lobbied for a mangrove protection ordinance in Lee County, for manatee awareness and protection locally and state-wide, and for the Southern Bald Eagle Habitat Protection Ordinance. Students were the first to conceptualize Manatee Park and were central to the negotiations between the land owner, Florida Power and Light, and the County.

Monday Group students also served as consultants to engineers for the environmental planning of Fort Myers Centennial Park, a river front park on the Caloosahatchee River.

The Monday Group regularly conducts field study trips to local beaches, bays, mangrove swamps, salt marshes, and fresh water streams, ponds, and swamps. Many Monday Group students are active in water quality monitoring projects in their home schools, particularly the Estero River Project and the Manuel's Branch project.

One of the most recent Monday Group initiatives was an attempt to get an environmental Management Plan, or GREEN Plan, established in Lee County schools. The School Board adopted the overall concept of the plan, and students are working to implement it. To accomplish this, the students are interviewing school district staff regarding current environmental efforts and the needs of each district department. These interviews will help establish a baseline of current environmentally-conscious practices and highlight the areas in which extra efforts need to be expended. The GREEN Plan will provide the blueprint to guide the district to environmental responsibility.

Chief Reef: Creating A Winning Video On the Constructive Use Of Plastics To Build An Artificial Oyster Reef

Phil Snow
Chamberlain High School
Tampa, Florida

Making an environmental video takes many more steps than most people think. Even before turning on the camera, there has to be an initial idea behind the video. Fortunately, the Chief Reef program provided a good idea for a video.

Once a concept is chosen, a script must be formulated. There are many stages to go through to put together any script -- researching the topic, organizing data, writing the rough draft, and finalizing the script. Once the script is completed, taping can begin.

Taping consists of putting together a production crew, finding a location, and shooting the footage. After taping comes editing, a slow process compared with taping. When editing, all footage must first be reviewed and cuts selected for final inclusion in the video. All cuts, or segments, must then be put back together on a master tape. The last stage of editing consists of touch-ups and addition of any music. After the video tape is finished, the final stage consists of two D's -- Duplication and Distribution.

In the end, all the labor is worthwhile because one is able to raise environmental awareness through today's most effective communication tool - video.

Starting A Recycling Program

Aimee Sandifer
Port Neches-Groves High School
Port Neches, Texas

As a fifteen year old freshman student at Port Neches-Groves High School, the author initiated and coordinated a pilot recycling project in the Southeast Texas communities of Nederland, Port Neches, and Groves, also known as Mid-County. The author's interest in recycling began during my spring break in May 1990 after attending the School of Environmental Education. The experiences there convinced the author of the need for nationwide recycling programs, and she felt that the best place to start would be her hometown.

The EPA issued a mandate to decrease the volume of waste going into existing landfills by 25% by the end of 1993, and the Mid-County landfill closed ten months earlier due to its location in a wetland area. This forced the use of a landfill in the City of Beaumont, some 15 miles away. These two conditions combined made the need for recycling even more urgent. Because so many materials and a great deal of space could be saved in landfills if materials are recycled, the author felt this should be done in her community.

The project goals were to heighten awareness of the need for recycling, convince the administration of the three cities that their residents were willing to recycle voluntarily, provide measurable quantitative results from a recycling project, and establish a permanent curbside recycling program.

After determining that these goals could best be attained by establishing a one week pilot project, the author contacted Browning-Ferris Industries and asked them to supply recycling containers to use in the collection efforts. After placing several telephone calls, the author attended a meeting of the Mid-County Municipal League, which represents the 50,000 residents of the three cities. The Municipal League, upon hearing this idea, quickly decided that the author could be part of the solution to the cities' waste problems.

The members of the Nederland High School Key Club and the Port Neches-Groves High School Student Council & Honor Society were enlisted to provide the manpower needed to collect the recycled items. These two high schools are bitter football rivals, and the author was extremely nervous when speaking on their campuses. But their assistance was crucial to making this idea work. Many new friendships were made, and the students were able to work closely as a team in this joint endeavor.

The author personally contacted and spoke with a variety of groups and individuals, including school administrators, Groves and Port Neches city councils, Nederland City Manager, Port Neches Elementary School, Port Neches Rotary and Lions Club, and the Mid-County Municipal League. The author was not accompanied by any faculty members of Port Neches High School at these speaking engagements, and she was the sole instigator of the project.

After receiving and invitation from the Southeast Texas Planning Commission to speak on Earth Day in Port Arthur,

a neighboring city, the author used this opportunity to stress the need to recycle and promote the upcoming recycling drive. It was proposed to the mayors and city councils of Port Neches, Nederland, and Groves that, when the drive ended, the income from the project would be donated to create a permanent recycling program.

To help publicize the eight-day recycling project, a poster contest was sponsored at both high schools, with a cash prize awarded to the winning entrant. The prize money was donated by area businesses and other organizations. A 30-second television commercial to promote the project was conceived, underwritten by Browning-Ferris Industries, and it was produced by the local television station, KJAC. Six representatives from each high school wrote the commercial, which included the spirited addition of the schools' mascots. The commercial aired for four days during the recycling drive.

The pilot recycling project reached across all segments of the communities in Nederland, Port Neches, and Groves. As previously mentioned, it included students at Nederland and Port Neches-Groves high schools, elementary school students, the local Rotary Club and Lions club, administrators of each city, and the Municipal League. It also received widespread media attention from local newspapers and attracted the attention of the editors of the Port Arthur News and the Beaumont Enterprise newspapers. There were 28 articles & four editorials written on the Mid-County Recycling Project. The local television stations also provided coverage numerous times as the project progressed.

Over seven tons of newspaper and 300 pounds of aluminum cans were collected, and when the proceed checks from the sale of the recycled items to the mayors of each of the three cities, they were reminded of their prior promise to use the money to establish a permanent recycling program in their communities. Ten months later, Browning-Ferris Industries signed a five year contract with the three cities. At the time it was initiated, the Mid-County Project was the largest curbside recycling contract in the State of Texas, involving over 50,000 residents.

Following the recycling drive, I learned of the President's Environmental Youth Award. The Mid-County Project was selected as a finalist from EPA Region VI, which covers Texas, Louisiana, New Mexico, Oklahoma, and Arkansas. The project won the first place award over 23 applicants, and the author was one of 10 students nationwide to receive this award. Sister Thomas Ann LaCour, Principal of the School of Environmental Education, sponsored the project, and she flew to Washington, D.C. with the author to receive the award from President George Bush and EPA Administrator William Reilly.

My initial interest in recycling began as a fascination in what we could save from going into our landfills. In the first year of the Mid-County Program, almost 2 million pounds of recyclable items were collected, saving 9,408 loose yards of landfill space and 9,073 trees.

Future generations of children should be able to enjoy beautiful forests and rolling hills, not mountains of trash. What better place to begin than with the youth of today. Recycling is the way for a better tomorrow.

Mid-County Recycling Project Additional Facts

March 1991 - February 1992

Nederland, Texas
By Trips To Recyclery
221 Trips X 29 Yds. = 6,409 Yds. X 85% (full) = 5,448 Yds.

By Commodity Weight To Volume Conversion Factors For Recyclables

Commodity	Lbs. Collected	-	Lbs. per Cubic Yard	=	Landfill Yards Saved
Aluminum	21,811		62		352
News	342,940		500		686
Glass	187,475		800		234
Hdpe	16,119		24		672
Pet	15,433		35		441
Tin	44,789		62		722
Total	628,567 lbs.				3,107 Yds.

Groves, Texas
By Trips To Recyclery
209 Trips X 29 Yards = 6,061 Yds. X 85% (full) = 5,152 Yds.

By Commodity Weight To Volume Conversion Factors For Recyclables

Commodity	Lbs. Collected	- Lbs. per Cubic Yard	= Landfill Yards Saved
Aluminum	21,811	62	352
News	342,940	500	686
Glass	187,475	800	234
Hdpe	16,119	24	672
Pet	15,443	35	441
Tin	41,404	62	722
Total	628,567		3,107 Yds.

Port Neches, TEXAS
By Trips To Recyclery
211 Trips X 29 Yards = 6,119 Yds. X 85% (full) = 5,201 Yds.

By Commodity Weight To Volume Conversion Factors For Recyclables

Commodity	Lbs. Collected	- Lbs. per Cubic Yard	= Landfill Yards Saved
Aluminum	18,841	62	304
News	352,880	500	706
Glass	173,256	800	217
Hdpe	14,755	24	615
Pet	14,705	35	420
Tin	41,404	62	668
Total	615,841 Lbs.		2,930 Yds.

Environmental Savings

City	News Tons	Trees	Electricity or Gas KWH	Gallons
Pt. Neches	176.44	2,999	1,835,152	17,644
Groves	171.47	2,915	1,783,459	17,147
Nederland	185.81	3,159	1,932,610	18,581
TOTALS	533.72	9,073	5,551,221	53,372

Saving In Manufacturing By Using Secondary Materials - % Reduction

	Aluminum	Steel	Glass	Paper
Energy	95%	55%	15%	55%
Air Pollution	95	86	20	74
Water Pollution	97	76		35
Mining Waste		97	80	
Water Use		40	50	58

Figures supplies by: Browing-Ferris Industries, Inc. Beaumont District

F. Hands-On-Training

SAML-NSF Minority Work-Related Experience Aboard National Marine Fisheries Service Research Vessels

Alonzo Hamilton
National Marine Fisheries Service
Pascagoula, Mississippi

The Southern Association of Marine Laboratories (SAML) Minority Participation Project is the product of 9 of its 31 member institutions. The project was developed by Doctors Dirk Frankenberg and Harold Howse to increase the participation of Historically Minority Colleges and Universities (HMCU) in marine and natural sciences. These institutions lag in these subject areas, and this project represents the foresight and initiative of the projects authors, directors, and participants.

SAML used its comparative advantage as a regional organization, with close ties between its members and HMCU's, to seek funding from the National Science Foundation (NSF). A grant from the NSF was used to sponsor four workshops to lay the groundwork for a minority participation project. The Minority Institutions Marine Science Association (MIMSA), the official outreach organization for SAML minority projects, was established as a result of the third workshop. MIMSA is operated from the School of Science and Technology at Jackson State University, Jackson, Mississippi, under direction of Dr. Jonathan Wilson, Professor of Marine Science studies at the University.

The National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center is an active sponsor of the minority participation project. NMFS received NSF/SAML funding to place minority faculty and students aboard NOAA vessels, and the NSF/SAML/NMFS Project provides students with at-sea experiences in marine science disciplines. The project is conducted from NMFS/Mississippi Laboratories in Pascagoula under the direction of Ms. Gladys B. Reese. The project began in 1991 and will run through 1993. The grant provides funds for participant travel to and from NOAA vessels and student stipends when students must miss work to participate on cruises.

Approximately twenty minority students have participated aboard NOAA vessels operating from Pascagoula, Mississippi and Woods Hole, Massachusetts. Vessels participating in the project include the NOAA ships OREGON II, CHAPMAN, ALBATROSS IV, and DELAWARE II. Participation in this type of effort demonstrates the Federal government's resolve to enhance its commitment to provide technological and academic expertise to minority institutions. Providing such opportunities for scientific experience, hopefully, inspires students to pursue scientific careers and increases the applicant pool of eligible minority professionals in the fields of science and technology. Participating institutions benefit further through expanded academic research opportunities.

Raceland Jr. High Conservation Club And FFA

Kory St. Pé
Slade Basson
Raceland Jr. High School
Raceland, Louisiana

Located 40 miles west of the city of New Orleans and the Mississippi River, 40 miles east of the Atchafalaya Basin, and 40 miles north of the Gulf of Mexico in one of the largest and most productive estuaries in North America, Raceland Junior High School students are offered a variety of opportunities for outdoor educational activities. To channel student activities in a positive direction, the Raceland Junior High School Conservation Club was formed in 1975. The club has a long history of working on projects beneficial to the community and the environment.

One of the most popular programs the club carries out is the Wood Duck Nesting Box Project. Over the years, more than 300 wood duck nesting boxes have been built and placed throughout Lafourche and Terrebonne parishes to provide valuable habitat for wood ducks. This program was expanded to include squirrel den boxes.

The club sponsors annually a Hunter Education and Safety Program. This program teaches wildlife management and hunter safety, ethics, and responsibility. Students receive state-required certification after successfully completing the course. This program has been expanded to include a Young Sportsman Education Day. The subjects of lectures and demonstrations include survival skills, game laws, and current environmental issues.

Club members have conducted field water quality studies of area lakes under the supervision of Louisiana Department of Environmental Quality personnel. Students measured dissolved oxygen concentrations, pH, salinity, and light penetration using various instruments and test kits. These outings gave students hands-on experience working with a biologist in the field and an understanding of water quality principals.

Working with local land companies, the club planted 3,000 oak and cypress seedlings. The trees were planted to provide cover and food for wildlife in areas cleared for agriculture.

Since 1982, club members have taken part in an exchange program with students at the Model Laboratory School at East Kentucky University in Richmond, Kentucky. This provides students with the chance to see a very different geographic area.

The Raceland Jr. High Conservation Club has been recognized seven times as the outstanding youth organization in Louisiana by the Louisiana Wildlife Federation. The club was recently featured in an international broadcast on worldwide environmental issues.

Club members take part in community cleanup and beautification activities. Interest in conservation and the environment is not limited to the Conservation Club. For instance, all Raceland Jr. High Clubs compete for the title of "Trashiest Organization on Campus" by collecting the most litter in one day. Also, the Raceland Jr. High Future Farmers of America actively supports environmental programs. As part of the Bettering Our American Community program, the FFA has become involved with a major marsh restoration project. Club members have transported and placed 4,000 discarded christmas trees in cribbing to restore and protect eroding marshland. This program was carried out under the supervision and direction of the Lafourche Parish Coastal Zone Management Commission and Louisiana State University.

The FFA is currently establishing a fish hatchery at Raceland Jr. High with the help of the LSU School of Environmental Engineering and state and federal wildlife agencies. Upon completion, it is hoped that the project will produce 17,000 largemouth bass fingerlings to release into area lakes and bayous.

The activities of the Raceland Jr. High Conservation Club and FFA have raised the environmental awareness of the entire school community.

G. Environmental Programs To Enhance The Learning Experience

Marine Environmental Sciences Consortium-Discovery Hall Program

Margaret Gordon
Mobile, AL

The Discovery Hall Program, located at the Dauphin Island Sea Lab, explores ideas of education that will have the greatest impact on students. Not only are there classroom lectures, but also a variety of hands-on teaching techniques that are often necessary to fulfill a complete understanding of the material presented. Through these techniques, students benefit from the experience they receive by working in the field rather than exclusively in the classroom. Because of the informal atmosphere created while studying in the field, a bond develops between the student and the teacher that allows for a more relaxed and comfortable learning environment.

This atmosphere creates, within each student, a greater desire to learn and complete the program with the highest possible honors. The living quarters allow students to share their ideas with others, form valuable relationships with their peers, and discover aspects of their own personalities they may have overlooked in the past. From this, the experience and knowledge gained at the Discovery Hall Program helps these students to return home with the desire to excel in school and stand out among others in their community.

Attending the program gives students hands-on experience with numerous types of marine life. Each student is required to set up and monitor a salt water aquarium by taking samples of marine life and observing their habits. One way of obtaining samples is through weekly excursions in the Gulf of Mexico or Mobile Bay. During the boat trip, a shrimp net containing a turtle excluder device allows students to gather and sort through marine life while obtaining samples beneficial to their aquariums. Not only do students take part in boat trips, but they also participate in seining excursions, marsh walks, and the popular adventure through the waters of Port St. Joe and St. Andrews Bay.

Along with these adventures, students complete a study of the geographical formations of the earth, identify the major species of plant life on the Island, perform challenging lab experiments, and present a final research paper. Students must also gain complete understanding of the material presented in order to be able to perform well on periodic exams. Through each of these events, students are exposed to numerous branches of science while obtaining learning skills that most young people do not acquire until their college education begins.

As a result of the learning techniques and the inspiration received from the educators in the Discovery Hall Program, the author discovered a love for science and the environment. Since completing the Program, the author won numerous science awards, established an environmental club at her high school and became heavily involved in the Mobile Bay Audubon Society.

The Discovery Hall Program is highly recommended for those who would like to discover the excitement of learning.

Project Marine Discovery: Sea Camp

Walter A. Skupien III
Gulf Coast Research Laboratory & Mississippi-Alabama Sea Grant Consortium
Ocean Springs, Mississippi

Project Marine Discovery Seacamp was initiated in 1988 to foster a better understanding and awareness of the fragility of the marine environment, primarily among students 6 to 14 years old. Seacamp has grown from 421 students in 1988 to over 1,300 students in 1992. Campers are mainly from the Mississippi Gulf Coast, but the children who have attended Seacamp represent approximately 30 states and several foreign countries.

Seacamp is co-sponsored by the Gulf Coast Research Laboratory and the Mississippi-Alabama Sea Grant Consortium. Seacamp consists of six to eight one-week sessions during the summer months, and it is conducted at the J.L. Scott Marine Education Center and Aquarium (MEC&A) in Biloxi, Mississippi. The MEC&A contains two classrooms and five laboratories designated for use by Seacamp.

Each weekly session of Seacamp covers at least four main topics concerning the marine and coastal environments -- endangered sea turtles, the salt marsh, fish biology, and creature

features (animal adaptations). Each topic has several associated activities which emphasize its importance. The majority of these activities are either educational games or hands-on endeavors. These major topics are covered in three days.

On Tuesdays and Thursdays, the Gulf Islands National Seashore (in Ocean Springs, MS) and Ship Island are the specified field trip destinations, respectively. In the field, the students test water parameters, study marsh animals, and discover marine creatures via seining and sieving. Other field trips include a short walk to the Seafood Industry Museum and an hour-long tour of the Glen L. Swetman (a Biloxi Schooner replica).

On Friday afternoons, Seacamp students leave with a better perception of the inter-relationships between themselves and the environment, and many leave with the desire to make a positive difference.

Youth Outreach Programs Outside The School

Jason Baca
Bay City High School
Bay City, Texas

Students spend most of their time in school learning because they have to, but when receiving education outside of school, the student must take the initiative due to a true interest in the subject. Marine projects give students that opportunity by experiencing the marine environment and learning more about coastal habitats.

Matagorda County, Texas has a unique program that caters to the marine interests of its young adults. The program, for children between the ages of 9 and 18, is sponsored by the 4-H Club. This group is directed by the County Extension Marine Agent, Willie Younger, and several other community leaders. The group has many local sponsors, including the Texas A&M Sea Grant Program.

The primary objectives of the marine group are to increase understanding and appreciation of marine and coastal environments, develop an excitement for learning through hands-on experience, generate a sense of responsibility for the future, and develop leadership skills. These objectives are established through four different levels of projects.

The first programs take place through the 4-H Marine Education Camp. In Matagorda County, there are two camp programs. One is the Summer Ocean Awareness Retreat (SOAR), through which students spend a week at Matagorda Island.. The second is the Winter Ocean Awareness Retreat (WOAR), which has students go to either Matagorda Beach or Sargent Beach. The programs are specifically planned to educate the children on the local environment and seasonal differences in biology, geology, and water chemistry. The camps are fun and give the students the opportunity to learn little things that one might have taken for granted. These camps also help establish leadership skills that are carried over into other school, 4-H, and community endeavors. The camps are very primitive; participants sleep in tents in remotely-located camps in order to obtain a better appreciation for the forces of nature.

The second level of programming is the 4-H Discovery Expeditions. This is a new level, and only two trips have been made. One was a Washington Exchange Trip in which youth from Washington State came to Texas for the summer SOAR trip, and later that summer, youth from Matagorda County area traveled to Washington for a week. The second trip was a week-long trip to the Crystal River in Florida. On these trips, the participating youth experience something they may never experience again. The facilities are well-furnished, and the group is able to see what the communities are like. These trips give the children the opportunity to compare other coastal regions with their own and demonstrate how coastal and marine areas differ from region to region, but face similar environmental, social, and economic challenges. This proved especially true in the areas of water quality, habitat destruction, fisheries management, and coastal development.

The third classification of educational programming is investigative field trips, of which many have occurred. Trips have been taken to the turtle hatchery in Galveston, the Texas State Aquarium in Corpus Christi, the state-run red drum hatchery in Corpus Christi, the Marine Education Center and a seafood processing plant in Palacios, and the Nautical Archaeology Laboratories in College Station. The trips are planned so the youth can get a bird's-eye view of marine-oriented activities. The students discovered the maritime past, learned about the efforts to save the endangered Kemp's Ridley sea turtles from extinction, saw fish and other marine organisms of the Texas Gulf Coast, and learned about the marine industry in our county and about our bays and beaches. The trips enable the students to understand environmental functions and problems in the Gulf.

The final level is the Environmental Enhancement Projects. Several projects in which the students participate are Beach Clean-ups, Mad Island Marsh Reestablishment, and water quality monitoring. The Beach Clean-Ups are a national activity, pioneered in Texas, that provide students with the feeling that they can make a difference by picking up trash on beaches. When the group works at Mad Island, it rebuilds wetland areas for wildlife, particularly declining populations of waterfowl. By monitoring water quality, it sees how the water quality compares to that in other areas, and, also, that information can be used to improve the environment and develop a greater understanding of scientific procedure.

These projects are truly what the group is looking for because they give young people the unique chance to work with their environment. They also enhance the self-esteem of the students and engender a greater respect for the environment.

Mississippi Gulf Coast Community College/Gulf Coast Research Laboratory Intern Program

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The Cooperative Intern Program of Mississippi Gulf Coast Community College, Gulf Coast Research Laboratory, and J. L. Scott Marine Education Center and Aquarium, which is now in its fifth year, has enjoyed great success in providing a demanding program requiring dedication and a high ethical standard. Honors Biology students participating in the internship are responsible for attending General Biology I and II lectures and labs, which are completed at an accelerated pace by the end of the second semester.

Each year before the internship actually begins, Dr. Sharon Walker, Administrator of the J. L. Scott Marine Education Center and Aquarium, explains the various research projects available to interns. After students decide which project they wish to research, they are assigned to a mentor specializing in that specific area. Rather than spending lab time at the college like most students, they spend their lab time at the Gulf Coast Research Laboratory, or at the J. L. Scott Marine Education Center, working with their mentor. Trips to the laboratory become either a Tuesday or Thursday afternoon ritual.

The Gulf Coast Research Laboratory is located in Ocean Springs, Mississippi, approximately 10-12 minutes from the college. The Laboratory was established to conduct research experiments which contribute to a better understanding of the environment. Research ranges from chemistry to the study of tributyl-tin, a carcinogen found in paints used on ships, to marine biology projects, such as larval migrations, habitats, feeding studies, or reproductive cycles of various fish.

One of the authors had an internship at the Laboratory under Mr. Larry Nicholson, head of the Anadromous Department. The research conducted during the internship attempted to determine if striped bass were reproducing in the Pearl River. This was achieved examining water samples taken from the Pearl River on a bi-weekly basis during a two month period in late spring. Water samples were studied under a dissecting microscope; fish eggs and larvae were extracted for classification from debris in the samples. The eggs and larvae were then studied to determine if any striped bass were present. Results indicated that striped bass were not reproducing in the Pearl River at that time.

The J. L. Scott Marine Education Center and Aquarium is located in Biloxi, Mississippi, approximately 20 minutes from the College. The original purpose of the Center was to display the results of research conducted at the Gulf Coast Research Lab. The Center contains 11 aquariums which provide habitat to fish, snakes, turtles, and alligators, just to name a few.

Another author participated in an internship there and displayed research conducted at the Laboratory on the cobia fish (*Rachycentron canadum*). Mrs. Margaret Howell of the Center served as project mentor, and Mr. Jim Franks of the Laboratory's main campus conducted the research. The exhibit "bridged the gap" between Mr. Franks laboratory and the general public by using color photographs, an artificial cobia, a tagging kit, and various maps that demonstrated catch/release of cobia and their migratory patterns. The exhibit is still located at the Marine Education Center and is seen annually by approximately 64,000 visitors, demonstrating the success of internship projects.

While the internship is a enjoyable, it also involves many hours of hard work. Interns are required to devote a minimum of three hours a week at the laboratory. Some interns' research involved hours well beyond the minimum requirements, including holidays (when working with living organisms, there are no such things as holidays).

One of the best characteristics of the internship is that there are several projects from which students can choose so they can select the projects in which they are most interested. Such projects include creating interactive educational programs, observing organisms under a microscope, working in the library, developing exhibits, studying crab behavior, chemistry experiments, and drawing various animals. By allowing students to choose a project in which they are interested, they are more likely to be more involved and, therefore, increase their knowledge as a result of the additional effort.

The final stage of an internship is presenting research results at the Mississippi Academy of Sciences. Before the actual presentation, many hours are spent practicing, critiquing, and improving speeches, constructing posters, and/or developing other types of visual aids. By making presentations at regular intervals throughout the program, students gain valuable speaking experience and are given constructive criticism by Drs. Melton and Walker, mentors, and fellow students.

The Mississippi Academy of Sciences is divided into two different presentation styles -- poster sessions and platform sessions. During poster sessions, interns stand by their posters and explain their project to interested individuals. These presentations are similar in design to science fair projects. During the platform sessions, interns are given fifteen minutes to discuss their project. Many students' presentations include video or slide presentations. This cooperative program provides increased content knowledge and presentation experience to each student participant.

The internship has become a valuable part of the time a student spends at Mississippi Gulf Coast Community College.

Students learn the importance of responsibility by regularly attending laboratory sessions and meeting deadlines, increasing their sense of responsibility and accomplishment. Because of the internship, the authors now have a published abstract in a scientific journal, as well as a better understanding and knowledge of the environment.

H. Widening The Environmental Horizon

Kids For Saving Earth: Case History Of What A Kid Can Do

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Kids For Saving Earth Club #12,337
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Kids For Saving the Earth was started by Clinton Hill. Clinton was not a politician, nor a scientist. He had no titles or degrees. He was an 11 year old boy who displayed a courage, purpose, and sensitivity toward the world around him that belied his years.

Many people wonder about the future of the world around us, about how poisons can continue to be released into the sky and water while species of animals disappear. Clinton didn't just wonder, he acted. He wrote companies, drew posters, and inspired friends and classmates to become involved in saving the environment.

Shortly before cancer tragically took his life, Clinton organized the first Kids For Saving Earth Club with his 6th grade class. They were committed to the environment, and it soon became a school project.

When Target Department Stores heard the story of Clinton and Kids For Saving Earth, it became a program sponsor. KSE now has 645,149 members in 22,323 clubs world wide.

What can one person do? In the spirit of Clinton Hill, the members actively learn about environmental issues, plant trees, begin recycling and composting programs, clean parks and neighborhoods, and write national leaders concerning issues. The opportunities are endless. Each club, along with the club advisor, decides upon which environmental issues the club will become involved and the most effective plan of action. This provides an opportunity to make a difference in their communities.

Membership is free, and all receive a full-color certificate. Adult club advisors are supplied a wide variety of information to assist the group.

Perhaps the Spirit of Kids For Saving Earth can be best described in the KSE Promise:

The earth is my home;

I promise to keep it healthy and beautiful;

I will love the land, the air, the water, and all living creatures;

I will be a defender of my planet;

United with friends, I will save the earth.

Inquiries can be directed to:
Kids For Saving Earth
P.O. Box 47247
Plymouth, MN 55447-0247

Linking Children To Environmental Action Projects

David Smith Hernandez
Austin, Texas

CAPE, the Children's Alliance for Protection of the Environment, is an international organization that promotes children's environmental programs around the world. It helps children understand how the world's people and their local ecologies depend on one another and provides hope for a healthy habitat in the future. CAPE has been recognized by the United Nations Environment Programme (UNEP), and CAPE was added to UNEP's Global 500 Roll of Honor on World Environment Day, June 5, 1990. The past three years, CAPE members spoke at the International Youth Forum on the Environment sponsored by UNEP at the United Nations General Assembly Hall in New York City.

CAPE began when its founder Ingrid Kavanagh, then Honorary Consul to Costa Rica, organized a cooperative beach clean-up between children in Costa Rica and Texas. This initial effort has grown and is repeated several times during the year with a major event, known as the International Beach Appreciation Day, held annually in September, coinciding with the Gulf-wide beach cleanup. A second large effort, the conception and dedication of CAPE's Children's Rainforest on the Osa Peninsula in Costa Rica, also became a primary focus of activity in the development of Children's Forests in Oregon and Texas.

One of CAPE's goals is to have Children's Forests designated in existing community parks as well as in the larger state and national forests. This would allow youths to have a vested interest in reforestation projects in their communities. Another goal is to reach children through existing scholastic programs where the structure exists but there is no focus or direction on how to get environmental projects and discussions included with the regular studies. In response to this need, CAPE developed a *Program Guide* for teachers and students to use in adapting their science, health, social studies, or language arts course work.

One thing that makes CAPE unique is its international connection. Many CAPE members have become pen-pals with their international peers, sharing project ideas, concerns, and information about the unique nature of their own communities. The idea of "thinking globally, acting locally" has been well served by CAPE's newspaper, *Many Hands*, which is written by and for children and youth members. Contributions to the newspaper are also made by members of the international network. The newspaper provides updates on activities and educational articles on subjects such as acid rain, pollution, and wildlife habitat preservation, and it is distributed to the far flung chapters. The idea that a young person's individual effort on a local level can become part of a worldwide movement is not just a dream when children see CAPE's ideas accepted by children in 49 states and 35 countries around the world.

CAPE has proven effective in sparking the imagination and promoting activity among children of all ages. The environmental conservation efforts of families whose children are members of CAPE allow the youngest to accept and learn their family's activities such as recycling, composting, litter clean-up, and selecting environmentally safe products for the home. Older school children can become active in the types of projects promoted in the *Program Guide*, and teenagers can begin asking harder questions, making greater contributions in assuming leadership roles, and getting environmental issues addressed in their schools, neighborhoods, and communities.

CAPE sponsors an Ambassador's Club for children and young people who have the personal motivation and energy to actively lead their peers in starting and promoting new projects. CAPE Ambassadors participate in international conferences and workshops, representing active youth involvement in global environmental concerns.

CAPE represents an idea that cannot fail! Not only is the environmental message that it brings essential, but the messengers who carry it represent the perfect means to overcoming cultural differences separating the peoples of the world. Children are the hope, the energy, the intellect, and the future of their individual countries and the world at large.

What government can deny the basic good of children seeking to clean up their cities and parks and beaches? What culture can deny their children the hope for a healthy environment? What political or cultural group can question the motives of children who simply want a clean place to play and grow?

This may be the case where children lead and adults, indeed the world, should follow. The messengers are the children, and the message is "we want to protect and restore the Earth so that it will provide a healthy place for the children of today and tomorrow to live and grow."

A Project For Future Problem Solvers To Tackle Tough Issues

Daniel Cohan
Dallas, Texas

The problems of the Gulf of Mexico environment may seem very different from the problems of drugs or nuclear waste. But each can be addressed using a simple, five-step problem solving process -- brainstorming problems, defining an underlying problem, brainstorming solutions to that problem, evaluating those solutions with criteria, and implementing the solution. As a member of the international champion Future Problem Solving team, the author used this method, which can tackle a variety of problems facing the country and the world.

The first step to solving a problem is to decide what problem needs to be solved. In FPS competition, this means examining a futuristic situation and generating a list of problems that could occur because of that situation. In real world problem solving, it means researching a situation and deciding what the problems really are. Trying to find solutions is useless if you don't know what you're trying to solve.

In the problem-finding phase, it is necessary to be broad-minded and look at an issue from all angles. One way to accomplish this is to look for problems from a multitude of categories, such as economic, environmental, or legal. When looking for problems, consider all the groups and people who are affected by a situation. In the case of the Gulf of Mexico, that might include viewing the situation from the perspectives of fishermen, environmentalists, government agencies, and others.

Now that a list of problems has been developed, an underlying problem should be chosen, one that is significant and solvable. Since no group is capable of solving all of the problems of the Gulf of Mexico, a narrow problem should be chosen. Even though the problem should be narrow, it must be significant enough that, if solved, the overall situation will improve. Therefore, choosing a well-focused underlying problem is critical because all the solutions will be geared toward solving it.

By now, the problem has been determined, and it's time for the fun part -- brainstorming solutions. The goal is to create a list representing a broad range of possible solutions to the underlying problem. One of the best ways to generate solutions is to research what other groups have done in similar situations and adapt their solutions to the underlying problem. Look for solutions that tackle the factors perpetuating the problem.

At this point, simply write down every solution that comes to mind without worrying about details or practicality. As is always the case with brainstorming, off-the-wall solutions will be named during this process, but, often, they can be altered or combined into a legitimate solution with other ideas. Rather than criticizing off-the-wall or impractical solutions, think of a way to alter or combine them with other solutions to make them feasible. Many of the best ideas have come when one person blurted out a crazy idea and another person was able to turn that idea into a creative and effective solution.

Criticism should be avoided at this stage because it can make the participants less comfortable in sharing ideas. The working environment must be conducive to all participants sharing their ideas, especially during the brainstorming phase.

The list of solutions is evaluated to determine which should be undertaken. A set of criteria is developed to include whichever solution would be most effective. Examples of criteria include how long it would take to implement a solution, how much it would cost, and how much resistance would be given by opposing interests. Criteria that specifically relate to the problem being addressed should be used, and each solution should be evaluated on how well it fulfills the criteria. The best solution will be the one that best meets the criteria while solving the underlying problem.

When the best solution has been determined, it should be implemented by the group.

The Next Generation In The Environmental Movement

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Society for Environmental Education
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The tumultuous 1960's gave rise to a sense of urgency for environmental reform that culminated in the birth of the Environmental Movement. This monumental action officially began on April 22, 1970, the first Earth Day. Though many adults were involved, it was a phenomenon fueled by youth, especially at the college level. During the past two decades, this environmental generation has called the American way of life to task and sensitized the world about environmental concerns.

The present generation of youthful, environmentally-aware citizens will have many opportunities, most of which were not options for their parents and older relatives. As examples, consider the following career tracks. Nature centers and environmental education centers were few and far between before 1970. Most were founded in response to the first Earth

Day; today there are over 500 such centers, as well as thousands of environmental activist groups, zoo and aquarium education departments, environmental science curricula in various levels of education, and so forth.

During the 1970's and 1980's, most contributions to the environmental movement resulted from activism and education. Though both will remain critically important, possibly the most important future contributions will come from within industry. Now is the time for environmentally-oriented chemical engineers, petroleum engineers, CPA's, lawyers, managers, and other professionals.

Why is this the time to work more easily from within? The answer lies with all the environmental reform that is taking place today within business. The college-aged kids from the 1960's are now in their 40's. They are now managers, owners, CEO's, and sit on executive boards. Even though these folks followed a business track when they left school, they took the environmental attitude with them. Twenty years later, they have educated their children, experienced the impact of poor environmental controls, had many frustrations with the "we can out-engineer this environmental problem" approach, and are ready for reform. How interesting that they will now manage their children's generation that has been environmentally sensitized by them!

The environmental movement may be divided into five themes, each coinciding with a decade:

- **Awakening** - 1960's - the period during which society was awakened to a potential environmental crisis,
- **Call to Order** - 1970's - the period during which attitudes and approaches were formulated (this was the most active period of the development of new nature centers),
- **Greenwashing** - 1980's - the period during which many (not all) businesses attempted to "cash in" on the environmental movement by making false claims about their products,
- **New Awakening** - 1990's - the period during which everyone finally agrees that a clean environment is good for everyone (including the economy), and
- **We've Always Done It That Way** - 2000+ - the final period, during which today's youth will argue that a clean environment is the way society should live and in which today's environmental novelties will be commonplace. It was shared by one gentleman that the Native American attitude of stewardship toward the earth will be incorporated into each citizen's ethical attitudes.

The bottom line is that the generation of the 1960's is ready for the next to take the movement to the next level and is willing to help.

One must bear in mind that the most pressing dilemma is designing a workable solution to uncontrolled human population growth. If that growth continues, and there is no indication that it will not, without more resources and/or better methods for distributing what we have, there will always be another crisis like those in Somalia, Ethiopia, Bosnia, and America's inner cities.

VI. Cooperative Programs

A. Galveston Bay National Estuary Program

Managing Galveston Bay: New Solutions For A Gulf Estuary

Frank Shipley
Samra Jones-Bufkins
Herbert Hudson
Galveston Bay National Estuary Program
Webster, Texas

Americans increasingly express their expectations for a clean environment in terms of entire ecosystems. Until recently, the tendency was to view environmental problems in isolated pieces easily understood. This view was institutionalized in an elaborate mosaic of fragmented jurisdictions, usually based on political, rather than natural boundaries. The National Estuary Program is a forerunner in elevating management of coastal environments to the ecosystem level. This innovative approach is encouraging a new cooperative spirit among traditionally disparate institutions.

Current management of Galveston Bay involves at least 15 agencies and authorities, is issue-oriented, and driven by diverse mandates. Working independently, these entities have traditionally been unable to address completely the wide-ranging impacts to water quality and living resources in the Bay. Development and implementation of a comprehensive plan that coordinates the efforts of these entities, eliminating the potential for omissions and duplication of effort, will streamline management of the Bay's resources.

Galveston Bay consists of 600 square miles of shallow, brackish water surrounded by 203 square miles of estuarine marsh, 14 square miles of forested wetlands, 61 square miles of fresh water ponds, and one of the largest urban areas in the United States. The Houston metropolitan area is home to more than 3.5 million people, as well as the third largest port in the U.S. and one of the largest petrochemical complexes in the world. Over 500 chemicals are manufactured in the numerous petrochemical plants that line the shore and tributaries of Galveston Bay, and nearly one-third of the nation's oil refining capacity is here as well. Sixty percent of the permitted wastewater in Texas --including that from Dallas and Fort Worth -- flows into the Galveston Bay System. Recreational and commercial fishing industries contribute hundreds of millions of dollars to the area economy each year.

Managing the resources of Galveston Bay is a complex effort to balance use versus conservation of resources in the public's interest. Deciding how to use those resources is difficult, because the alteration of one part of the system will ultimately cause changes throughout that system. Recognizing this, in 1988, with the help of the non-profit Galveston Bay Foundation and the Texas Water Commission, Texas Governor Bill Clements nominated Galveston Bay as an "Estuary of National Significance," creating the Galveston Bay National Estuary Program (GBNEP) in 1989.

In the first year the Management Conference was convened, discussions by resource managers, scientists, and the Bay-user community resulted in a consensus agreement on the Galveston Bay Priority Problems List. This list (see table) is the basis for characterization studies and management planning efforts for Galveston Bay.

GBNEP has attacked scientific issues head-on in a three-year program aimed at characterizing estuarine problems. Now, as knowledge of the "State of the Bay" is at an all-time high, 16 task forces are drafting more than 100 initiatives for the Galveston Bay Comprehensive Conservation and Management Plan, scheduled for completion in fall 1994. Initial public review is underway, and some key Action Plans are already being implemented.

Among the Action Plans being implemented are the creation of two new Texas Coastal Preserves for Christmas Bay and Armand Bayou, which are among the last nearly-pristine areas in the Galveston Bay System. Another project was implemented to restore fringing salt marsh habitat for living resource benefits and erosion protection. That project relies heavily on volunteer labor from community groups and industry to transplant smooth cordgrass in areas of need. A third project seeks to reduce toxicity in the Houston Ship Channel by working cooperatively with industries having the greatest potential contributions to this problem. Finally, a pollution reporting and response system was successfully initiated to enable one-call reporting by citizens. This innovative approach to pollution response provides a single, toll-free number for citizens to call. Staff members track the complaint through the proper agencies and notify the caller of the resolution of their complaint. In 1993, GBNEP will implement a project to create oyster reefs from coal combustion by-products.

The lessons learned from these early implementation projects can be applied to management throughout Galveston Bay and the other significant estuaries in the Gulf of Mexico.

The Galveston Bay Priority Problems List

A. Reduction/Alteration of Living Resources

1. Loss of Physical Habit
   - wetlands and sea grasses
   - oyster reefs
   - shallow bay bottom (unvegetated)
2. Alteration of Salinity Gradients
   - impoundment, diversion, and inter-basin transfer of fresh water inflow
   - bathymetric and circulatory changes (salinity intrusion)
   - ungaged inflows from rainfall in coastal watersheds
3. Alteration of Nutrient and Organic Loading
   - eutrophication and hypoxia
   - point and nonpoint sources
4. Bathymetric and Circulatory Changes
5. Land Subsidence and Sea Level Rise
6. Chemical and Pathogenic Contamination (biotic impairment)
   - point and nonpoint sources
7. Increased Turbidity and Sedimentation

B. Public Health Issues

1. Discharge of Pathogens to Bay Waters
   - point and non-point sources
2. Chemical Contamination of Water, Sediments, and Living Organisms
   - point and nonpoint sources
3. Restriction of Contact Recreation
   - chemical and pathogenic contamination

C. Resource Management Issues

1. Regulatory Problems
2. Fish and Wildlife Resource Depletion
3. Marine Debris
4. Public Access to Resources

D. Shoreline Erosion

1. Land Subsidence and Sea Level Rise
2. Bathymetric and Circulatory Change
3. Loss of Buffer Vegetation (Wetlands)
4. Use of Littoral Property

B. Sarasota Bay National Estuary Program

The State Of Sarasota Bay: Implications For Managing Coastal Waters

Mark Alderson
David Tomasko
Heidi Smith
Sarasota Bay National Estuary Program
Sarasota, Florida

Sarasota Bay, an estuary located on Florida's fast-growing southwest coast, is the hub of a community of more than 500,000 people. The region depends on the Bay for recreation, commerce, and aesthetics. During the past 50 years, the Bay has been damaged by dredge-and-fill activities, stormwater and wastewater pollution, and the loss of natural habitats, particularly wetlands.

Since 1989, the Sarasota Bay National Estuary Program (SBNEP) has worked to develop a Comprehensive Management Plan for the Bay. Successful management requires three elements -- technical work to define problems, early action to demonstrate potential solutions, and public outreach to educate and involve citizens in restoration.

In 1992, the SBNEP completed the majority of a comprehensive characterization, including wetland assessments, estuarine bottom habitats, fishery resources, pollutant loadings, circulation, water and sediment quality, shellfish contamination, sea level rise, and recreational use.

The Program's findings were nationally peer-reviewed and published in Sarasota Bay: 1992 Framework for Action. Generally, the findings revealed a resource in jeopardy, although some improvements were noted after wastewater treatment was improved in the upper and central portions of the Bay. Other results include:

- a decline in fisheries -- sea trout landings are down 50% since 1950, recreational anglers average only one keeper fish every three to four hours, and shellfishing is banned in many areas due to contamination,

- *vital habitats* were lost or damaged -- 39 percent of intertidal habitat, 16 percent of freshwater wetlands, 30 percent of seagrass habitats were destroyed. 5,000 acres (15%) of Bay bottom acreage was disturbed by dredging, significantly reducing productivity in some areas,
- water quality has declined since the area was developed -- land-based nitrogen loadings increased 300 percent -- wastewater and stormwater are the major sources, and
- sediments in particular tributaries show high levels of lead and other metals, residues of pesticides and traces of PCBs. Concentrations of heavy metals in some sediments were found to be at levels of ecological risk, but posed no health risk to humans.

The SBNEP's technical work -- particularly on water quality monitoring and pollutant loading -- revealed management issues deserving special attention by environmental managers throughout Florida and the Gulf of Mexico.

Water quality monitoring by the SBNEP reveals that the extent of eutrophic conditions was under-estimated due to inadequate data collection for dissolved oxygen. Extreme diurnal fluctuations of dissolved oxygen, detrimental to marine life, can be characterized using newer continuous-recording instruments.

The Program's monitoring efforts evolved into a useful water quality index describing relative differences in water clarity and quality in various portions of the bay. This relative index allowed the SBNEP to assist local governments in understanding the complex relationships between land use, pollutants, water quality, circulation, habitat, and resource productivity. The index also helped highlight areas deserving special attention in data collection and management strategies.

A Pollutant Loading Assessment revealed that septic systems and small package treatment plants load more nitrogen to the Bay than closely-monitored, carefully-regulated point sources. For example, in Lower Sarasota Bay, inadequate wastewater treatment contributes approximately 30% of nitrogen loadings. In that area, wastewater treatment is provided by 45,000 septic systems and 71 small package treatment plants. Septic systems at homes and businesses, as well as percolation ponds and drain fields at package plants, load nitrogen to the bay through groundwater transport. These non-point sources of nitrogen are not regulated by federal, state, or local agencies.

To develop and test creative solutions, the SBNEP implemented a variety of Early Action Demonstration Projects in cooperation with local, regional, and state government, as well as citizens. Eleven habitat-related projects and two stormwater management projects were completed or are ongoing. Intertidal habitat restoration projects will restore 80 acres, or 4.5% of habitat lost since 1950.

Public outreach activities, to educate citizens and generate support for the program, included workshops, publications and videos, classroom instruction, speeches to community groups and elected officials, news media coverage, volunteer activities, and a community grants program.

Solutions are currently under discussion by scientists, managers, and members of the SBNEP's Citizen and Technical Advisory Committees. Options are included in the Framework for Action and will be refined into recommendations for the final Comprehensive Conservation and Management Plan, due in Summer 1994.

Some options describe strategies for:

- reducing stormwater pollution by 30% baywide with financial support from local stormwater utilities,
- improving wastewater treatment in the Lower Bay to reduce nitrogen loadings in that area by about 25%,
- implementing an innovative, comprehensive approach to wetlands protection and management, and
- involving citizens in restoration strategies, particularly for stormwater pollution prevention through participation in the Florida Yard Program, which will be marketed to the public beginning in 1993.

In summary, the Sarasota Bay NEP's analysis indicates that unique opportunities exist for improving Sarasota Bay through the concerted efforts of scientists, governments and citizens.

C. Tampa Bay National Estuary Program

Watershed Management Initiatives Of The Tampa Bay National Estuary Program

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The future of Tampa Bay depends upon the ability of local residents to prudently manage the region surrounding it. While the Bay itself covers 398 square miles, land draining into the Bay spans a five-county area almost six times its size.

It is here, within Tampa Bay's 2,300-square-mile watershed, that bay management and restoration ultimately begins. While some damage to the bay occurs as a result of activities on the water, most of the pollution and practices that adversely affect the health of the bay originate on land.

Improvements in overseeing land-based activities that may damage the bay or cause pollution is the foundation of a master plan for watershed management now being developed by the Tampa Bay National Estuary Program, a partnership of local, State, and Federal agencies.

While water quality traditionally has served as the barometer for the success of protection efforts, the Tampa Bay NEP's strategy emphasizes a critical next step by linking water quality standards to the environmental requirements of the bay's most important habitats and the aquatic communities they support.

The Tampa Bay NEP has targeted the bay's five most essential habitats for restoration and enhancement, including tidal marshes, mangroves, seagrass and other submerged aquatic vegetation, nonvegetated bay bottom, and open water or pelagic communities.

Recognizing the diverse environments within the bay and its rivers, the Tampa Bay NEP will select aquatic plants and animals vital to each segment as indicator species. Monitoring the health of these plants and animals will be critical in determining the overall health of their portion of the bay.

Seagrass, which provide food and shelter to many important species of fish and shellfish, offer an excellent example of the procedure to be followed for almost all targeted habitats. Specific goals for seagrass recovery, documented in terms of acreage, will be set by recording historic levels and identifying permanently altered areas that would prevent or limit growth. Maps of current seagrass meadows represent protection targets, where healthy grass beds are now growing and must be maintained. Longterm goals for restoration will be set for areas that once supported seagrass and could be enhanced by reducing pollution or other physical impacts, such as boating and dredging.

While enhancing structural habitat is important, the ultimate measure of success is whether these habitats are functional, supporting healthy aquatic communities. New monitoring standards, that look for indicators of the health of the Bay's living resources, are now being developed by the Tampa Bay NEP.

The Tampa Bay NEP is completing a comprehensive review of conditions in the Bay, as well as scientific studies which will define the environmental requirements of essential bay habitats and animals. Concurrently, we are conducting in-depth research to quantify the level and concentrations of pollutants now being discharged into Tampa Bay.

The Tampa Bay NEP and other agencies are creating mathematical models which will predict improvements in water quality as pollutant levels are lowered. Although numeric goals for water quality are not the final objective of the Bay restoration plan, they will be used as interim criteria. Numeric objectives for reducing pollution will be set for each major section of the Bay based on the long-term goals for enhancement and restoration of habitats and animals.

Finally, a watershed action plan outlining specific commitments, timelines, and funding sources from government agencies participating in the Tampa Bay Program will be developed and included in the overall plan for bay management.

Florida Neighborhoods

Watershed protection ultimately depends on all citizens of the region. Florida Neighborhoods, a program developed by the Tampa Bay National Estuary Program and administered through the county cooperative extension offices in the Bay Area, brings concepts of environmental stewardship to the home and yard.

The Program, which now is in its pilot phase, pairs neighborhoods with team of experts trained to assist residents in preventing pollution from stormwater, conserving water, and restoring native habitat. Florida Neighborhoods begins with a two-part environmental checkup -- a survey of homeowners to determine landscaping and homecare practices and an on-site neighborhood assessment by a team

of experts. Following the checkup, the team develops a 12-month action list identifying ways that residents can improve the local environment. Hands-on assistance is provided through a series of workshops that teach conservation and environmental landscaping techniques.

Efforts such as these, that make *watershed protection a* part of our daily lives, are crucial to the long-term protection of the Bay.

D. Barataria-Terrebonne National Estuary Program

An Ecological Exploration Of Coastal Louisiana's Barataria-Terrebonne Estuarine System: Its Uniqueness And Importance

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Coastal Louisiana is a mix of truth and fiction, fact and fascination, past and present, and a sincere desire to brighten her own future. Before one can begin to discuss the merits of Louisiana's ecological present, one must revisit her long and colorful past.

Recognition of Louisiana's vast coastal resources began when the French settled the region in the early 1700's. In documents related to early exploration expeditions, enormous numbers of duck, geese, snipe, teal, and other birds are recorded, as well as a great variety of animals, such as stags, deer, and buffalo. Later explorers describe the Barataria Bay region as having the finest oaks in the world, which covered the whole coast. Striking in these early descriptions is the understanding of the French that the annual overflow of the Mississippi River was necessary to maintain the fertility of the area's soil.

Also associated with the great variety of wildlife, fertile soils and lush vegetation was the ample fishery resources. As testament to the productivity of this enormous resource, over 500 prehistoric Indian settlements have been discovered on the dry land adjacent to the region's waterbodies. These relic settlements are distinguished by the presence of mounds of oyster and clam shells indicating their utilization as a primary food source. Since their prehistoric use by native Indians, these highly productive estuaries have been utilized by many ethnic groups for a variety of purposes. Each group was forced to reach its own balance with the forces of nature present in the region, constantly struggling with one another to dictate the physical shape and texture of coastal Louisiana.

Because this part of Louisiana was settled over the past 200 years by groups as diverse as pirates, smugglers, and bootleggers and farmers, fishermen, and recreationalists, the pressures upon various ecological resources have varied over time. Today, it is estimated that almost 20% of the commercial marine fish caught nationwide spend at least some part of their life cycles in the Barataria-Terrebonne estuarine complex. Although the largest and oldest ethnic group to inhabit coastal Louisiana is of French descent, at one time, the largest foreign fishing population in the Gulf States was located in these coastal wetlands. Those foreign populations included Spanish, Irish, German, Cuban, Greek, Italian, Yugoslavian, Latin American, and Chinese. All were drawn by the extremely productive fishery resources, but each utilized and interacted with the environment differently.

All who ventured to exploit Louisiana's coastal resources were forced to deal in some manner with seasonal floods, the threat of hurricanes and associated storm surges, and the effects of apparent subsidence (the combination of sea level rise and true subsidence). Chronicles describing past hurricanes are littered with stories of storms that struck during the night and destroyed entire communities. By the turn of the century, about 3,000 people affiliated with trapping, shrimping, oystering, truck farming, commercial raising of terrapin turtles, and fishing lived in the Barataria Basin. Toward the end of the 1800's, individual hunters are said to have marketed 1,000 alligator hides each. Abundance of alligator, otter, raccoon, muskrat, and mink have long made Louisiana one of North America's largest fur producers.

In addition to fish and wildlife, the harvest of resources, namely oil and gas, and to a lesser extent sulphur, has led to the development and alteration of the coastal Louisiana landscape. Drilling for oil in wetlands began in the 1920's and became common in the 1930's. In the late 1940's, oil exploration began in offshore areas beyond the sight of land, making Louisiana the third-largest oil and gas producing state in the country. Between the years 1954 and 1983, about 94 percent of the nation's oil and 91 percent of the natural gas produced in the Outer Continental Shelf was extracted off the coast of Louisiana. This intensive petroleum and gas development in Louisiana's coastal and offshore areas impacted the natural environment, primarily via the infrastructure, access, and transport necessary to accomplish extraction and collection oil and gas resources.

Sulphur extraction, although not widespread, had a

significant influence upon the Barataria estuary. In the early 1930's, Freeport Sulphur began constructing what would become the oldest producing and the second largest sulphur mine in the world at Grand Escaille on the eastern shore of Barataria Bay. By the time the mine closed in 1978, it had produced the equivalent of a block of almost pure sulphur one mile square and about 30 feet high. The infrastructure required for the sulphur industry (exploration, as well as refining and transport) also contributed to the alteration of the state's coastal landscape and, thus, its dependent fish and wildlife species.

Over time, the interaction of coastal residents with the coastal environment has changed, due primarily to how residents derived their income. Prior to the settlement, the Mississippi River was free to meander in response to seasonal flooding regimes. To protect settlers from these annual events, levees were built along the river, and sediment flow to adjacent wetlands was interrupted. Although many continued to harvest fish and wildlife resources after the 1940's, many were employed in oil, gas, or sulphur related activities. Unfortunately, the uncontrollable effects of long-term subsidence, coupled with activities necessary to facilitate newly introduced mineral extraction industries after the 1940's, created the current environmental crisis in coastal Louisiana.

The Barataria-Terrebonne Estuarine Complex: Priority Problems And Possible Solutions

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The Barataria-Terrebonne Estuarine Complex, the vast coastal region between the Mississippi River and the Atchafalaya East Guide Protection Levee, encompasses some 3,600 square miles (9,324 sq. km.) of shallow bays and salt, brackish, intermediate, and fresh water marsh, as well as forested wetlands within the Mississippi Deltaic Plain. Nominated by Governor Buddy Roemer in October 1989, it was approved by Environmental Protection Agency Administrator William Reilly on April 20, 1992. It is one of 17 National Estuary Programs across the country, and one of five within the Gulf of Mexico. The system has a wealth of natural resources, including fish, shellfish, waterfowl, and many other species of wildlife, as well as minerals.

The system consists of two reasonably discrete basins, the Barataria and Terrebonne. The natural levees along Bayou Lafourche serve as a barrier preventing interchange between the two basins, however, a series of man-made canals, including the Gulf Coast Intracoastal Waterway, provides some exchange. After accounting for all differences between the two basins, both are very similar. Geologically, they both owe their existence to holocene sediments transported via the Mississippi River. The environmental problems experienced in one basin are experienced in the other.

The Management Conference Agreement Between the State of Louisiana and the EPA identified seven priority issues, including hydrological modification, reduced sediment flows, habitat degradation, changes in living resources, eutrophication, pathogen contamination, and toxic substances. Because these priority problems are interrelated, actions pursued to address one problem may affect another.

Priority Problems

Hydrological modification has resulted from the interruption of fresh water inputs from the Mississippi and Atchafalaya Rivers, from the construction of linear canals, many of which are deeper than surrounding waterbodies, and the diking of wetlands. These activities have affected the estuarine basins in several ways -- first, by reducing freshwater input, second, by reducing the retention of freshwater, and last, by increasing tidal influence. Hydrologic modification has been regarded as the key problem because of its influence on each of the other priority problems.

Consequences of hydrologic modification include salt water intrusion, resulting in wetland loss, especially fresh water types, further increasing the rate of loss.

Reduction in sediment flows is a direct effect of hydrologic modification. Levee systems have effectively walled in the Mississippi and Atchafalaya Rivers. Much of the sediments carried by the Mississippi are dumped off the Continental Shelf into hundreds of feet of water. As a result, no delta is created. However, sediments traveling the Atchafalaya eventually are deposited within the basin or the active delta of the Atchafalaya. The Atchafalaya delta is the only prograding, or building, delta at this time.

Habitat loss and modification is due to wetland loss and salt water intrusion resulting from the cumulative effects of natural and artificial influences. Natural influences include subsidence, abandonment of river deltas, storms, and sea level rise. Artificial losses include flood control practices, impoundments, dredge and fill activities, and erosion of artificial channels.

Changes in living resources result from habitat loss and modification, as well as overharvesting. However, eutrophication and salt water intrusion are also to blame. Production of estuarine dependent species can be correlated to the amount of vegetated wetlands and the extent of interface between shallow water and vegetated wetlands.

Eutrophication is a natural process resulting from artificial and natural additions of nutrients to waterbodies. As a result

of several human practices, the process of eutrophication has been hastened. Most waters of the upper and middle Barataria and Terrebonne basins are eutrophic and characterized by frequent algal blooms that cause fish kills by reducing the amount of available oxygen. Nutrients sources include runoff from domestic waste, unsewered communities, and urban and agricultural runoff.

Pathogen contamination results from septic tanks, urban runoff, agricultural runoff, wildlife, etc. The potential contamination of oyster growing areas by fecal coliform bacteria poses a significant health threat to the public, and it seriously affects the oyster industry in Louisiana, which is losing growing areas at an alarming rate. Salt water intrusion from the Gulf of Mexico allows predators and parasites to move inland, thereby forcing the productive areas inland, and pathogen contamination from coastal runoff pushes the approved areas seaward.

Introduction of toxic substances into estuarine environments has become a serious problem nationwide. Sources of toxics include pesticides, including herbicides and insecticides, heavy metals, and PCB's. The role that toxic substances play in this system is inhibited by the fact that very little effort has been expended on the distribution of toxics within this system. The State of Louisiana has had no consistent program to gather water, sediment, or tissue data regarding this area, however some studies have indicated toxic contamination from pesticides in the two basins.

References

Governor's Nomination and Request (1989) for a Management Conference under the National Estuary Program: Barataria - Terrebonne Estuarine Complex (Governor's Nomination), 109 pp.

The Impact Of Hurricane Andrew's Force On The Barataria And Terrebonne Estuary: Lessons Learned

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On August 25, 1992, after causing millions of dollars of damage in southern Florida, Hurricane Andrew zeroed in on the coast of South Louisiana. Hurricane force winds, extending approximately 50 miles on either side of the storm's eye, and the accompanying storm surge caused extensive damage to the sensitive Barataria-Terrebonne estuarine ecosystem.

High-water marks measured by the U.S. Geological Survey after the storm along north to south transects in flooded structures indicated a surge of flood waters from the Gulf of Mexico reaching up to 12 feet.

Surge waters over-washed the fragile chain of islands along the southern boundary of the Barataria-Terrebonne Estuary, causing the most extensive erosion in recent years. These barrier islands are critical to maintaining the delicate mixture of salt and fresh water in inner estuaries. Additionally, they protect the drinking water supplies of hundreds of coastal communities to the north and disperse the destructive energies of hurricanes before they enter the more vulnerable organic soils of the inner wetlands.

Due to the angle at which the eye of Andrew passed over the islands, severe erosion occurred on both the front and back sides. On Trinity Island, 128 feet of beach was lost, which is roughly equivalent to about 4 years of normal erosion. Most of the islands were destroyed completely. The combined effect of Hurricane Andrew on Louisiana's barrier islands has shortened previous life expectancy estimates. The Terrebonne chain is now expected to disappear by the year 2000.

By some estimates, 200,000 acres of marsh was severely damaged by Hurricane Andrew. The damage was most evident in floating marshes, where entire sections were translocated and compressed, giving them the appearance of a windrow or accordion.

In some cases, marsh substrates were reworked as a slurry of mud or mud balls, varying in size from fist-sized clumps to desk-sized clods. The mud slurries also buried about 70% of the state's oyster beds.

Storm-related damage to the Louisiana offshore and inshore oil industry was extensive. The U.S. Minerals Management Service estimated approximately $200 million in losses from offshore production. Several large oil spills caused by physical damage to oil production facilities resulted in additional monetary and environmental costs.

One spill resulting from hurricane-related damage to an offshore oil pipeline impacted Trinity Island and the internal wetlands shoreward. Another major spill occurred near Grand Isle, Louisiana's only populated barrier island, when the contents of a large oil pit were washed into adjacent vegetated wetlands by the storm surge.

Within two days following the passage of Hurricane Andrew, over 30 individual fish kills were reported in the estuary. All of these mortalities were the result of oxygen depletions. In most of these incidents, dissolved oxygen concentrations in the water column were severely reduced or totally depleted by the resuspension of the richly organic sediments found in Louisiana's marsh systems.

In some areas, it is estimated that nearly 50% of the standing crop of fish was lost. In Bayou Lafourche, an old distributary of the Mississippi River, dead fish extended for

40 miles. In the Atchafalaya River Basin, which borders the western side of the Barataria-Terrebonne Basin, the total value of freshwater fish lost due to Hurricane Andrew has been assessed at $160 million.

The incredible impact of Hurricane Andrew on the Barataria-Terrebonne estuary was a convincing demonstration of the awesome forces of nature on one hand and its extreme sensitivity on the other. It is man's nature to search for some shred of meaning in the face of disaster. Perhaps, Hurricane Andrew is a reminder that estuaries are not infallible and can not be taken for granted, but that they should be respected and receive stewardship.

F. Florida Coastal Management

Development Of A Management Plan For The Florida Keys National Marine Sanctuary

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Mounting threats to the ecological health and future of the coral reefs in the Florida Keys prompted Congress to protect this fragile resource. The continued possibility of oil drilling and reports of deteriorating water quality occurred when scientists were assessing the adverse affects of several environmental perturbations on Florida's coral reefs. Then, within a 21 day period, three ship groundings occurred. It was this final threat to the reef that resulted in the enactment of the Florida Keys National Marine Sanctuary and Protection Act signed into law by President Bush on November 16, 1990.

The Act designated 2,800 square nautical miles of coastal waters off the Florida Keys as the Florida Keys National Marine Sanctuary (FKNMS). The FKNMS boundary extends southward along the Atlantic Ocean from the northeastern-most point of the Biscayne National Park to the Dry Tortugas, where it turns northeast, encompassing a portion of Florida Bay on the Gulf of Mexico side of the Keys. It incorporates the Key Largo and Looe Key National Marine Sanctuaries, but not Everglades, Biscayne, nor Dry Tortugas national parks.

The Act prohibited leasing, exploring, developing, or producing minerals or hydrocarbons within the Sanctuary. The legislation also prohibited the operation of tank vessels greater than 50 meters in length in the Area to Be Avoided, except for the necessary operations of public vessels. The Act required the Environmental Protection Agency and the State of Florida to develop a Water Quality Protection Program for the Sanctuary, while implementation was left to the discretion of the Secretary of Commerce. Lastly, NOAA was given 30 months to develop a comprehensive management plan.

Although the Sanctuary was established by an Act of Congress rather than through the normal designation process of Title III of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA), the legislation proscribed that the FKNMS be managed and regulated as if it had been designated through the normal process outlined in Section 304 of the MPRSA.

Since approximately 65% of the FKNMS encompasses State waters and numerous State and Federal areas of jurisdiction overlap or lie adjacent to the FKNMS boundary, it was imperative that the planning process for the Sanctuary be an inter/intra-agency effort. Also, due to the high level and diversity of public utilization of the Florida Keys and the importance of tourism to the economy, it was equally important that the public have a strong role in developing the Comprehensive Management Plan.

The planning process was initiated with six public meetings in April and May of 1991 to get comments on the scope of issues affecting the area. Proponents and opponents of the Sanctuary agreed that deteriorating water quality was the major issue affecting the ecosystem. Other issues included depletion of resources, physical impacts to the benthic communities, and problems associated with over-development.

In the summer of 1991, an Inter/Intra-agency Core Group was established to assess the issues identified by the public at the scoping meetings, from written comments, and from surveys. The Core Group consists of representatives from NOAA, National Park Service, U.S. Fish and Wildlife Service, EPA, Florida Governor's Office, Department of Natural Resources, Department of Environmental Regulation, Department of Community Affairs, South Florida Water Management District, and Monroe County.

The Act called for the public to be a part of the planning process, and for a Sanctuary Advisory Council (SAC) to aid in developing a Comprehensive Management Plan. A 22 member SAC was appointed in January 1992 by the Secretary of Commerce and the Governor consisting of members of

various user groups, including local, State, and Federal agencies, scientists, educators, environmental groups, and private citizens.

Numerous public workshops were held to get input on a wide range of topics that could be implemented in managing the Sanctuary, including education, mooring buoys, benthic mapping, research, cultural and historical resources, water quality, and zoning. Each was extremely productive and resulted in the development of strategies that could be implemented in the Sanctuary. However, it was important to tie the workshop results to specific management actions addressing the issues identified during the planning process.

In February 1992, NOAA and its planning partners organized a four-day work session in Marathon, Florida and invited 49 Federal, State, and local managers and scientists familiar with the Keys to participate in a strategy assessment workshop to identify and describe tools that could be used to address the various issues. The SAC participated in a similar, two day workshop session to develop strategies.

The Agency Core Group took the more-than 350 proposals and bundled them into more general groups that could be categorized from the most-protective to the least-protective alternatives. Each step required an enormous amount of inter/intra-agency cooperation. In October 1992, the same agency managers and scientists invited to the February Strategy Assessment workshop were invited to return and review the management alternatives assembled by the Core Group from the results of the workshop. At this second workshop, they were also asked to help identify institutional arrangements, requirements for implementation, and approximate costs to implement various strategies.

The Act called for Sanctuary Managers to consider the use of zoning to manage the Sanctuary. Realizing the public's sensitivity to being told where it can undertake activities, management staff decided to involve the public in developing a zoning plan. The process began with agency managers identifying the various types of zones useful in managing particular areas of jurisdiction. Then, environmental groups, commercial fishermen, recreational fishermen, divers, and scientists attended a week-long workshop, the results of which were used by the strategy assessment work group in February to aid in its identification of zones useful for managing the Sanctuary. The members of the Sanctuary Advisory Council helped develop the zoning concept by identifying types of zones and marking on maps where activities would be conducted. The members were also asked to identify areas where their uses conflict with other groups, where access is need to conduct activities, and ecologically important areas. Three zoning alternatives have been developed, and the SAC is making recommendations on the size and number of various zones.

A Draft Environmental Impact Statement and Management Plan are due out in mid-summer 1993. EPA and DER, which are working on the Water Quality Protection Program, have been working to develop the Sanctuary plan, and their plans are being merged by the Agency Core Group.

The management planning process for the FKNMS had an unprecedented level of inter/intra-agency and private sector involvement. Sanctuary staff feel the time invested in working with the various groups has been well spent. There has been a continuous effort to focus on the management needs of the ecosystem, not on jurisdictional rivalries. All of the individuals and agencies involved in developing the management plan for the Florida Keys National Marine Sanctuary deserve tremendous thanks for their willingness to cooperate in this process.

State/Federal Partnership Issues

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The development of the management plan for the Florida Keys National Marine Sanctuary is a prime example of how intergovernmental relationships should develop to protect a pristine, prime resource, such as the Florida Keys.

Before the sanctuary was established, the State became very involved in management of the Keys after three major vessel groundings occurred within 21 days and the threat of future oil drilling in the Florida Keys. Citizens groups, governmental entities, and, particularly, Congressional Representatives recognized that the Florida Keys needed protection.

Development of the sanctuary was unique and unprecedented. Rather than going through a long planning process, proposing a sanctuary, and other bureaucratic obstacles to establishing it that take two years or more to complete, Congress passed a law designating the Florida Keys National Marine Sanctuary. The greatest challenge was in developing water quality and management plans acceptable to the diverse interests of Florida and the nation.

President George Bush signed the Act into law on November 16, 1990, giving the State 30 days to determine what waters would be included in the management plan. The area covers nearly 3,000 square miles, which is larger than the coastal zone of some Gulf States. Over 60% of the water surrounding and included in the Florida Keys National Marine Sanctuary boundary are State waters, making the State a major player in developing a workable management plan. These waters surround a 100 mile chain of small islands on which are thriving communities.

On December 18, then - Governor Martinez responded to the Secretary of Commerce, enclosing a resolution from the Florida Cabinet to improve state waters with certain conditions. The primary condition was that there would be no transfer of title or authority to the State's sovereign submerged lands, and it also designated key agencies to work with NOAA as the management plan was developed.

The Act requires the input of local, State, and Federal government. Monroe County has been very involved in developing the plan. The citizens and government of Monroe County have been integrated in the planning process. The Interagency Management Committee of the Coastal Management Program is the mechanism used to interact with NOAA, and many agencies are members of the Management Committee.

Another major aspect of this is the Citizens Advisory Committee. It has 22 members representing different user groups in the Florida Keys. They meet once a month and work among themselves to develop the management plan. Some of the groups most affected by the sanctuary management plan include commercial fishing interests, dive boat operators, and treasure salvagers.

The program being developed for the Florida Keys has many different actors, and it is nearly a mini-Gulf of Mexico Program. Every group necessary must be involved in the process at the outset, because if they become involved later, it will make obtaining their consensus more difficult.

The Signing Ceremony for the Gulf partnership was a good example of the array of agencies involved in the program. The structure is necessary to address all of the issues in an ecosystem as complex as the Florida Keys, requiring a committed plan of action by all of the agencies.

NOAA has done a wonderful job in putting together the core strategy group in which over 30 Federal, State, and local agencies are represented. As in the Gulf of Mexico Program, all these agencies have an interest and were represented early in the process. They included citizens, citizens groups, scientists, politicians, businesses, and economic interests.

Management Issues Of The Florida Keys National Marine Sanctuary

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The Florida Keys National Marine Sanctuary (FKNMS) is the largest National Marine Sanctuary in the United States and the third largest protected barrier reef in the world. Coral reefs within the 2,600 square nautical mile area attract more than 1.5 million divers per year due to their natural beauty and biological diversity. More than a hundred species of coral and five hundred species of tropical fishes, including moray eels and endangered sea turtles can be found in the Keys.

President Bush's enactment of the Florida Keys National Marine Sanctuary and Protection Act (Act), on November 16, 1990, was a milestone in marine resource protection. It compares to the first major effort to protect upland resources, when President Grant established Yellowstone National Park in 1872.

This was the first time a marine sanctuary was designated by legislation. Prior designations had been accomplished through the process provided in the Marine Protection, Research and Sanctuaries Act of 1972, which created the National Marine Sanctuary Program.

However, in the fall of 1989, three major ship groundings occurred, precipitating drafting the Act to provide accelerated protection for the Florida Keys and precluding a lengthy designation process. The groundings emphasized the need to address catastrophic threats to the reefs. However, the Act also provided the authority and opportunity to address the management issues that collectively contribute to the decline of the natural resources in the Florida Keys by using holistic marine ecosystem management.

A number of factors threaten the Florida Keys, including natural and anthropogenic factors. The coral reefs, especially in the northern areas, are near the northernmost areas of reef development. They are more vulnerable to natural and anthropogenic disturbances than reefs of the southern Caribbean due to the increased environmental stresses resulting from their location.

Coral reefs may benefit from tropical storms, hurricanes, and other naturally occurring phenomena by flushing confined bays accumulating excess nutrients or becoming hypersaline. However, catastrophic physical damage may result from the tremendous force of wave action created by these storms.

Gradual climate changes will also inevitably affect the fragile coral reef ecosystem of the Florida Keys. In fact, some scientists believe that recent coral bleaching events resulted from elevated water temperatures due to global warming. For instance, the "Black Band" coral disease that recently occurred in the Keys is a natural phenomenon whose effects may have increased due to climate changes and man's impact on the environment. The recent die-off of the sea urchin *Diadema sp.* throughout the Caribbean is another naturally occurring phenomena not thoroughly understood, but it could result from the same causes.

Naturally-occurring phenomena seriously concern the managers of protected marine areas, but little can be

accomplished to curtail them through on-site management practices. Therefore, the FKNMS management plan will focus on anthropogenic impacts.

Catastrophic physical damage to the coral reefs of the Florida Keys has resulted from the grounding of large freighters, such as the 400 foot "Wellwood" that ran aground on Molasses Reef in Key Largo NMS in 1984 and destroyed more than 640 square meters of reef. Ship groundings destroy decades, even centuries, of coral growth. Even though the sanctuary program recovered $6.6 million from the litigation related to the incident, this type of resource cannot be restored. The Act addresses the problem by establishing an "Area to be Avoided" by large freighters, restricting their travel to areas beyond the FKNMS boundary.

Large vessels are not alone in damaging reefs. Groundings and anchorings by small vessels cause significant damage throughout the Keys, especially to seagrass habitats and coral reefs. Also, the impact of divers repeatedly touching and standing on sensitive coral formations destroys major areas of reefs by removing the protective mucous coating on coral polyps, damaging their delicate tissue. The use of environmentally destructive techniques to recover historical resources, including sunken treasures, also causes severe habitat damage.

There are many consumer activities affecting the ecosystem of the Florida Keys, including the dramatic depletion of fish populations from spearfishing, wire trap fishing, and collecting tropical fish and invertebrates for sale. Littering and other pollution also causes destruction in the marine environment.

The importance of water quality issues to protecting the Florida Keys is recognized and emphasized by the Act. A Water Quality Plan must be included in the FKNMS Comprehensive Management Plan. Public awareness of water quality issues is growing, as demonstrated by the testimony at Public Scoping Meetings. Many issues related to development of upland areas, such as stormwater runoff, mangrove pruning, land based pollution, nutrient over-enrichment, and organic, chemical, and heavy metal contamination were mentioned by citizens attending those meetings.

The management issues have been placed in five categories to develop strategies in the comprehensive management plan:

(1) boating (direct and indirect impacts),

(2) fishing (commercial and recreational),

(3) land use/land based pollution,

(4) recreation and cultural/historical resources, and

(5) water quality.

The management plan development process is a cooperative effort of local, State, and Federal agencies with considerable public input. It is hoped that the strategies established will minimize or eliminate human impacts on the Keys through scientific research, user awareness, environmental education, and enforcement.

Florida Keys National Marine Sanctuary - Water Quality Issues

Peggy H. Mathews
Florida Department of Environmental Regulation
Tallahassee, Florida

The Florida Keys National Marine Sanctuary, an area almost 10,000 kilometers square, extends from just southeast of Miami in a southwesterly arc through the Florida Keys and, then, 350 kilometers to the Tortugas. The Sanctuary includes portions of Florida Bay and, essentially, all of the Keys' coral reef. The reef is the only such ecosystem in North America, one that is viewed as the marine equivalent of a tropical rainforest.

The Florida Keys gained marine sanctuary designation in 1990 when Congress enacted legislation in response to a series of damaging ship groundings in the area. While such groundings are a threat to the Sanctuary, it is now believed that water quality is the most important immediate threat to the ecosystem. Two major threats to the Sanctuary ecosystem's water quality have been identified. These are reduction of freshwater inflow to Florida Bay and domestic wastewater discharges from the Florida Keys.

Regarding the first of these threats, Florida Bay, which extends from the southern coast of mainland Florida down to the Florida Keys, historically received massive freshwater inflow from the Everglades. However, beginning in 1910, freshwater was diverted from the Everglades, and it continued to the point where, presently, about 60% of the freshwater that flowed into Florida Bay is diverted for agricultural, municipal, and industrial use.

The effect on the chemistry and hydrodynamics of the bay is dramatic. Florida Bay was once an estuary, a basin where freshwater mixed with oceanic water, and salinity ranged seasonally from zero (freshwater) to about 35 ppt (ocean water). Today, Florida Bay is a hypersaline lagoon, a negative estuary where evaporative loss of water exceeds freshwater inflow. Peak salinity in the central basin range from about 45 to 70 ppt (Michael Robblee, James Forqurean, Ronald Jones, pers. comms.).

There have been important biological consequences of the alteration in chemistry of the bay. Mangroves in Florida Bay are stressed and dying, and excessively high salinity has been implicated. In the mid 1980's, seagrass, mainly *Thalassia*

testudinum, covered 80% of the bay bottom. However, since 1987, almost 30,000 hectares of seagrass have been lost or affected by what researchers believe to be salinity stress, exacerbated by the elevated water temperatures evident from 1987-90 (Mark Butler, Michael Robblee, Michael Durako, Joseph Zieman, pers. comms.).

The loss of seagrass has direct ecological and economic impacts. For example, grouper, snapper, tarpon, bonefish, stone crabs, pink shrimp, and spiny lobster all depend on seagrass meadows as nursery or foraging grounds. Already, it has been noted that, corresponding with seagrass decline, pink shrimp catch has declined 60% since the late 1980's (John Hunt, pers. comm.).

There are cascading disturbances from the loss of seagrass as well. Phytoplankton blooms of up to several hundred square kilometers in extent (Patricia Donovan-Potts, Karl Lessard, pers. comms.), fueled by nutrients released from suspended sediments no longer held in place by seagrass rhizomes, resulted in mass mortality of Florida Bay sponges (Mark Butler, Thomas Mathews, Ken Haddad, pers. comms.). Sponges are a critical habitat for juvenile spiny lobster, and the impact on lobster catches, as well as the effects on other components of the ecosystem, remain to be seen.

The coral reef itself may be threatened by Florida Bay's hypersalinity. Monitoring by the Florida Institute of Oceanography, supported by The Nature Conservancy, demonstrated that on occasion, hot, salty water from Florida Bay extends across Hawk Channel, encroaching the reef (John Ogden, pers. comm.). This degraded water may be responsible for stressing corals, which most scientists believe to be in decline (James Porter, Kathleen Sullivan, Mark Chiappone, pers. comms.).

The second important water quality threat to the marine sanctuary is the domestic waste generated by the 78,000 residents of Monroe County, essentially the population of the Florida Keys.

Of the 67 counties in Florida, Monroe County is rated 66th in soil suitability for septic tank treatment of domestic waste (George Garrett, pers. comm.). Yet, Monroe County has the state's highest proportion of septic tank usage. An estimated 24,000 on-site disposal systems and 5,000 cesspits, often located close to the sea, discharge into the porous limestone "soil" of the Florida Keys. The result is that, relative to all other domestic waste sources, these on-site systems contribute about 66% of the nitrogen and 75% of the phosphorus load to the ultra nutrient-poor waters surrounding the Keys (David Gettleson, pers. comm.).

The biological consequences of this nutrient discharge to nearshore Keys' waters are elevated nutrient concentrations, elevated phytoplankton biomass, increased epiphyte growth on seagrass, increased seaweed abundance, and reduced dissolved oxygen concentration (Brian Lapointe, pers. comm.).

There is, to date, no evidence that the degraded seawater adjacent to densely developed portions of the Keys has impacted the coral reef. Yet, marine fauna are, generally, reliant on a matrix of habitat types, and degradation of inshore seagrass meadows and hardbottom areas may affect coral reef animals.

These two water quality issues, hypersalinity of Florida Bay and domestic waste treatment in the Keys, will take intensive efforts to resolve. Restoring freshwater flow to Florida Bay and developing and implementing effective domestic waste treatment methods for the Keys are high cost, politically- and scientifically-complex, long-term endeavors. Cooperation and coordination are essential if these goals are to be accomplished. With regard to the Florida Keys National Marine Sanctuary, Federal, State, and local governments, environmental and user groups, researchers and the public have all been involved in issue identification and problem resolution. It is hoped that this will result in broadly supported solutions that will preserve the nation's only coral reef ecosystem for the use and appreciation of this and successive generations.

Development Of The Water Quality Protection Program For The Florida Keys National Marine Sanctuary

Fred McManus
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Region 4
Atlanta, Georgia

On November 16, 1990, President George Bush signed into law H.R. 5909, designating over 2,800 square nautical miles of coastal waters as the Florida Keys National Marine Sanctuary (FKNMS). This was the first marine sanctuary required to have a Water Quality Program as well as a Management Plan. The Comprehensive Management Plan is being developed by the National Oceanic and Atmospheric Administration, the Water Quality Protection Program (WQPP) by the U.S. Environmental Protection Agency with the State of Florida. The purpose of the WQPP is to recommend priority corrective actions and compliance schedules addressing point and nonpoint source pollution to restore and maintain the chemical, physical, and biological integrity of the FKNMS.

The development of the WQPP is occurring in two phases. In Phase I, an inventory of data describing the status of the Florida Keys environment was produced. A set of priority problems was developed from this data by a consensus of

experts attending technical workshops. The Phase I report was delivered to EPA in July 1992 and distributed to the public.

During Phase II, the problems identified in Phase I will be evaluated to recommend priority corrective actions and schedules for implementation to include in the WQPP document. EPA and the Florida Department of Environmental Regulation (FDER) organized the activities into the following tasks:

- develop the Work/Quality Assurance Project Plan,
- identify institutions and agencies with jurisdiction affecting water quality in the FKNMS,
- develop a range of management strategies and systems for each problem statement developed in Phase I,
- develop and evaluate engineering options to address significant pollution sources in need of attention,
- identify and evaluate funding sources for implementation,
- develop a Water Quality Monitoring Program to determine the effectiveness of controls, monitor water quality and biotic resources, and redirect the Program as needed,
- develop a research program to identify the cause/effect relationships between pollutants, transport pathways, and biotic communities,
- promote public awareness by developing a public education and outreach program,
- produce a preliminary draft Phase II report,
- present the results of Phase II to experts, public, NOAA Advisory Council, and FKNMS Steering Committee,
- draft FKNMS Water Quality Protection Program document and submit it to EPA, the State of Florida, and NOAA,
- solicit public comments on the draft document, and
- publish the final document.

The Water Quality Monitoring Program will provide information on the status and trends of water quality and biotic community resources within the FKNMS. The Program will be used to redirect and refocus the WQPP and determine the effectiveness of institutional and structural controls. The research plan will identify the pollutants, transport pathways, and cause/effect relationships.

EPA and FDER conducted a workshop to present the draft monitoring program and research plan, receive detailed and specific guidance and advice from researchers and resource managers, build consensus on priorities, sampling designs, and methodologies, and receive public comments. Subsequently, the Tasks 6 and 7 reports were revised.

A second workshop was held to discuss potential institutional, management, and engineering options addressing pollution sources impacting the FKNMS. Potential funding mechanisms were also reviewed. The discussions focused on two major areas. The first concerned pollution sources directly related to the Florida Keys, including wastewater, stormwater, hazardous materials, landfills, spills, and pesticides. The second concerned the impact of water from the Everglades, Florida Bay, and Biscayne Bay on the FKNMS.

During the workshop, each of the issues and problems was reviewed and discussed. Also, a preliminary draft set of institutional, management, and engineering options was presented to the workshop participants, which included representatives from federal, state, regional, county and local government agencies, academia, environmental groups, and the public. One must remember that the options were intended to include all corrective actions.

The institutional and management options ranged from no change in existing structure to over-regulation by various levels of government. The engineering options ranged from no action to the construction of 3 tertiary level (nutrient removal) regional wastewater treatment plants in the Keys. To the extent possible, the characteristics (administrative requirements, funding requirements, public acceptance, environmental effect, and pollution reduction) of the various options were reviewed and discussed. After the workshop, the Tasks 3 and 4 report were revised.

Next, the options for Tasks 3 and 4 were prioritized by NOAA's Core Work Group, which includes representatives from federal, state and local government agencies and has primary responsibility for developing the Comprehensive Management Plan for the FKNMS. The list of priority options will be included in the final Phase II report, which EPA and FDER received on November 2, 1992 and included reports on Tasks 2-8.

The draft Phase II report was copied and distributed to the public for a two week review prior to a scheduled workshop. Copies were mailed directly to past workshop participants, academic institutions, environmental groups, and libraries. Each task was reviewed and discussed, and all comments were considered during the revision. The final revised Phase II report will be delivered to EPA and FDER by February 28, 1993.

Next, the draft WQPP document was developed. It consisted of the Phase I and II reports and a recommended action plan listing priority corrective actions and compliance schedules addressing point and nonpoint sources of pollution. EPA and FDER will deliver the draft WQPP document to NOAA by May 7, 1993. It will undergo additional review in conjunction with NOAA's Comprehensive Management Plan through the National Environmental Policy Act/Environmental Impact Statement process, which permits public participation. Once final, it will be distributed to the public.

Any questions concerning the development of the WQPP document for the Sanctuary should be directed to:

Mr. Fred McManus	Ms. Peggy Mathews
Florida Keys Coordinator	Florida Keys Coordinator
EPA Region IV	Florida Dept. Env. Regulation
404-347-1740	904-488-0784

G. Offshore Operators And Coastal Vessel Traffic Systems

The Offshore Oil And Gas Producing Industry Environmental Stewardship Operations In The Gulf Of Mexico

Bernie Herbert
Amoco Production Company
New Orleans, Louisiana

Oil and gas producers operating in the Gulf of Mexico are constantly improving and increasing the environmental safeguards in their operations, both to remedy past problems and be good corporate citizens. Over the last 10 years, the industry has taken many steps to make these improvements, and there has been no slacking in its commitment to make itself a good citizen, good business partners, and a partner in the environmental movement.

The Offshore Operators Committee (OOC) is a 40 year old organization with 70 member companies operating oil and gas production facilities in the Gulf of Mexico. Its purpose is the pursuit of industry advancement and excellence, interacting with various government agencies, primarily the Minerals Management Service (MMS). It is a partner in the Gulf of Mexico Program.

Ninety percent of all U.S. offshore oil and gas production comes from the Gulf of Mexico -- almost entirely off the Louisiana and Texas coasts, although there has been some recent production off Mobile, Alabama. The first well was drilled in the Gulf in 1947, 12 miles from Louisiana. In 1992, there were 30,000 wells and 4,500 platforms, accounting for 25% of the nation's natural gas and 12% of its oil. It is estimated that 1/2 of the nation's undiscovered oil and 1/4 of the gas reserves are in the Gulf.

The industry employs 470,000 people in the U.S., of which 80,000 live on the Gulf Coast. Many common, every day products in use, whether deodorant, bubble gum, or gasoline, are derived from hydrocarbons that were likely produced in the Gulf.

Proceeds from offshore oil and gas production provides the second largest amount of revenue for the U.S. Government. Over $100 billion has been collected and spent on many programs. For instance, $82 billion was spent on health care, education, and housing, $13 billion on public parks, $2 billion on historic preservation, and, since 1986, the states of Louisiana and Texas received about $2 billion.

The offshore industry has some unpredicted benefits. Because rigs act as reefs, the 4,500 oil and gas platforms comprise 1/3 of the artificial reefs, providing fish habitat. Recreational fishing in Louisiana is approximately a $190 million-a-year business, and 70% of the anglers fish along these platforms. This is quite a statement about the environmental quality maintained around these structures. Artificial reefs have a life span of 3 to 30 years. When production is complete, the locations are stripped entirely, and those jackets sometimes become artificial reefs.

The MMS has produced extensive, thorough regulations for offshore operations, but as they evolve, industry's own safety systems and environmental policies become more effective. A great deal of credit belongs to the MMS, which has proposed a new Safety Environmental Management Plan requiring operators to integrate their plans -- safety, environment, risk assessment, and evacuation -- and management to assume responsibility for these activities.

There are many waste products from oil and gas production that must be disposed. Produced water, which comes out of a well with oil and gas, is the principal waste, and it is treated to reduce its toxic effects on the environment. Amoco's rigs are not allowed to have a sheen of any type on the water during these discharges.

Like a home, most waste produced is domestic. Cardboard, paper, and other non-hazardous and hazardous wastes must be brought to shore and disposed. Amoco has a committee to approve its waste management processes, which it is continually trying to improve.

No equipment can be left on the Outer Continental Shelf, and there must be safety systems in place during production. If something goes overboard, it must be retrieved. When a site is abandoned, it must be dragged and all equipment must be removed.

Most emissions from offshore platforms are no different than what comes from one's car. However, the OOC and MMS are conducting a 3 year study to evaluate the combined emissions from the 4,500 offshore rigs and onshore sites, such as Baton Rouge and Houston.

The OOC established a committee similar to the Gulf of Mexico Program with participants from government, special interests, and industry. Waste reduction goals and a marine debris baseline were established to monitor what industry waste is washing ashore so that it can be eliminated. For example, styrofoam is banned on many rigs, and recycling programs are being established.

Each year, the oil and gas industry provides 5,000 people for the national Coastal Cleanup. The industry is a major supporter of this activity, and in some cases, the predominant participant.

Environmental protection occurs in all phases of hydrocarbon exploration. The chance of finding hydrocarbons in commercial quantities is about 20%, so for every ten wells drilled, two may be viable. This is a very risky business when one considers that it costs $5-10 million to drill a well.

Therefore, much exploration activity is seismographic work where boats pass over an area and beam sound waves to determine what's present, so there is not a lot of pollution involved. Before drilling occurs, a comprehensive environmental studies must be conducted.

The primary goal in drilling is to control the well, and the industry seeks to have zero spills. If a spill occurs, the operation is considered a failure. A lot of time, money, and technology is involved in controlling the process, such as safety systems to shut down a well if there is a large variation in pressure. Also, the industry has many emergency contingency plans.

Pipeline technology has improved dramatically so that they can be installed with minimal environmental damage. This is important in areas with extensive oyster beds, such as Mobile Bay. Safety systems monitor pressure so that there are no surprise leaks. However, this is an area for continued improvements.

In addition to the Gulf of Mexico Program, the OOC is involved in many activities, such as the Clean Gulf Association, which is a cooperative of companies to ensures a ready supply of spill cleanup equipment. The OOC also supports university research and reclamation projects, especially in coastal marshes and wetlands, and it is a major donor to the Nature Conservancy and the Aquarium of the Americas in New Orleans.

In addition, the OOC has devised numerous projects in support of the Year of the Gulf of Mexico. It sponsored an essay contest, published 10,000 book covers that were handed out across the Gulf at the national Coastal Cleanup, and published a booklet explaining industry initiatives in more detail. The OOC supports many arts organizations and charities, as well as educational partnerships.

VIPS (Vessel Information And Positioning System): A Private Initiative Vessel Traffic System

John C. Timmel
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Tampa, Florida

A Vessel Traffic System (VTS) is an integrated assortment of personnel, procedures, equipment, and regulations to manage marine traffic in a particular body of water. An effective VTS will increase navigational safety and traffic efficiency and better protect the marine environment. Systems range in complexity from vessels reporting their position by radio to up-to-date radar, Radio Direction Finding (RDF), and Differential Global Positioning System (DGPS) technologies.

Although widely used on European and Asian waterways for many years, few U.S. ports are equipped with VTS. The first VTS began operating in Liverpool, England in 1948; however, it was not until the Ports and Waterways Safety Act of 1972 was passed did the Coast Guard upgrade its harbor advisory concept to a VTS program. Still, there were fewer than a six systems when the Exxon Valdez spill occurred in 1989. The most common VTS are shore-side radar based systems funded and operated by the U.S. Coast Guard.

Under the Oil Pollution Act of 1990, a VTS Port Needs Study was conducted at 23 ports to determine their navigational, commercial, and environmental risk and prioritize them for future projects. It recommended that systems be upgraded and new ones installed as federal money became available and appropriated. However, many ports are unlikely to receive federal moneys for a VTS until another catastrophe like the Exxon Valdez occurs.

Another result of the OPA was an enormous increase in the liability of petroleum shippers due to public uproar over the damage caused by the Valdez. Without the rapid deployment of VTS and other safety-related technologies, oil shipping companies have an impossible task -- prevent oil spills with no tools, causing shippers to evaluate their practices to reduce exposure and, possibly, whether to cease shipping oil. If companies leave the oil transportation business, more oil will be carried by foreign flag vessels or smaller, less capitalized companies.

Aware of increasing liability and seeking ways to reduce the risk of marine pollution, officials of Mobil Shipping Corporation and a traffic system technology company met to discuss the feasibility of industry-sponsored VTS's in high-risk ports. They presented the notion to officials in Tampa Bay because it is a difficult port in which to maneuver and had no VTS system. The idea was presented to the Greater Tampa Bay Marine Advisory Council, composed of maritime interests which make recommendation on various marine safety issues, for review. The Council was intrigued and formed a task force to consider the matter further.

The task force quickly determined that a VTS is desirable due to the many course changes and junctions in narrow channels, strong currents, and the loss of visual and radar cues during intense thunderstorms and squalls. These, combined with the lack of anchorages once inside the main channel, creates a very dangerous situation. Once a deep-loaded vessel begins transit, it has two options -- continue on regardless of conditions or ground itself in part of the channel where damage is less likely to occur.

The task force also determined that a hybrid system combining shoreside radar with DGPS would work best in Tampa Bay by providing navigational precision for vessels participating in the system and radar detection for those that do not. The DGPS system permits tracking during intense rainstorms that block out radar. A new, unique, self-contained, carry-on pilot system displays the position of the vessel and others in close proximity, as well as collision avoidance data. The information is provided in an Electronic Chart Display and Information System format. Other pertinent navigational data that is provided include: real-time tide and tidal current information; real-time weather radar information tracking storm cell and squall positions, intensities, and movement; traffic lists; Aids-To-Navigation discrepancy information; and safety broadcast information. The VIPS design provides the information in a visual form directly to the vessel pilot, allowing the pilot to use that data with the vessel's handling characteristics and the influence of the wind and current upon them.

Tampa Bay VIPS will be a non-profit corporation. Because the system is user-operated, the need for personnel is minimal. There will be only three paid employees -- a manager, a technician, and a bookkeeper. There will be an Advisory Board made up of maritime and environmental community members which will be responsible for appointing a Board of Directors to establish administrative policy. If the market for receive-only units for non-commercial vessels develops, additional marketing personnel, or licensing of a distributor outside of the organization, may be required.

The system will cost $1.2 million for hardware and software development, installation, licensing, siting, permitting and other related start-up costs. This is ¼ **the cost** of the federal system for Tampa Bay identified in the Ports Needs Study, and it includes many features which that system does not. The total operational costs are projected at $160,000 the first year, rising incrementally to $425,000 by the end of the fourth. The candidate system proposed by the federal study projects **labor costs alone** at $489,000 per fiscal year.

The Tampa Bay VIPS will be funded from four sources --start-up contributions from industry and environmental concerns, user fees, governmental users, and non-commercial, pleasure craft operators. As revenues from these sources increase, the fees on commercial vessels could be lowered.

The Tampa Bay VIPS effort is worthwhile, desirable, and feasible, and there is no reason to wait 6 to 8 years, or until the environment is damaged, to obtain it. It makes more economic sense to spend one local dollar than it does to spend four federal dollars to achieve the same goal. The cost effectiveness of the Tampa Bay VIPS makes it affordable and obtainable now, and this project can serve as a model for other communities seeking to protect fragile ecosystems while making its port safer and more efficient.

VII. Exhibitors At The Technical Poster Session

A. Vegetated Habitats

Monitoring Wetland Habitat Changes in Coastal Texas by Satellite Mapping
Warren Pulich, Jr. and James Hinson
Texas Parks and Wildlife Department
Austin, Texas

Factors Affecting the Distribution of Submerged Aquatic Vegetation in Lake Ponchartrain, Louisiana
K.P. Preston, M.A. Poirrier, and J.W. Burns
University of New Orleans
New Orleans, Louisiana

Alternative Access Technologies for Exploration and Production Drill Sites in Coastal Marsh Areas
J.M. Bruney and J.C. Taylor
Exxon Production Research Company
Houston, Texas

Clean Water Demonstration
Mike Calinski
Marine Habitat Foundation, Inc.
Captiva, Florida

B. Water Quality

Irrigations Water Management
Danny M. Lamberth
U.S. Department of Agriculture, Soil Conservation Service
Haskell, Texas

The Seco Creek Water Quality Demonstration Project
Phillip Wright, Wesley Newman, Melony Sikes, and Tom Fillinger
U.S. Department of Agriculture, Soil Conservation Service
Hondo, Texas

Dynamics of the Soil, Water, and Vegetative Regimes of the Coastal Marshes of Louisiana
Horace J. Austin
U.S. Department of Agriculture, Soil Conservation Service
Alexandria, Louisiana

C. Nutrient Enrichment

Environmental Control of Primary Production and Fate of Organic Matter in the Outflow Areas of the Mississippi River and Northern Gulf of Mexico
Gary L. Fahnenstiel and Gregory A. Lang
Great lakes Environmental Research Laboratory
National Oceanic and Atmospheric Administration
Ann Arbor, Michigan

Donald G. Redalju and Steven E. Lohrenz
University of Southern Mississippi
Stennis Space Center, Mississippi

The Role of the Mississippi River Discharge Plume in Recruitment Processes of Northern Gulf of Mexico Fishes
C.B. Grimes, D.A. DeVries, J.J. Govoni, K.L. Land, and R.J. Allman
National Marine Fisheries Service
Panama City, Florida

Effects of Nutrient Enrichment and Overfishing on Seagrass Beds in the Gulf of Mexico
K.L. Heck, Jr., L.D. Coen, J.R. Pennock, and J.F. Valentine
Marine Environmental Sciences Consortium
Dauphin Island Sea Lab
Dauphin Island, Alabama

D. Monitoring And Assessment

Fifteen Years in the Life of a Gulf Barrier Island Beach
Anthony F. Amos
University of Texas at Austin
Marine Science Institute
Port Aransas, Texas

Flower Gardens Marine Sanctuary, Research and Monitoring Efforts
Steve Gittings
National Oceanic and Atmospheric Administration
Flower Garden Banks National Marine Sanctuary
Bryan, Texas

E. Living Aquatic Resources

Marine Mammal Surveys in the Gulf of Mexico
Carol L. Roden and Carolyn Rodgers
National Marine Fisheries Service
Pascagoula, Mississippi

Seaweed Cleanup on a Sea Turtle Nesting Beach
Kennard Watson
St. Andrew Bay Resource Management Association
Panama City, Florida

Lorna Patrick
U.S. Fish and Wildlife Service
Panama City, Florida

Monitoring the Behavior and Movements of Sea Turtles Through the Use of Ratio Tags in the North-Central Gulf of Mexico
Karen Mitchell and Warren E. Stuntz
National Marine Fisheries Service
Pascagoula, Mississippi

Larry Bryant
U.S. Department of Agriculture, Forest Service
La Grande, Oregon

Bioacoustic Assessment of Plankton Stocks in the Northwest Gulf of Mexico
R.A. Zimmerman, D.C. Biggs, and A.L. Anderson
Department of Oceanography, Texas A&M University
College Station, Texas

Population Genetics of the Blue Crab, Callinectes sapidus, From the Northern Gulf of Mexico
Dr. Robert k. Okazaki and Nicole J. Berthelemy-Okazaki
Southeastern Louisiana University
Hammond, Louisiana

Benthic Ecology Data Base for the Gulf Coast
William T. Mason, Jr.
National Fisheries Research Center
U.S. Fish and Wildlife Service
Gainesville, Florida

Summary of Research Activities by the Benthic Ecology Program of Mote Marine Laboratory in the Eastern Gulf of Mexico
James K. Cutler and Jay R. Leverone
Mote Marine Laboratory
Sarasota, Florida

Macrobenthic Trophic Structure in Fine-Sediment Habitats of Gulf of Mexico Estuaries
Steven S. Brown and Gary R. Gaston
University of Mississippi
Oxford, Mississippi

Richard W. Heard
Gulf Coast Research Laboratory
Ocean Springs, Mississippi

Kevin Summers
U.S. Environmental Protection Agency
Gulf Breeze, Florida

Use of Benthos and Sediment Analysis to Describe Impact of Dredge Material
Barry A. Vitor
Barry A. Vitor & Assoc.
Mobile, Alabama

Gulf Sturgeon
Frank Parauka
U.S. Fish and Wildlife Service
Panama City, Florida

Fecundity of Gag (Pisces: Sierranidae: Mycteroperca microlepis) from the Northeastern Gulf of Mexico
L.A. Collins, A.G. Johnson, H.E. Kumpf, and C.P. Keim
National Marine Fisheries Service
Panama City, Florida

F. Coastal And Shoreline Erosion

Responses to Erosion on Gulf of Mexico Beaches
Scott L. Douglass
University of South Alabama
Mobile, Alabama

Shoreline Changes and Human Impacts, Ocean Springs, Mississippi, 1850-1992
Klaus J. Meyer-Arendt, Pete A. Kohn and Walter E. Kelley
Department of Geology and Geography
Mississippi State University
Mississippi State, Mississippi

Coast of Florida Erosion and Storm Effects Study
U.S. Army Corps of Engineers
Jacksonville District
Jacksonville, Florida

Gulf Coastal Programs at the Florida Geological Survey
Ronald W. Hoenstine, Ed Lane, Frank Rupert, Steven M. Spencer,
Connie Garrett, and Jacqueline M. Lloyd
Florida Geological Survey
Tallahassee, Florida

Coastal Erosion: Point Aux Chenes, Mississippi
Charles K. Eleuterius and G. Alan Criss
Gulf Coast Research Laboratory
Ocean Springs, Mississippi

Manmade and Natural Changes on the Mississippi Gulf Coast
Steven Oivanki, Jack S. Moody, and Barbara Yassin
Mississippi Office of Geology
Jackson, Mississippi

G. Environmental Policy

Applying a Policy Subsystem Framework to the Gulf of Mexico Program
Richard Larkin
University of Southern Mississippi
Hattiesburg, Mississippi

H. Environmental Education

Alabama Sea Grant Extension Educational Efforts
William Hosking
Alabama Cooperative Extension Service
Mobile, Alabama

Environmental Education Initiative
Charles Horn
Alabama Department of Environmental Management
Montgomery, Alabama

Wayne J. Aronson
U.S. Environmental Protection Agency
Atlanta, Georgia

Protecting the Environment and Promoting Conservation
Robert P. Jones
Southeastern Fisheries Association and Friends of the Environment
Tallahassee, Florida

Communicating Pollution Prevention Technologies
Catherine L. Mills
Science Applications International Corporation
Falls Church, Virginia

Studies in Florida Wetlands: Summer Marine Science Institute
Lawrence Olson
Tallahassee Community College
Tallahassee, Florida

William Halpern, Sneed Collard, and Susan Collard
University of West Florida
Pensacola, Florida

Awareness of Coastal Habitat
Catherine Porter
Palacios Marine Education Center
Palacios, Texas

Girl Scout Patch "The Gulf of Mexico"
Laura G. Jenkins
U.S. Fish and Wildlife Service
Panama City, Florida

I. Data Information And Technology Transfer

A Knowledge-Based Decision Support Geographic Information Service for Coastal Wetlands Management
Wei Ji, James B. Johnston, Marcia E. McNiff, and Lloyd Mitchell
National Wetlands Research Center
U.S. Fish and Wildlife Service
Lafayette, Louisiana

Louisiana Coastal Geographic Information Service Network
Randolph A. McBride, Matteson W. Hiland, and Lynda Wayne
Louisiana Geological Survey
Baton Rouge, Louisiana

Henry R. Strieffer
Decision Associates, Inc.
Baton Rouge, Louisiana

Farrell W. Jones, Dewitt Braud, Jr., and Anthony J. Lewis
Louisiana State University
Baton Rouge, Louisiana

The Environmental Monitoring and Assessment Program: Information Management System and Data Accessibility for the Gulf of Mexico Monitoring Data

Matt Evans and Renee Conner
Computer Sciences Corporation
Gulf Breeze, Florida

Kevin Summers
U.S. Environmental Protection Agency
Gulf Breeze, Florida

The Environmental Monitoring and Assessment Program: Estuaries of the Louisianian Province, 1991-1992

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