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Agency

Office Of Water
Gulf Of Mexico Program
Stennis Space Center, MS 39529

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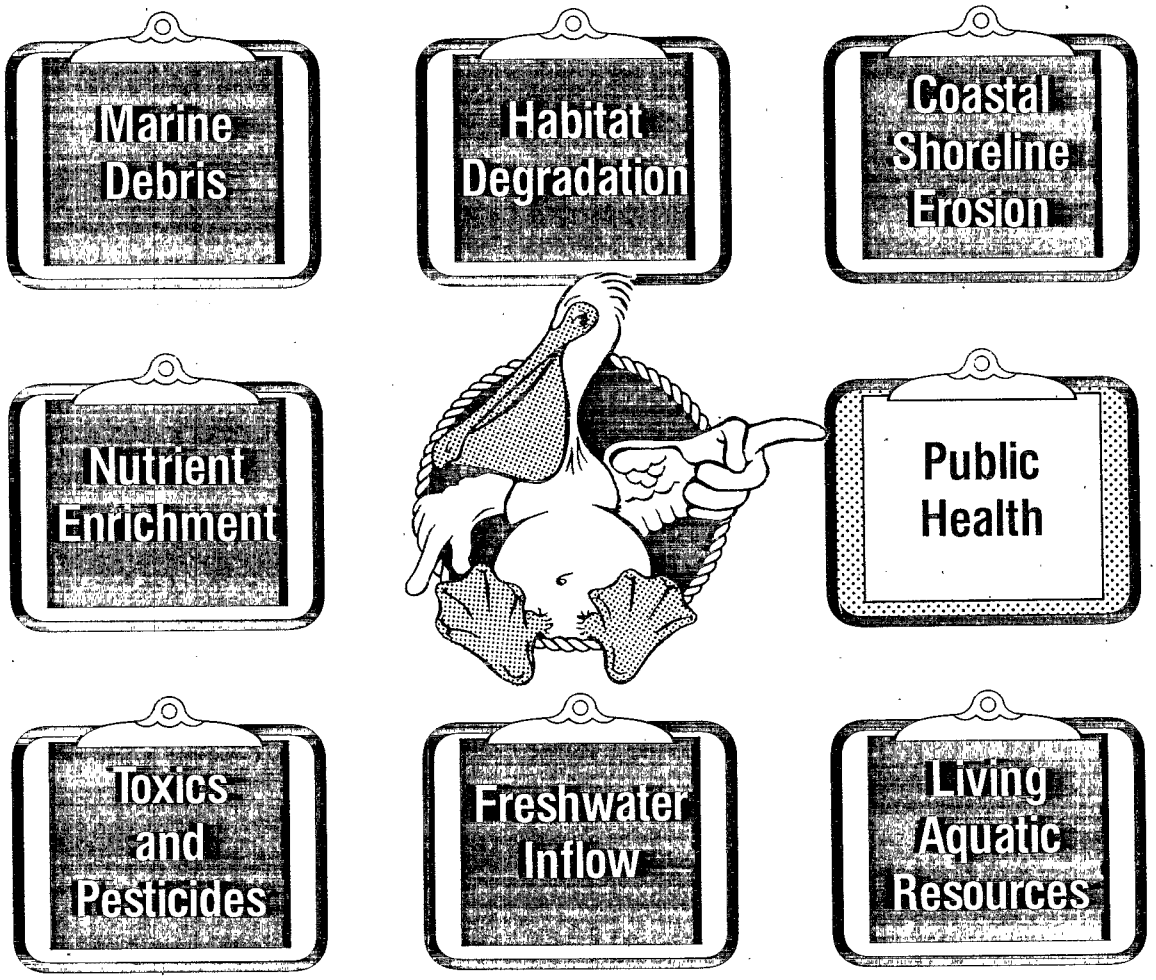
EPA

GULF OF MEXICO PROGRAM

Public Health Action Agenda For The Gulf Of Mexico

Framework for Action



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A STATEMENT FROM THE GULF OF MEXICO PROGRAM POLICY REVIEW BOARD

The Gulf of Mexico is a national treasure, containing ecological and commercial riches unmatched by other bodies of water. The Gulf's many resources include a larger annual yield of finfish, shrimp and shellfish than the South and Mid-Atlantic, Chesapeake and New England regions combined; 90% of U.S. offshore production of oil and gas; three of the nation's busiest seaports providing access to the 63% of the U.S. land area; critical habitat for 75% of migratory waterfowl traversing the U.S.; and vast wetlands that are about half of the national total. Yet, despite these riches and countless others, the Gulf of Mexico is being subjected to increasing environmental risks.

In many places, untreated human and animal wastes- rich sources of potentially harmful bacteria and nutrients- are directly discharged into the coastal waters of the Gulf of Mexico. Pathogenic microorganisms present a risk to swimmers in contaminated waters and to consumers of raw oysters and other shellfish harvested from such waters. An excess supply of nutrients- nitrogen and phosphorus - may trigger algal blooms that produce toxins harmful to humans and wreak havoc on coastal fish populations.

A significant step toward containing the Public Health problems in the Gulf was taken in 1988, when the Gulf of Mexico Program was initiated. The major purpose of the Program is to develop a comprehensive, interagency strategy to protect and enhance the environmental quality of the Gulf of Mexico. The Gulf of Mexico Program identifies key issues that are pervasive in the Gulf and that threaten the future long-term viability of the Gulf ecosystem. This Action Agenda has been developed to specify the primary activities needed to reduce, and eventually eliminate, public health menaces from Gulf of Mexico shores and waters.

On September 16, 1992, we, the Members of the Policy Review Board of the Gulf of Mexico Program, endorsed this Public Health Action Agenda in principle. We agree that the achievement of the goals and objectives stated in the agenda is crucial in solving the public health problems endemic to the Gulf of Mexico ecosystem, and that the action items listed will, collectively, move us in the direction of a solution. We are directing the Gulf of Mexico Program to initiate significant outreach activities on this Action Agenda to both improve the plan and generate support for its implementation. We are also requesting that all lead agencies identified for the action items provide the Gulf of Mexico Program with annual progress reports on either the status of implementation or the status of obtaining commitments for funding.

Public Health issues are a worldwide problem, because people are careless or undereducated about the disposal of toxic chemicals, pesticides, soluble metals, and even human and animal wastes in rivers and oceans. People are both the source and the answer to the pollution that endangers the public's health. We, the Members of the Policy Review Board, will do our part as well as encourage others, to help provide solutions to the pollution problems that imperils the public's health.

Leigh Pegues, AL Dept. of Environmental Management (State Co-chairman)
LaJuana Wilcher, U.S. Environmental Protection Agency (Federal Co-chairman)
Carol Browner, FL Dept. of Environmental Regulation
John Burt, Soil Conservation Service
Captain R. N. Cugowski, U.S. Navy
George Dodson, U. S. Air Force (ex officio member)
Charles N. Ehler, National Oceanic & Atmospheric Administration
Captain Thomas Greene, U. S. Coast Guard
Anthony M. Guarino, U.S. Food & Drug Administration
James I. Jones, MS-AL Sea Grant Consortium (ex officio member)
Andrew J. Kemmerer, NOAA National Marine Fisheries Service
Douglas A. Lipka, U. S. Environmental Protection Agency
Gale Martin, MS Soil & Water Conservation Commission (ex officio member)
Garry Mauro, TX General Land Office
Kai D. Midboe, LA Dept. of Environmental Quality
Warren T. Olds, U.S. Fish & Wildlife Service
James Palmer, MS Dept. of Environmental Quality
J. Rogers Pearcy, Minerals Management Service
Brig. General Pat M. Stevens, U.S. Army Corps of Engineers
William F. Taylor, National Aeronautics & Space Administration
Barbara S. Todd, Citizens Advisory Committee Vice-chairman
John Woeste, FL Cooperative Extension Service (ex officio member)

EXECUTIVE SUMMARY

The Gulf of Mexico contains ecological and commercial resources matched by few other bodies of water. Yet its blue-green waters disguise the increasing environmental threats that endanger these resources. In recognition of the growing threats, Regions 4 and 6 of the United States Environmental Protection Agency (EPA), which share jurisdiction over the five Gulf Coast States (Alabama, Florida, Louisiana, Mississippi, and Texas), initiated the Gulf of Mexico Program in August 1988. 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.

The Gulf of Mexico Program is a cooperative partnership among federal, state, and local government agencies, as well as with people and groups who use the Gulf. During the early stages of Program development, eight priority environmental problems were identified and the following Subcommittees have been established to address each of these problems: Marine Debris, Public Health, Habitat Degradation, Coastal & Shoreline Erosion, Nutrient Enrichment, Toxic Substances & Pesticides, Freshwater Inflow, and Living Aquatic Resources.

The Public Health Subcommittee was charged with characterizing factors contributing to public health problems and identifying ways to reduce the public health risk from Gulf of Mexico resources. The Subcommittee has been meeting for more than three years--to review information and data collected by citizens and scientists, identify problem areas, discuss actions that can resolve the problems, and evaluate methods for achieving and monitoring results. The culmination of their efforts is this Public Health Action Agenda which specifies the primary activities needed to reduce, and eventually eliminate, factors contributing to public health problems in the Gulf of Mexico. This Action Agenda is part of an evolving series of Action Agendas that will be developed to meet the future needs of the Gulf of Mexico.

Chapter I of the Action Agenda provides an overview of Gulf of Mexico resources and the threats now facing those resources. In addition, Chapter I describes the structure of the Gulf of Mexico Program, including the Action Agenda development process.

Chapter II is a summary of the preliminary scientific research compiled by the Public Health Subcommittee. The final characterization report is scheduled for completion in May 1993 and information contained in that report will be included in future Action Agendas.

Chapter III describes the legal and institutional framework currently in place in the Gulf of Mexico to address public health issues and support efforts to reduce public health risks.

Chapter IV, *The Unfinished Agenda*, contains the goals, objectives and specific activities established by the Gulf of Mexico Program to address public health issues. The four goals are to: 1) prevent adverse health effects resulting from consumption of raw shellfish harvested from the Gulf of Mexico, 2) prevent illness resulting from exposure to marine biotoxins in coastal waters of the Gulf of Mexico, 3) reduce long term health risks from exposure to toxic substances in Gulf of Mexico seafood while maintaining the beneficial effects of seafood consumption, and 4) prevent exposure to pathogens in coastal waters of the Gulf of Mexico.

The Gulf of Mexico Program hopes to accomplish these goals by addressing four categories of public health concerns. These categories were developed by the Public Health Subcommittee during the course of its characterization research on public health issues in the Gulf of Mexico. This work, discussed in Chapter II, resulted in the following prioritization of concerns:

1. Exposure to pathogens in Gulf waters via consumption of raw molluscan shellfish.

2. Marine biotoxins and their effect on human health.

3. Toxic substances in the food chain, the potential for biomagnification and human health effects caused by consumption.

4. Exposure to pathogens in Gulf waters from recreational or occupational contact.

Forty-four "action items" have been developed to support the goals and these are grouped under four strategies and seventeen objectives (see Index of Public Health Strategies and Objectives). The action items included in Chapter IV have been screened by the Gulf of Mexico Program and represent those activities that are currently the most significant and most achievable. This is a fairly comprehensive, but not exhaustive list. This document begins an evolving process of Action Agendas in which action items are designated, implemented, and then reassessed as progress in the Gulf is made. In the future, new action items will be developed to meet the changing needs in the Gulf of Mexico.

Index of Public Health Strategies & Objectives

Research and Demonstration

Objective: Conduct scientific studies designed to contribute new empirical information pertinent to the prevention of illness in those exposed to Gulf waters or from consumption of products harvested from Gulf waters.

Objective: Identify and characterize marine biotoxins and progenitors that have not been investigated and continue to develop and improve methods for the detection and management of marine biotoxins.

Monitoring/Assessment

Objective: Determine the extent of human fecal pollution of shellfish growing areas in the Gulf of Mexico.

Objective: Establish a formal database on the occurrence of seafood-borne disease.

Objective: Determine Gulf Coast residents at risk from consumption of potentially contaminated seafood.

Objective: Survey Gulf Coast bathing beaches for the presence of human fecal wastes and other pathogens (*i.e.*, vibrio).

Objective: Assess the public health significance of marine biotoxins in the Gulf of Mexico.

Objective: Implement remote-sensing technologies for the detection of phytoplankton blooms/red-tides in the early stages of development.

Standards/Enforcement

Objective: Reduce the level of human fecal wastes in the coastal waters of the Gulf of Mexico.

Objective: Establish a Gulf Coast Fish Contaminants Group (GCFCG).

Objective: Encourage states to adopt compatible policies for management of public health hazards.

Objective: Standardize methods for marine biotoxin recovery and analysis from phytoplankton producers and seafood vectors.

Objective: Organize a Gulf-wide marine biotoxins management and consulting group.

Public Outreach

Objective: Undertake an educational campaign to: 1) help the public understand and control or minimize potential risks associated with the consumption of raw molluscan shellfish; 2) help health care professionals understand the potential risks associated with the consumption of raw molluscan shellfish, especially for high risk patients, and to transmit information to those patients; and encourage the reporting of shellfish-associated illness; 3) help legislative and judicial members understand the seriousness of violations of shellfishing regulations related to public health; and 4) inform enforcement officials about public health aspects of shellfishing regulations.

Objective: Help the public understand both the nutritional/health benefits and the potential risks from consumption of seafood, other than raw molluscan shellfish, as well as how to maximize those benefits while avoiding, controlling, or minimizing the risks.

Objective: Help the public, especially high risk populations, understand the risks associated with recreational and occupational exposure to naturally occurring pathogens (*i.e.*: vibrio) in marine waters.

Objective: Help the public understand the risks associated with consumption of seafood contaminated with marine biotoxins and the risks associated with direct exposure to marine biotoxins.

Action items contained in Chapter IV are not listed in priority order. Some of the actions are already underway but not yet completed. Others are included because they will guide federal, state, and local government agencies and private sector organizations in allocating resources where they are most needed and in justifying future management strategies. This Action Agenda should prompt specific agencies and groups to become involved.

The Gulf of Mexico Program recently developed nine short-term environmental challenges 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, the Program has pledged 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 the 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.

This Public Health Action Agenda supports these five year environmental challenges.

For the public, the Gulf of Mexico Action Agenda should serve three purposes. First, it should reflect the public will with regard to addressing public health concerns. Second, it should communicate what activities are needed for eliminating risk to public health and provide the momentum for initiating these actions; and third, it should provide baseline information from which success can be measured.

This Action Agenda is a living document; therefore, the Gulf of Mexico Public Health Subcommittee anticipates that it will be periodically revised and updated. The first formal review is scheduled for 1994.

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I. OVERVIEW OF THE GULF OF MEXICO

The Gulf of Mexico - A Vast and Valuable Resource

Bounded by a shoreline that reaches northwest from Florida along the shores of Alabama, Mississippi, and Louisiana, and then southwest along Texas and Mexico, the Gulf of Mexico is the ninth largest body of water in the world. The Gulf's United States coastline measures approximately 1,631 miles--longer than the Pacific coastline of California, Oregon, and Washington. The Gulf region covers more than 617,600 square miles and contains one of the nation's most extensive barrier-island systems, outlets from 33 major river systems, and 207 estuaries (Buff and Turner, 1987). A cornerstone of the Nation's economy, the Gulf's diverse and productive ecosystem provides a variety of valuable resources and services, including transportation, recreation, fish and shellfish, and petroleum and minerals.

Encompassing over five million acres (about half of the national total), Gulf of Mexico coastal wetlands serve as essential habitat for 75 percent of the United States' migrating waterfowl (EPA, 1991a). Mudflats, salt marshes, mangrove swamps, and barrier island beaches of the Gulf also provide year-round nesting and feeding grounds for abundant numbers of gulls, terns, and other shorebirds. Five species of endangered whales, including four baleen whales and one toothed whale, are found in Gulf waters. These waters also harbor the endangered American crocodile and five species of endangered or threatened sea turtles (loggerhead, green, leatherback, hawksbill, and Kemp's Ridley). The endangered West Indian (or Florida) manatee inhabits waterways and bays along the Florida peninsula.

In addition, a complex network of channels and wetlands within the Gulf shoreline provides habitat for estuarine-dependent commercial and recreational fisheries. The rich waters yield approximately 2.4 billion pounds of fish and shellfish each year. Worth more than $780 million at dockside (estimated total economic impacts of $2.34 billion), this harvest represents 40 percent of the total annual domestic harvest of commercial fish (DOC, 1992). The Gulf boasts the largest and most valuable shrimp fishery in the United States, and also produces more than half of the yearly national harvest of oysters (DOC, 1992). Other Gulf fisheries include diverse shellfisheries for crabs and spiny lobsters, and finfisheries for menhaden, herring, mackerel, tuna, grouper, snapper, drum, and flounder. The entire U.S. Gulf of Mexico fishery yields more finfish, shrimp, and shellfish annually than the South and Mid-Atlantic, Chesapeake, and New England regions combined.

The Gulf's bountiful waters draw millions of sport fishermen and beach users to their shores each year. It is estimated that the Gulf supports more than one-third of the nation's marine recreational fishing, hosting 4 million fishermen in 1985 who caught an estimated 42 million fish (DOC, 1992). Popular nearshore catches include sea trout (weak fish), cobia, redfish, flounder, grouper, red snapper, mackerel, and

tarpon; offshore catches include blue marlin, white marlin, sailfish, swordfish, dolphin, and wahoo. Tourism related dollars in the Gulf Coast States contribute an estimated $20 billion to the economy per year (EPA, 1991a).

Gulf oil and gas production are equally valuable to the region's economy and are a critical part of the nation's total energy supply. In 1990, more than 1,600 Outer Continental Shelf (OCS) leases were in production, yielding approximately 90 percent of U.S. offshore production. These OCS royalties annually contribute about $3 billion to the Federal Treasury. Thirty-eight percent of all petroleum and 48 percent of all natural gas reserves in the United States are estimated to be in the Gulf of Mexico. The industry employs some 30,000 people in the region.

Approximately 45 percent of U.S. shipping tonnage passes through Gulf ports, including four of the nation's busiest: Corpus Christi, Houston/Galveston, Tampa, and New Orleans. The second largest marine transport industry in the world is located in the Gulf of Mexico. According to EPA, vessel trips in and out of American Gulf ports and harbors exceeded an estimated 600,000 trips in 1986. The U.S. Navy's Gulf Coast Homeporting Plan will dock at least 25 vessels in Ingelside, TX, Pascagoula, MS, and Mobile, AL.

Thousands of people depend on the Gulf of Mexico to earn a living and flock to its shores and waters for entertainment and relaxation. The temperate climate and abundant resources are attracting more and more people. The region currently ranks fourth in total population among the five U.S. coastal regions, accounting for 13 percent of the nation's total coastal population. Although the Gulf region is not as densely settled as others, it is experiencing the second fastest rate of growth; between 1970 and 1980, the population grew by more than 30 percent (DOC, 1990a). According to the U.S. Department of Commerce, the Gulf's total coastal population is projected to increase by 144 percent between 1960 and 2010, to almost 18 million people. Table 1.1 shows the Gulf of Mexico coastal population density or population per shoreline mile projected to the year 2010. Florida's population alone is expected to have skyrocketed by more than 300 percent by the year 2010. The increasing coastal population is of concern with regard to public health issues because the population at risk increases, as well as the potential for environmental degradation.

Table 1.1 ***Gulf of Mexico Coastal Population per Shoreline Mile***

State	1960	1988	2010
Florida	433	1064	1411
Alabama	599	800	886
Mississippi	527	928	1102
Louisiana	248	352	420
Texas	798	1517	1956
Gulf of Mexico	429	820	1046

(Source: DOC, 1990a)

The Gulf's resources and environmental quality are affected not only by the millions living and working in the region, but also by activities occurring throughout much of the nation. Two-thirds of the land area of the contiguous United States drains into the Gulf, bringing with it potential environmental problems associated with pesticides, fertilizer, toxic substances, and trash.

The Gulf of Mexico - A Resource At Risk

Increasing populations result in increased use and demands on Gulf of Mexico resources. Until recently, the Gulf was considered too vast to be affected by pollution and overuse. However, recent trends indicate serious long-term environmental damage unless action is initiated today. Signs of increasing degradation throughout the Gulf system include the following (EPA, 1991a):

- Fish kills and toxic "red tides" and "brown tides" were an increasing phenomenon in Gulf waters during the 1980s.
- Alabama, Mississippi, Louisiana, and Texas are among those states that discharge the greatest amount of toxic chemicals into coastal waters.
- More than half of the shellfish-producing areas along the Gulf Coast are permanently or conditionally closed. These closure areas are growing as a result of increasing human population along the Gulf Coast.

- Louisiana is losing valuable coastal wetlands at the rate of approximately 78-126 km^2/year (30-50 mi^2/year). This represents approximately 80 percent of the coastal wetland loss for the contiguous U.S.

- Almost 1,800 kg/mi (2 tons/mi) of marine trash covered Texas beaches in 1988.

- Up to 7770 km^2 (3,000 mi^2) of oxygen deficient (hypoxia) bottom waters, known as the "dead zone," have been documented off the Louisiana and Texas coasts.

- Gulf shoreline are eroding up to 30 m/year (100 ft/year). Few coastal reaches in the Gulf can be characterized as "stable" or "accreting."

The Gulf of Mexico Program - Goals and Structure

Problems plaguing the Gulf cannot be addressed in a piecemeal fashion. These problems and the resources needed to address them are too great. The Gulf of Mexico Program was formed to pioneer a broad, geographic focus in order to address major environmental issues in the Gulf before the damage is irreversible or too costly to correct.

The program is part of a cooperative effort with other agencies and organizations in the five Gulf States, as well as with people and groups who use the Gulf. In addition to EPA, other participating federal government agencies include: National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), U.S. Department of Defense (DOD), U.S. Fish and Wildlife Service (FWS), U.S. Soil Conservation Service (SCS), U.S. Minerals Management Service (MMS), National Park Service (NPS), U.S. Coast Guard (USCG), National Aeronautics and Space Administration (NASA), U.S. Army Corps of Engineers (COE), Department of Energy (DOE), U.S. Geological Survey (USGS), U.S. Food and Drug Administration (FDA), and Agency for Toxic Substances and Disease Registry (ATSDR).

The Gulf of Mexico Program also works in coordination and cooperation with four National Estuary Programs (NEPs) within the Gulf: Tampa Bay, Sarasota Bay, Galveston Bay, and the Barataria-Terrebonne Estuary. The Gulf of Mexico Program supports and builds on certain activities of these programs, bringing a Gulf-wide focus and forum for addressing issues of Gulf-wide concern.

By building on and enhancing programs already underway, as well as by coordinating new activities, the Gulf of Mexico Program will serve as a catalyst for change. The program's overall goals are to provide:

- A mechanism for addressing complex problems that cross federal, state, and international jurisdictional lines;
- Better coordination among federal, state, and local programs, thus increasing the effectiveness and efficiency of the long-term effort to manage and protect Gulf resources;
- A regional perspective to address research needs, which will result in improved transfer of information and methods for supporting effective management decisions; and
- A forum for affected groups using the Gulf, for public and private educational institutions, and for the general public to participate in the solution process.

The Gulf of Mexico Program is managed by three committees: a Policy Review Board, a Technical Steering Committee, and a Citizens Advisory Committee. Composed of 20 senior level representatives of state and federal agencies and representatives of the technical and citizens committees, the Policy Review Board guides and reviews program activities. The Citizens Advisory Committee is composed of five governor-appointed citizens who represent environmental, fisheries, agricultural, business/industrial, and development/tourism interests in each of the five Gulf Coast States. This committee provides public input and assistance in publicizing the Gulf of Mexico Program's goals and results. Representatives of state and federal agencies, the academic community, and the private and public sectors appointed by state governors or by the Policy Review Board are members of the Technical Steering Committee and provide technical support to the board.

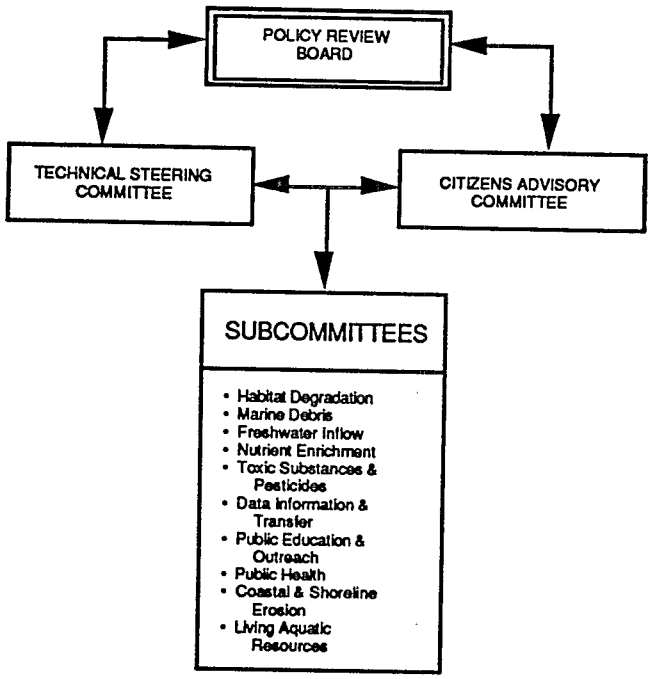
During the early stages of program development, the Gulf of Mexico Program established the following seven technical subcommittees, each co-chaired by one federal and one state representative, to address priority environmental problems:

- Habitat Degradation of such areas as coastal wetlands, seagrass beds, and sand dunes;
- Freshwater Inflow (*i.e.*, diversions of water away from coastal estuaries) for use in flood control, navigation, and recreation, and to service growing coastal populations;
- Nutrient Enrichment resulting from such sources as storm water, industries, and agriculture;

- Toxic Substance and Pesticide contamination originating from industrial and agriculturally based sources;
- Coastal and Shoreline Erosion caused by natural and human-related activities;
- Public Health threats from swimming in and eating seafood products coming from contaminated water; and
- Marine Debris from land-based and marine recreational and commercial sources.

In December 1991, the Gulf of Mexico Program Policy Review Board approved the formation of an additional technical subcommittee to address Living Aquatic Resources. Two other subcommittees, the Public Education and Outreach Subcommittee and the Data and Information Transfer Subcommittee, support the other eight technical subcommittees.

Figure 1.1 ***Gulf of Mexico Program Committees***



The action planning process used by each Gulf of Mexico Program Subcommittee includes the following key activities:

- ❑ Definition of environmental issues;
- ❑ Characterization of identified problems, including sources, resources, and impacts;
- ❑ Establishment of goals and objectives;
- ❑ Evaluation/assessment of corrective actions and control measures, including cost/benefit analysis;
- ❑ Selection of priority action items;
- ❑ Establishment of measures of success;
- ❑ Implementation of actions; and
- ❑ Evaluation of success and revision of the Action Agenda.

As the Subcommittees progress through each of these activities, ample opportunities are provided for public review, and Policy Review Board endorsement is requested at appropriate points. Through the consensus of Program participants, a coordinated response will be directed to the successful maintenance and enhancement of resources of the Gulf of Mexico.

The Public Health Subcommittee

Co-Chairs:

Dr. Frederick Kopfler	EPA Gulf of Mexico Program
Mr. Bobby Savoie	Louisiana Department of Health and Hospitals

Members:

Dr. Ann Anderson	Tulane School of Public Health and Tropical Medicine
Mr. Bruce Brackin	Mississippi State Dept. of Health
Dr. David Cook	Gulf Coast Research Laboratory
Mr. Robert Dickey	Food and Drug Administration
Mr. Spencer Garrett	National Marine Fisheries Service
Dr. Anthony Guarino	Food and Drug Administration
Dr. Brian Hughes	Alabama Dept. of Public Health
Dr. Richard Hunter	Florida Dept. of Health and Rehabilitative Services
Mr. Robert P. Jones	Southeast Fisheries Association (Alternate CAC Rep)
Mr. Jeff Kellam	Agency for Toxic Substances and Disease Registry
Dr. Marilyn B. Kilgen	Nicholls State University
Mr. Donald Lirette	Concerned Shrimpers (CAC Rep)
Dr. Merrill McPhearson	Food and Drug Administration
Dr. G. Malcolm Meaburn	National Marine Fisheries Service
Ms. Cheryl Overstreet	U.S. EPA Region 6
Dr. Raoul Ratard	Louisiana Office of Public Health
Mr. Lloyd Regier	National Marine Fisheries Service
Mr. Dugan Sabins	Louisiana Dept. of Environmental Quality
Mr. Donald Scharr	Mississippi Gulf Coast Regional Wastewater Authority
Dr. Karen Steidinger	Florida Marine Research Institute
Dr. Jerry Stober	U.S. EPA Region 4
Mr. Richard Thompson*	Texas Department of Health
Dr. Carmelo R. Tomas	Florida Marine Research Institute
Dr. Charles Woernle	Alabama Dept. of Public Health

*Previous Co-Chair 1988-1991

The Public Health Subcommittee developed the following goals for addressing public health issues in the Gulf of Mexico:

- Prevent adverse health effects resulting from consumption of raw shellfish harvested from the Gulf of Mexico.
- Prevent illness resulting from exposure to marine biotoxins in coastal waters of the Gulf of Mexico.
- Reduce long term health risks from exposure to toxic substances in Gulf of Mexico seafood while maintaining the beneficial effects of seafood consumption.
- Prevent exposure to pathogens in coastal waters of the Gulf of Mexico.

The Gulf of Mexico Policy Review Board endorsed these goals on November 8, 1990. In developing this Action Agenda, the Public Health Subcommittee has sought input and advice from other technical Subcommittees as well as from organizations, interest groups, and private concerns outside of the Gulf of Mexico Program. A "brainstorming meeting" sponsored by the Subcommittee in New Orleans, LA, on November 6-8, 1991, to review an early version of the Action Agenda, was attended by approximately 40 persons comprising a mix of Program and non-Program participants. This meeting generated a significant number of comments that were addressed in the present document.

II. PUBLIC HEALTH ISSUES IN THE GULF OF MEXICO

Public Health Concerns

Many pollutants found in Gulf of Mexico waters have the potential to produce acute and chronic human health effects. Whether these pollutants pose human health risks depends upon the specific characteristics of the pollutants (*e.g.* whether they biodegrade or are persistent), as well as their potential to reach and thereby cause adverse impacts in humans.

Humans can be exposed to potentially hazardous contaminants in the Gulf of Mexico through two principal pathways--indirectly through consumption of fish and shellfish, and directly from contact with water and aerosols. Consumption of contaminated seafood can be a significant route of exposure to toxic organic chemicals and metals because these substances are able to persist and accumulate in fish and shellfish. Exposure to toxic constituents from water contact is generally considered to be less significant, except near storm drains, industrial discharges, and sewage overflow points. In the case of human pathogens, exposure through contact or consumption of contaminated food can be significant because only small numbers of microorganisms may be necessary to cause acute illness.

During its initial year, the Public Health Subcommittee developed a list of agents of public health concern and various potential routes for human exposure, and reached consensus on their relative importance within the Gulf of Mexico (See Table 2.1).

Table 2.1 ***Consensus of the Relative Importance of Public Health Hazards in the Gulf of Mexico***

	Exposure Route							
	Solid Waste[1]			Molluscan			Direct	
Agent	SW	MW	MD	Shellfish	Finfish	Crustacea	Water	Air
Pathogens								
Vibrio[2*]	L	L	L	H	L	L	M	0
Norwalk[3]	U	L	L	H	L	L	M	U
Toxic Substances								
PCBs[4]	H	L	L	U	U	U	U	U
Hg[5]	H	L	L	H	H Local	H Local	L	U
Toxins								
NSP[6]	0	0	0	H	U	L/M	L/M	M
CFP[7]	0	0	0	L	H	L	0	0

1 SW = Solid & Hazardous (to the extent not covered by MW and MD) Waste; MW = Medical Waste; MD = Marine Debris
2 Naturally occurring
3 Contaminant
4 Organic
5 Inorganic
6 Neurotoxic shellfish poison
7 Ciguatera fish poison
*Note: Vibrio exposure is "H" for immuno-compromised individuals.

H= High
M= Medium
L= Low
U= Unknown
0= None

(Source: Gulf of Mexico Program Public Health Subcommittee, 1989)

Using this matrix, the Subcommittee identified four potentially significant public health problems. These problems in priority order are:

1. Exposure to pathogens via consumption of raw molluscan shellfish;

2. Marine biotoxins (such as ciguatera fish poisoning) and their effect on human health;

3. Toxic substances (such as mercury) in the food chain, the potential for biomagnification and human health effects caused by consumption; and

4. Exposure to pathogens in Gulf waters from recreational or occupational contact.

These public health issues are discussed in greater detail in the following sections.

Exposure to Pathogens Via Consumption of Raw Molluscan Shellfish

The Gulf of Mexico, a multiple use estuarine system affected by human waste, contains the most classified shellfish-growing waters (almost 9,000 square miles) in the U.S. About 3,800 square miles of these are approved for harvesting. However, more than half (about 52 percent) of all classified waters in the region have regulatory limitations on harvest or harvest is prohibited (NOAA, 1991). In Galveston Bay, 44.9 percent of the total 334,565 acres of shellfish beds are polluted (Galveston Bay National Estuary Program, 1991).

Almost 15 million pounds of oyster meats were harvested in Gulf waters in 1989 (NOAA, 1990). Commercial harvest occurs throughout the region, from Charlotte Harbor to Laguna Madre, and is especially significant in Apalachicola Bay and Breton/Chandeleur Sounds. Most harvest limitations are on a conditional basis, depending on freshwater inflow from highly variable rainfall. Most of the region's productive reefs are in these conditional areas (DOC, 1990).

Shellfish are non-moving or slow-moving, filter-feeding organisms that cannot escape pollution; they concentrate the microorganisms in that pollution, or any other disease-causing agent, to many times higher than the level to which they are exposed. Although only a tiny fraction of all seafood consumed in the U.S. involves molluscan shellfish consumed live, raw, and whole, including the intestinal tract, this accounts for approximately 85% of all seafood related illness (FDA, 1991). More people get sick from eating raw oysters, clams, and mussels than from any other seafood (NAS, 1991). Most illnesses are mild, but a small number can be serious and even fatal, specifically in high risk individuals exposed to pathogens such as *Vibrio vulnificus* (See Table 2.4 for Hazards and Risks of Seafood Consumption).

Two types of pathogenic microorganisms are transmitted to the consumer by raw molluscan shellfish (See Table 2.2):

- naturally occurring marine organisms; and
- pollution-related or man-induced pathogenic bacteria and viruses.

Illness associated with consumption of oysters from the Gulf that are not associated with the classification of the growing area are those caused by naturally occurring marine vibrios. These marine bacteria may cause illnesses particularly in shellfish consuming persons whose immune system has been compromised. This immuno-suppression has been associated with underlying diseases such as diabetes, cirrhosis, alcoholism, hemochromatosis, etc.

Table 2.2 *Microorganisms Responsible for Causing Adverse Human Health Effects** *(NOAA, 1988)*

Disease	Pathogenic Organism	Seafood Source
Hepatitis	Hepatitis A virus	raw oysters, steamed and raw clams, cockles
	Non-A and non-B hepatitis	raw molluscan shellfish
Gastroenteritis	*Aeromonas hydrophilia* and *Plesiomonas shigelloides*	shellfish
	Vibrio mimicus	raw oysters
	Vibrio parahaemolyticus	clams, snails, raw oysters, crab, shrimp, lobster
	Vibrio vulnificus	raw oysters
	Vibrio cholera, O group	raw oysters, boiled shrimp, boiled crab
	Vibrio cholera, Non-O group 1	raw oysters
	Norwalk virus	raw oysters, raw clams
	Small round structured virus	raw oysters
	Campylobacter jejuni	raw clams

*Includes naturally occurring microorganisms as well as microorganisms associated with pollution.

Note: At least 11 species of *Vibrio* are associated with human disease, some from gastroenteritis, but also from systemic infections. Also, species of *Salmonella* and *Shigella* are associated with typhoid.

(Source: EPA, 1991)

Indigenous *Vibrio* species associated with contamination of shellfish include *V. parahaemolyticus*, *V. vulnificus*, and other species. Consumption of seafood contaminated with *V. parahaemolyticus* has been associated with outbreaks of gastroenteritis, while consumption of *V. vulnificus*-contaminated shellfish can result in primary, frequently fatal, septicemia (blood poisoning) in patients with liver disorders and in diabetic or immuno-compromised individuals (NAS, 1991).

The most significant public health concern in the Gulf of Mexico is with those pathogens (*i.e.*, Norwalk and Norwalk-like viruses) that have caused several thousand illnesses between 1978 and 1987, but no deaths (Kaplan *et al.*, 1982). The preponderance of evidence indicates that the etiologic agent for water-borne outbreaks of acute gastroenteritis (AGI) are the Norwalk-like viruses (Kaplan *et al.*, 1982). Because these pathogens are pollution related, something *can* be done about this public health concern.

Many of these pathogenic microorganisms have been associated with both point and nonpoint source pollution. For example, Hepatitis A virus (HAV) and Norwalk viruses may be present in seafood as a result of fecal pollution from municipal discharges, industrial/agricultural discharges, and surface water runoff. Of these sources, municipal wastewater sewage presents the greatest risk of infectious disease via direct contact through recreational activities such as swimming and surfing, and consumption of seafood. Municipal wastewater treatment plants are numerous throughout the Gulf region (DOC, 1990). Storm water runoff may contribute to this problem as well. Although storm water typically contains little human fecal waste, this runoff may contribute pathogens due to animal waste.

In addition, bacteria responsible for typhoid and cholera are known to be water- and seafood-borne. These pathogens can enter the estuarine environment through the discharge of raw sewage, wastewater effluent from sewage treatment plants, failing or inadequate septic tanks, and the dumping of sewage sludge (OTA, 1987). Shellfish-associated cholera-like disease caused by non-01 strains of *V. cholerae* is infrequent. A few cases of Asiatic cholera due to non-01 strains of the organism have been detected in specific locations in the Gulf of Mexico.

Septic tanks and other forms of on-site sewage disposal systems (OSDS) are commonly used to dispose of sewage from residences in Gulf rural areas. Septic tanks in coastal areas and estuarine watersheds may represent a major source of disease-causing microorganisms in coastal waters. Such systems are relatively inefficient at degrading human wastes unless several conditions are maintained, including unsaturated soil conditions, minimal densities, and routine pumping of solids from the tank. Discharges from boats and ships may be a source of diseases as well.

Public health problems are aggravated because many of the best shellfish growing waters are located in close proximity to discharges of sewage and other wastes. This phenomenon is increasingly evident in highly developed coastal areas, as shellfish flourish in low salinity nearshore waters.

The National Shellfish Sanitation Program and the Interstate Shellfish Sanitation Conference are charged with ensuring that shellfish brought to market are as safe as possible (see description in Chapter III). Each state shellfish growing area is required to be correctly designated by the state shellfish control authority with one of the following classifications, as described in Part I, Section C, of the NSSP *Manual of Operations* (Table 2.3 shows classification percentages by Gulf State for 1985 and 1990):

- Approved Area - A growing area that has been approved for growing or harvesting shellfish for direct marketing. An approved shellfish growing area may be temporarily closed when a public health emergency is declared (*i.e.*, hurricane or flooding).

- Conditionally Approved Area - A growing area determined to meet approved area criteria intermittently. The area is closed when approved area criteria are not met, and the conditions affecting this degradation of the water quality must be predictable and specified in a management plan.

- Restricted Area - An area from which shellfish may be harvested only if permitted and subsequently subject to a suitable and effective purification process.

- Conditionally Restricted Area - An area that meets restricted area criteria intermittently. The area is closed when restricted criteria are not met, and the conditions affecting the degradation of water quality must be predictable and specified in a management plan.

- Prohibited Area - An area prohibited for the harvesting of shellfish for any purpose except depletion thereby eliminating the potential for illegal harvest.

Growing areas are classified on the basis of sanitary and marine biotoxin survey information. All state coastal and estuarine shellfish growing areas that have not been surveyed are designated as prohibited. All closures and classifications are the primary responsibility of the state shellfish control authority. In 1990, 48% of shellfish growing waters were approved Gulf-wide; 34% were prohibited; 16% were conditionally restricted or approved; and 2% were restricted.

Table 2.3 ***Distribution of Gulf of Mexico Classified Estuarine Waters, 1985 and 1990***

	Percent Classified							
	Approved		Prohibited		Conditional		Restricted	
State	1985	1990	1985	1990	1985	1990	1985	1990
*Florida**	28	15	33	35	39	43	0	5
Alabama	16	15	24	28	60	57	0	0
Mississippi	35	64	25	15	40	8	1	13
Louisiana	52	56	24	35	13	10	11	0
Texas	80	56	20	37	<1	7	0	0
Total % of Gulf of Mexico Waters	54	48	24	34	17	16	6	2

*Note: 1990 data from Florida is incomplete by 2%.

(Source: NOAA, 1991)

While NSSP provides guidelines for shellfish growing area classification, none of the Gulf Coast States is in total compliance with these guidelines. Often this is a result of inadequate financial resources, a poor understanding of the preventative nature of classification and inspection activities, and a lack of patrol and enforcement of shellfish closures.

Various regulatory strategies are available to address pollution related concerns. For example, to ensure proper conditions are maintained by those using septic tanks, several strategies can be undertaken, such as increasing the number of field inspectors to detect and assist in the prosecution of those with failing systems. Another low-cost and effective option to ensure proper functioning of OSDSs in coastal areas would be to require an operating permit for system users. A permit renewal could be required every few years, and a renewal granted only if an inspection proved that the system was functioning properly.

There are several types of OSDSs that greatly reduce levels of disease-causing microorganisms. These include composting toilets, incinerator toilets, and aerobic systems that use methods similar to those used by municipal sewage treatment plants. The widespread use of improved OSDSs in critical areas, coupled with requirements for system operating permits, would substantially reduce the input of disease-causing effluents to the Gulf of Mexico.

In addition, the Subcommittee recommends a broad education effort to communicate the risks and significance of contaminated seafood. Fishermen and the public should know why shellfish beds are closed, the potential impacts to a large human population from eating contaminated shellfish, and the penalties that could be levied for violating the law. Consumers need information that would help in the selection and purchase of uncontaminated seafood. Finally, education of district attorneys and judges about populations at risk and potential harm to shellfish consumers is needed to establish appropriate penalties for violations.

Marine Biotoxins (and their effect on human health)

Marine biotoxins are natural products produced by a variety of marine plants and animals. Marine dinoflagellates, algae classified under the division Pyrrhophyta, are among the most prolific biotoxin producers known. Other divisions of algae, bacteria, and cyanobacteria are also known to produce biotoxins which can have a severe impact on human health.

Most of the known biotoxins are heat stable, odorless, colorless, and otherwise completely undetectable by the human senses. Many biotoxins can accumulate in important seafood species in the marine environment and cause human illness when consumed. A few of the biotoxins can become airborne in coastal aerosols, causing respiratory irritation; others are known to cause contact dermatitis.

In most cases methods of seafood preparation will not purge biotoxins from suspect seafood. Detection of biotoxins in seafood products is currently possible only by cumbersome laboratory methods, although enzyme immuno-assay technology for generic detection of some biotoxins is rapidly approaching the point of commercial application.

Gulf waters contain the majority of known toxin producing species. There are two definite, three probable, and several potential marine biotoxin threats to public health. The two definite threats are human illness caused by Neurotoxic Shellfish Poisoning (NSP) and Ciguatera Fish Poisoning (Ciguatera) (See Table 2.4).

Neurotoxic Shellfish Poisoning is caused by the planktonic, vegetative stage of a dinoflagellate. The species, *Gymnodinium breve,* causes water column blooms and can kill fish through respiratory inhibition. Although it can kill fish and some invertebrates, the toxin of *Gymnodinium breve* accumulates in oysters and other molluscs without harming them, and is responsible for NSP, which can occur throughout the Gulf. These organisms can form extensive "red tides" which have also been responsible for massive mortalities of marine life in the Gulf, as well as along the southeast U.S. coast. Red tides are perennial in southeast Florida and noteworthy red tides have also been recorded in Corpus Christi Bay, Texas. In 1986, one covered almost the entire Texas coast.

Gymnodinium breve toxins can cause human illness if toxic shellfish meats are consumed. Cooking of shellfish does not destroy the toxic properties. Neurological symptoms of NSP are dizziness, tingling sensations in the extremities, and dilated pupils, which usually disappear within 3 days. No human fatalities have been documented with NSP (Steidinger, 1983). The toxin also affects humans directly when the blooms of the algae come near shore and the toxin is aerosolized by the surf. This "red tide aerosol" effect causes respiratory irritation which is short-lived when the affected person leaves the beach or uses a mask to filter out the toxin.

Table 2.4 Hazards and Risks of Seafood Consumption and their Control (Arranged According to Order of Importance)

Hazardous Seafood[a]	Hazard[b]	Severity of Hazard[c]	Risk to Consumers[d]	Factors Enhancing Risk	Factors Reducing Risk	Present Control Systems[e]	Deficiencies of Present System[f]
Raw bivalve molluscs (oysters, clams, mussels)	(1) Viruses, enteric bacteria (2) *Vibrio* species	(1-2) Mostly mild gastroenteritis (2) Severe for susceptible hosts	High for consumers of raw molluscs	(1) Polluted growing waters (1-2) Temperature abuse (2) Host factors	(1-2) Cooking (2) Rapid cooling (1-2) Irradiation	(1) Shellfish sanitation program (2) None	(1) Unreliable indicators (2) No indicators
Naturally toxic finfish Molluscs	(1) Ciguatera (2) Scombroid poisoning (3) Paralytic Shellfish Poisoning, Neurotoxic Shellfish Poisoning, Diarrheic Shellfish Poisoning, Amnesic Shellfish Poisoning	Moderately severe Mild Mild to severe	(1) High in endemic areas (2) High for consumption of few species (3) High if harvest is uncontrolled	(1) Recreational fishing on reefs (2) Temperature abuse after capture (3) Recreational shellfish harvest	— (2) Good temperature control (3) Informed consumers	(1) Voluntary harvest restriction (2) Rapid cooling; histamine testing (3) State surveillance and harvest control	(1) No widely available test (2) Limited effectiveness of control (3) Harvest closure not always effective
Processed seafood	(1) *Clostridium perfringens* (2) *Salmonella* (3) *Shigella* (4) *Staphylococcus aureus* (5) *Vibrio parahemolyticus* (6) *HAV*	(1-5) Usually mild	Low when adequate cooking precedes consumption	Cross-contamination; temperature abuse; processor presentation errors	Adequate cooking; temperature control; proper processing and food service	Sanitation inspection; process control	Limited inspection; ineffective inspection methods; diverse processing

[a] Fish or shellfish, the consumption of which can lead to disease.
[b] An organism, substance, or condition having the potential to cause disease.
[c] Severe: may cause disability, extended sequelae, and in some cases, death;
moderate: may require medical intervention to avoid debilitating or life-threatening effect, rarely self-resolving;
mild: symptoms are transitory, rarely lasting more than a few days, no sequelae, no threat to life, usually self-resolving.
[d] Probability that a consumer will become ill from the hazard.
[e] Mechanisms to reduce or eliminate risk from hazard(s) by government, industry, or related individual action.
[f] Aspects of control systems that reduce their effectiveness.

(Source: Institute of Medicine, 1991)

Ciguatera toxins are produced by a group of epiphytic dinoflagellates. Any one of a large variety of shore or reef fishes, which are usually subtropical or tropical, could carry ciguatera toxins, and thus cause poisoning if ingested. Ciguatera is a fish-borne disease whereby the biotoxin or its derivatives are accumulated through the food web and biomagnified in the flesh of higher carnivores, particularly reef fishes (Steidinger, 1983). There is no evidence of a seasonal incidence in ciguatoxicity, but the spawning season in some of the large predacious fishes may be a more dangerous period than the other seasons of the year (Halstead, 1967). In the Gulf, ciguatera toxins are prevalent in south Florida and may possibly exist in Texas. Outbreaks of ciguatera are sporadic, unpredictable, and not necessarily preceded by noticeable algal blooms or red tide events. There is no way to detect a ciguatoxic fish by its appearance, and the degree of freshness has no bearing on its toxicity. The most recent outbreak in the Gulf region occurred in south Florida in 1988.

Ciguatera fish poisoning is often confused with other forms of gastrointestinal disturbances, particularly bacterial food poisonings, and other types of fish biotoxications. The disease is caused by a specific poison, or complex of poisons, which affect primarily the gastrointestinal and nervous systems of humans. Ciguatera, like many other diseases, may vary greatly in its clinical manifestations depending upon the toxicity of the fish that is eaten, the individual's sensitivity to the poison, amount of fish ingested, and other factors (Halstead, 1967). Symptoms range from nausea, abdominal cramps, weakness, and numbness to severe neurotoxic effects, lasting over a period of years, and even resulting in death.

The three probable marine biotoxin threats are Diarrheic Shellfish Poisoning (DSP), Amnesic Shellfish Poisoning (ASP), and Tetrodotoxic Fish Poisoning (Pufferfish Poisoning). Although no cases of human poisoning from any of these sources have been identified in the Gulf, undiagnosed or misdiagnosed symptoms corresponding to these forms of seafood poisoning may well have occurred.

Diarrheic Shellfish Poisoning is caused by the consumption of shellfish that have accumulated toxins produced by several species of the dinoflagellate genus *Dinophysis* and possibly *Prorocentrum*. Human illness caused by DSP has not been confirmed on the Gulf Coast; however, several species of *Dinophysis* implicated in toxicity of shellfish elsewhere have been identified from Gulf waters. Furthermore, because of the close similarity in human symptomatology, it is possible for DSP to be misdiagnosed as a commonplace bacteria-related gastrointestinal disorder. Outbreaks of diarrheic shellfish poisoning are not necessarily preceded by algal bloom or red tide events. Low levels of the causative dinoflagellates over shellfish beds are sufficient to cause toxicity in shellfish.

Amnesic Shellfish Poisoning is caused by the consumption of shellfish that have accumulated toxins produced by the diatoms *Nitzschia pungens f. multiseries* and *Amphora cofaeiformis*. Algal bloom or red tide events appear to precede the occurrence of toxic shellfish. Confirmed cases of ASP have not been reported from the Gulf Coast; however, *N. pungens* has been identified in plankton samples taken from Galveston Bay. As is the case with DSP, medical records have not been evaluated for undiagnosed or possible misdiagnosed symptoms corresponding to this form of seafood poisoning.

Pufferfish Poisoning is caused by the consumption of pufferfish (blowfish) that have accumulated tetrodotoxin, a potent toxin of unconfirmed origin. Human cases of pufferfish poisoning have not been reported from the Gulf of Mexico. Insufficient information is available to determine the potential for this type of seafood poisoning in the Gulf of Mexico; however, the toxicity of pufferfish is generally thought to be widespread.

Other potential biotoxin threats are represented by species which are known to be toxic but are poorly understood in the Gulf of Mexico. These species include *Alexandrium tamarensis, A. monilatum, A. tropicale, Gymnodinium catenatum, G. nagasakiense, Prorocentrum minimum, P. treistenum,* and *P. lima*. Several species of toxic chloronomads, marine bacteria, and cyanobacteria are also known to exist in the Gulf of Mexico. However, none of these species have been directly associated with human illness in the Gulf area.

There are data and information gaps concerning the levels of marine toxins in seawater and seafood that may present a risk to human health, as well as the best monitoring methods to prevent contaminated products from being introduced into the market. There also are data gaps with regard to the survivability, transmission, and lifecycles of pathogenic microorganisms and dinoflagellates in the marine environment. Research in these areas may help control the potential health threat from exposure. Presently, public health protection depends on control at harvest sites, so it is important to transfer the results of research and new technologies to the industry.

In addition, with regard to information transfer, a communication network needs to be set up to inform "downstream" areas of the presence of phenomena such as toxic blooms and red tide events. An early warning information network could alert downstream states of these problems and activate specific monitoring for early detection of potential problems. Efforts can be coordinated within existing facilities which have set up response teams for detecting and regulating toxic bloom problems. Communication and coordination of technical expertise in these areas is of critical importance to the Gulf region.

Toxic Substances (in the food chain, the potential for biomagnification and human health effects caused by consumption)

The Gulf of Mexico region has more point sources of pollution (over 3,700) than any other region in the Nation (NOAA, 1990). This is a region with concentrations of industrial activity associated with oil and gas production and development. Over half of the point source discharges are industrial facilities, and many of these are petrochemical discharges. Galveston Bay, TX, has the greatest concentration of point sources, followed by Mississippi Sound (DOC, 1991).

In 1982, it was estimated that approximately 11.7 million pounds of commonly used pesticides were applied to agricultural lands in the Gulf of Mexico region, the most among all U.S. regions. The average application of pesticides was 366 pounds per square mile. Apalachicola Bay, FL, had the highest intensity of application in the region (1,041 pounds per square mile), followed by Apalachee Bay, FL, (1,023 pounds per square mile) (Pait *et al.*, 1989).

Quantifying the potential human health effects resulting from exposure to toxic chemicals present in the marine environment is difficult since the effects may not take the form of an obvious acute effect. Few studies have been able to actually measure the impacts of exposure to toxic chemicals (D'Itri and D'Itri, 1977); however, this should not necessarily imply that effects do not occur. Exposure to toxic chemicals may induce chronic effects such as an increased incidence of cancer which may not yet be detectable in an epidemiological study of an exposed population.

According to the National Academy of Sciences (NAS, 1991), the levels of toxic chemicals in seafood in certain areas are high enough to warrant additional control measures. It is suspected, however, that the risks from toxic chemicals are not on the order of magnitude of environmental health hazards associated with human pathogens for the population as a whole (NAS, 1991), although certain groups within the population may be at high risk (*e.g.*, recreational and subsistence fishermen, children, and pregnant women).

The Subcommittee decided that direct exposure to hazardous waste (where it occurs) is a problem in the Gulf of Mexico. However, little information is available about the frequency of exposure in the Gulf States. The Subcommittee classified toxic chemicals as organic and inorganic compounds. It is known that inorganic contaminants, such as mercury, accumulate in both fish and shellfish consumed by humans. The potential for exposure to organic toxic contaminants through biomagnification in the food chain is not well documented. Some toxic substances introduced into Gulf Coast waters may bioaccumulate in the food chain and may cause illness at some levels.

Toxic chemicals of primary concern have the following properties:

- High persistence in the aquatic environment;
- High bioaccumulation potential;
- High toxicity to humans; and/or
- Common chemicals released to the environment by human activity (EPA, 1989).

Chemicals with these properties that have been found in fish tissue and the marine environment include dioxins and furans; polychlorinated biphenyls (PCBs); polycyclic aromatic hydrocarbons (*e.g.*, benzo(a)pyrene); pesticides; and heavy metals such as arsenic, lead, mercury, and selenium. In addition, a variety of potentially toxic chemicals are introduced into the marine environment from aquaculture. Chemotherapeutic drugs such as sulfonamides and nitrofurans are the primary aquaculture chemicals of concern to human health (NAS, 1991). Although the effects of many of these compounds on different organ systems in man and/or animals are known, it is difficult to establish with certainty the degree of hazard posed by their presence in seafood. This is because of a lack of information on the exact concentrations present in edible fish tissue and, in the case of metals, the form in which they exist (*e.g.* inorganic vs. organic, oxidation states, etc.). Moreover, the health effects of exposure to complex chemical mixtures, and the relationships between chemical contaminants and susceptibility to infectious disease need to be studied.

Arsenic, cadmium, lead, and mercury are particularly important because of their known or potential toxicity to humans and their presence in relatively high concentrations in wastes disposed of in estuaries and coastal waters. Metals of secondary concern include chromium, copper, and selenium. Other toxic metals are present in much lower concentrations, both in wastes and in regions of the marine environment that are likely to lead to human exposure (OTA, 1987). In marine environments, consumption of contaminated seafood is generally the major route of human exposure to metals. Direct human exposure to metals is usually less important because they are generally present in very low concentrations in the water column (OTA, 1987).

Table 2.5 *Properties and Effects of Metals of Primary Concern in Marine Environments*

	Arsenic	Cadmium	Lead	Mercury
Bioaccumulation	Low except in some fish species	Moderate	Low or none	Significant (methylated form)
Biomagnification	Low or none	Low or none	Low or none	Significant (methylated form)
Properties	Metallic form: insoluble Readily methylated by sediment bacteria to become highly soluble, but low in toxicity	Metallic form: relatively soluble Not subject to biomethylation Less bioavailable in marine than in fresh water Long biological residence time Synergistic effects with lead*	Generally insoluble Absorption rate age-dependent, 4 to 5 times higher in children than in adults Synergistic effects with cadmium*	Metallic form: relatively insoluble Readily methylated by sediment bacteria to become more soluble, bioavailable, persistent, and highly toxic
Major environmental sink	Sediments	Sediments	Sediments	Sediments
Routes of human exposure in marine environments	Seafood: very minor route, except for some fish species	Seafood contributes approximately 10% of total for general population	Seafood comparable to other food sources	Seafood is primary source of human exposure
Health effects	Acute: gastrointestinal hemorrhage; loss of blood pressure; coma and death in extreme cases Chronic: liver and peripheral nerve damage; possibly skin and lung cancer	Emphysema and other lung damage; anemia; kidney, pancreatic, and liver impairment; bone damage; animal (and suspected human) carcinogen and mutagen	Acute: gastrointestinal disorders Chronic: anemia; neurological and blood disorders; kidney dysfunction; joint impairments; male/female reproductive effects; teratogenic and peripheral nerve damage; possibly skin and lung cancer	Kidney dysfunction; neurological disease; skin lesions; respiratory impairment; eye damage; animal teratogen and carcinogen**

(Source: OTA, 1987)

* The toxicity of lead and cadmium depends on nutritional status.

** Debate exists over whether mercury should be listed as a carcinogen. While there is a correlation between mercury and chromosomal aberrations or cancer, mercury's mechanism of action by binding to sulfhydryl or thiol groups or concurrent exposure to other genotoxic substances could explain these results.

Bioaccumulation and biomagnification are important processes that largely determine the potential for indirect human exposure to toxic metals and organic chemicals. Marine organisms, especially benthic organisms, can bioaccumulate metals by filtering water during feeding or swimming, ingesting particulate matter onto which such substances are absorbed, or ingesting other contaminated organisms (OTA, 1987). Biomagnification of a metal can result in an increase in an organism's tissue concentration of several orders of magnitude or more, and hence represents a major potential pathway for human exposure.

Even when bioaccumulation is not a factor, significant quantities of metals can concentrate in the gut or gills of marine organisms without actual absorption into the tissues. This is especially true for shellfish that filter large quantities of seawater and ingest solid matter during feeding. Because people generally eat these organisms whole, toxic substances can be passed to humans even in the absence of any actual bioaccumulation. This mechanism probably accounts for most instances of shellfish contamination involving metals that do not bioaccumulate (OTA, 1987).

Toxic metals are capable of inducing a variety of human health effects--lethal and sublethal, acute and chronic. Some of the known properties and effects of exposure to the metals of primary concern in marine environments are summarized in Table 2.5.

Organic chemicals vary considerably with respect to their behavior and toxicities in natural environments. Given this complexity, it is essential to use some type of simplified classification if a health hazard evaluation is to become manageable (OTA, 1987). One approach is to classify compounds according to how they behave in the environment, thus concentrating on those substances that have a potential to reach humans; information on human health effects would then need to be developed for only this group.

As is the case for metals, the consumption of contaminated seafood is the primary pathway for human exposure to most organic chemicals (See Table 2.6). Indeed, compounds such as PCBs and DDT have been shown to accumulate in humans through consumption of contaminated seafood (OTA, 1987). The importance of bioaccumulation and biomagnification varies greatly for different organic chemicals and for different organisms, and there is relatively little information on the long-term fate and behavior of most organic compounds in marine environments.

Few documented cases exist of human health impacts from waste-derived organic chemicals in marine environments. However, the potential for such exposure and effects clearly exists in the United States (OTA, 1987).

Table 2.6 *Properties and Effects of Major Classes of Organic Chemicals in Wastes Disposed of in Marine Environments*

Chemical Class	Major Examples	Properties	Primary Routes to Humans	Health Effects
Low molecular weight hydrocarbons	Benzene Toluene Xylene	Volatile Biodegradable Low bioaccumulation potential	Inhalation Drinking water	Benzene: central nervous system (CNS) effects, blood disease, leukemia Toluene: possible CNS effects, low toxicity Xylene: irritant; teratogen
Low molecular weight chlorinated hydrocarbons	Chloromethanes: carbon tetrachloride (CTET) chloroform methylene chloride	Volatile Lipid-insoluble Low bioaccumulation potential Some (e.g., CTET and chloroform) are persistent; others (e.g., methylene chloride) are readily biodegraded	Inhalation Drinking water	CTET and chloroform: liver, kidney, blood, and gastrointestinal disorders; liver and kidney cancer Methylene chloride: possible CNS effects
	Trichloroethylene, tetrachloroethylene, tetrachloroethane	Volatile Lipid-insoluble Low bioaccumulation potential	Inhalation Drinking water	All: CNS effects, liver toxicity Tri- and tetrachloroethylene: liver cancer
	Vinyl chloride	Volatile Low bioaccumulation potential	Inhalation	Animal and human carcinogen; liver toxicity
	Chlorobenzenes	Range of volatilities Lipid-soluble Significant bioaccumulation potential	Food (including seafood)	Hexachlorobenzene: carcinogen
Chlorinated pesticides	Cyclodiene pesticides: aldrin, dieldrin, heptachlor, chlordane DDT and metabolites Chlorinated phenoxyacetic compounds (2,4,5-T; 2,4-D) Hexachlorocyclohexanes: lindane, BHC	Nonvolatile High bioaccumulation potential Moderate to high toxicity Most are highly persistent	Food (including seafood)	Known or suspected human carcinogens; neurotoxic effects; chloracne and other skin diseases
High molecular weight chlorinated hydrocarbons	Polychlorinated biphenyls (PCBs) Chlorinated dioxins (TCDD) Chlorinated dibenzofurans	Nonvolatile High bioaccumulation potential Moderate to high toxicity Highly persistent	Food (including seafood)	All: neurological, liver, and skin disorders PCBs: tumor promoters or carcinogens TCDD: highly carcinogenic
Aromatic hydrocarbons	Phthalate esters (e.g., DEHP) Polycyclic aromatic hydrocarbons (PAHs)	Low to moderate volatility Highly insoluble Range of bioaccumulation potential Low to moderate toxicity	Food (including seafood)	Phthalates: many are teratogens DEHP: possible carcinogen PAHs: many (e.g., benzo(a)pyrene) are carcinogens; some are teratogens

(Source: OTA, 1987)

In addition to the health risks associated with toxic substances discharged directly into the marine environment, the potential health risk of atmospheric deposition needs to be investigated further. Air pollution can cause water pollution either by direct deposition or through runoff from land. This transfer of toxic substances among media has already been documented in the Great Lakes and Chesapeake Bay regions, and may be a source of contamination in Gulf of Mexico waters. Potential risks need to be assessed, as well as appropriate alternatives for reducing the amount of toxic substances released into the atmosphere (*i.e.*, scrubbers for smokestacks).

Once an indication of the relative hazard posed by a pollutant in the marine environment has been established, the next step is to characterize the potential risk to the human population from exposure to the particular contaminant using risk assessment methods. Risk assessment involves quantifying the levels of contaminants in seafood, identifying the populations exposed to the toxic agent, estimating the intensity, duration and nature of human exposure, and evaluating the toxicity of the chemical contaminant. Several methods have been developed recently to assess the human health risks from exposure to toxic chemicals in the marine environment. EPA's Office of Water is currently developing a comprehensive guidance manual addressing risk assessment of marine pollutants with respect to seafood. However, there are several data gaps and uncertainties associated with the risk assessment process that may be improved by further research in this area. Identifying the populations likely to be exposed to marine pollutants and estimating the duration and frequency of exposure require accurate seafood consumption data. However, currently there are a wide range of national seafood consumption values being used by regulatory agencies.

There is insufficient information for public health officials to determine the risk these contaminants in seafood pose to consumers and there is difficulty in communicating this risk to the public. In addition to the lack of information regarding the human health effects from contaminants, there is a paucity of information on the elimination of chemical contaminants from shellfish. The few existing studies indicate that metals remain high for many months, even following depuration.

Exposure to Pathogens in Gulf Waters From Recreational or Occupational Contact

Human wastes are discharged from many sources into coastal waters that are also used for contact recreation. There is a direct correlation between the level of these wastes (fecal coliform, *E. coli*, and enterococcus) in water and the occurrence of illness in swimmers (Cabelli, 1983). Municipal wastewater sewage presents the greatest risk of infectious disease from direct contact through such activities as swimming, surfing, and diving.

While the implementation of water quality guidelines and sewage treatment requirements has substantially reduced the outbreaks of serious human diseases attributable to direct contact with polluted waters, bathing in sewage-impacted waters is still responsible for relatively high rates of gastrointestinal illness in the United States. In fact, the number of outbreaks of water-borne disease, particularly nonbacterial diseases such as viral gastroenteritis and hepatitis, have been steadily increasing in recent decades (OTA, 1987). Because of its relatively benign nature, this type of illness is probably significantly under-reported as well.

Epidemics of serious bacterial disease, while rare, have been caused by swimming in sewage-contaminated water. For example, in 1974, an outbreak of shigellosis was traced to swimming in a stretch of the Mississippi River downstream of a secondary treatment plant. Fecal coliform counts in the river were almost 90 times higher than the federal standard (OTA, 1987).

Scuba diving in contaminated marine waters can also lead to increased incidence of water-borne disease (OTA, 1987). These diseases include dermatitis, wound infection, and other skin-related ailments, as well as enteric illness. Under-reporting of these diseases is also judged to be considerable.

Naturally occurring marine bacteria may also cause illnesses by invading wounds. The *V. vulnificus* microorganism has been responsible for wound infections among users of coastal and estuarine waters (NOAA, 1991); other species of Vibrio may also be responsible for wound infections. These infections have been relatively few in number, but very severe in nature and possibly under-reported.

Most Gulf States use the fecal coliform criterion as a contact recreation bacterial standard for aquatic habitats. In 1986, EPA described new criteria organisms (*E. coli* and enterococcus) to monitor the microbial quality of fresh water and enterococcus for monitoring microbial marine water quality. EPA has recommended that states consider using the new indicators. To date, there has been little activity by states in using the new criteria organisms in recreational water quality monitoring programs, although some non-Gulf states are using the new indicators. The consensus of the Public Health Subcommittee is that the new indicators are better predictors of swimming-related health risks than the old criteria.

Economic Implications of Consumer Risk

The following section discusses the economic implications of consumer risk related to potential illness from contaminated seafood.

Determining consumer risk and appropriate control measures are complex issues. The area of seafood safety and product quality needs not only improved scientific analysis of the nature and extent of public health risks, but also good economic analyses.

When an outbreak of seafood-borne illness occurs, consumer willingness to pay for seafood declines because of expectations of increased risk. Consequently, total demand declines, there is a loss in benefits, market prices are reduced, and there is a decrease in sales and potentially employment. The impacts of such changes can reverberate from the fishing grounds to the retail markets.

Not only will there be a loss in the market for the species/product that is the source of the outbreak, but other markets may suffer losses because consumers have imperfect information. For example, an outbreak of ciguatera in barracuda may cause a reduction in the demand for snapper, another species associated with ciguatera. Also in calculating welfare losses, one must consider that those that do get sick require medical attention, that there will be a loss in production due to employee illness, and that government resources will be expended in determining the cause of the outbreak.

The costs of food-borne diseases are not borne by one sector of society but are shared among governments, society, individuals, and firms. Policy makers desire information which will allow them to understand how the cost burden is shared and also require some mechanism to allow them to relate costs to control measures. In addition to the complex issues already identified, the desire on the part of government to take action on food safety issues is often tempered by limited resources available for the task.

Summary

Fish and shellfish accumulate varying degrees of pollutants (*e.g.*, petroleum, hydrocarbons, synthetic organic compounds, pesticides) that enter the environment through agricultural and industrial activities and disposal of wastes. These pollutants affect the ability of fishery resources to reproduce and enter into human food supplies. Seafood--shellfish in particular--may also harbor pathogenic bacteria and viruses originating largely from human and animal waste at levels that can cause illness to consumers. Shellfish and finfish can also accumulate extremely toxic compounds naturally produced by toxic marine phytoplankton. These toxins eventually adversely impact humans when they consume seafood (all types), come into direct contact through marine aerosols, or swim in contaminated waters. According to NMFS, the impact of these contaminants will increase dramatically as the human population on the coasts grows faster than waste/run-off management can be implemented (GAO, 1991).

The association between exposure to human pathogens, by ingestion of contaminated seafood or swimming in contaminated water, and the development of human illness has been established for some agents. This association is best established for exposure to pathogens such as viruses and bacteria. Diseases such as hepatitis, gastroenteritis, and cholera are known to be caused by water- and seafood-borne pathogens. However, many gaps exist with regard to potential health risks from exposure to other pathogenic microorganisms. The association between marine pollution and increased incidence of these human pathogens has not been firmly established, particularly for the *Vibrio* species. Information gaps exist concerning the levels of microorganisms and marine toxins in seawater and seafood that may present a risk to human health, as well as the best methods for monitoring these microorganisms. There also are data gaps with regard to the survivability, transmission, and life cycles of pathogenic microorganisms and dinoflagellates in the marine environment. Research in these areas may help control the potential health threat from exposure to pathogenic microorganisms and marine toxins.

Pollution of coastal and offshore fishing grounds has resulted in intermittent closures of some areas to both finfish and shellfish harvesting. NMFS believes that without long-term planning for pollution control, the nation's fish stocks are being jeopardized (GAO, 1991). The safety of consuming fish from these areas or marginally contaminated waters is not well understood. The likelihood of human exposure to these pollutants depends on their physical, chemical, and biological form; concentration; and persistence or survival. The character and nature of environmental pathways leading to human exposure are also important variables.

According to NMFS, critical information is missing about the depuration of viral agents in shellfish, and controlled studies have been hindered by a lack of methods to enumerate viruses in shellfish (GAO, 1991). Even with the best treatment

technology to reduce marine pollution, seafood may still be contaminated with pathogenic microorganisms and marine toxins. Effective methods for the removal, reduction, and/or inactivation of pathogens in fish need to be explored further.

Overall, the incidence of shellfish-borne disease in the United States may be increasing (OTA, 1987). This trend largely involves increases in the number of outbreaks of viral disease. For example, in a series of apparently related cases stretching back over the last 14 years, several dozen people contracted cholera after consuming shellfish harvested from coastal marshlands in southwestern Louisiana (OTA, 1987). These represent the first indigenous outbreaks of cholera in the U.S. since 1911.

Toxins in finfish, molluscan shellfish (clams, oysters, mussels, scallops), and possibly shrimp have increasingly been implicated in human health disorders. According to the Centers for Disease Control's records for 1983-87, ciguatera and scombroid poisoning were the first and second most frequently reported illness associated with eating fish. In addition to consumer safety issues, toxins pose a severe economic threat to the shellfish industry.

III. AGENCY FRAMEWORK AND EXISTING LEGISLATION

This section describes the legal and institutional framework currently in place in the Gulf of Mexico to address public health problems. It also outlines some of the positive efforts already underway at the federal, regional, and state levels.

Federal Level

Federal Statutes Affecting Public Health Issues

Agricultural Marketing Act of 1946, as amended (7 U.S.D. 1621 et seq.), Fish and Wildlife Act of 1956 (16 U.S.C. 742a et seq), and Reorganization Plan No. 4 of 1970.

The Agricultural Marketing Act authorizes the Secretary of Agriculture to establish a voluntary inspection and certification program for agricultural products, including fish and shellfish, in interstate commerce through services made available on a fee-for-service basis. The Act also requires the Secretary to, among other things, conduct research and development on methods of processing, packaging, handling, storing, and preserving products and develop and improve standards of quality, condition, quantity, grade, and packaging to encourage uniformity and consistency in commercial practices.

Pursuant to the Fish and Wildlife Act, USDA's functions and authorities pertaining to commercial fisheries were transferred to the U.S. Department of the Interior in 1958. The transfer included the voluntary seafood inspection program. The Act also authorizes the Secretary of the Interior to improve production and marketing practices. Reorganization Plan No. 4 of 1970 transferred the functions described in the Fish and Wildlife Act including the voluntary seafood inspection program, from the Department of the Interior to NOAA.

Clean Water Act of 1977, as amended by the Water Quality Act of 1987

The objective of the Clean Water Act (CWA) is to restore and maintain the quality of our water resources to protect the health of humans, fish, shellfish, and wildlife from harmful pollutants. CWA establishes national water quality goals and creates a national permit system with minimum standards for the quality of the discharged waters (effluent). CWA does not set specific standards for water bodies, but does provide guidance to the states. States, however, are required to establish standards based on the designated uses of these waters.

CWA also establishes types of pollution to be regulated and categories of industries to be regulated. Conventional pollutants, toxic or "priority " pollutants, and non-conventional pollutants are regulated under CWA. Federal numerical "criteria" designating allowable concentrations in receiving waters have been established for the priority pollutants. Translating these "criteria" into enforceable standards for specific water bodies may be as simple as copying the federal recommendations to a state's standards. However, for developing criteria other than federally recommended criteria, additional site-specific evaluations may be required.

CWA requires that direct point source dischargers obtain National Pollutant Discharge Elimination System (NPDES) permits that regulate their discharges to attain effluent standards. Specific waste water dischargers into rivers and storm water drainage systems must also receive permits. CWA requires direct point source industrial dischargers to control conventional, as well as toxic and non-conventional, pollutants.

Pretreatment of specified discharges from point sources is the mechanism for controlling toxic and non-conventional pollutants discharged into the sewage treatment system. As mandated by CWA, the intent of the pretreatment program is to achieve a total reduction in discharges of priority pollutants from indirect dischargers that is roughly equivalent to those required by direct point source dischargers.

Municipal waste water treatment plants (called Publicly-Owned Treatment Works or POTWs) and direct industrial dischargers are required to meet different technology-based effluent standards. However, both municipal and industrial dischargers are required to meet the same ambient water quality standards. Technology-based regulation of POTW discharges focuses almost exclusively on conventional pollutant control through the requirement that POTWs achieve "secondary" (85% removal of suspended solids and biological oxygen demand) levels of treatment.

CWA also establishes a program for managing contaminated runoff from nonpoint sources of pollution. Each state identifies all water body segments that fail to meet water quality standards for designated uses due to runoff, boating wastes, faulty septic systems, and other sources of nonpoint pollution. The states must then submit a four-year management program for controlling the pollutant sources. The plans are subject to EPA approval and may be eligible for grants of up to 60 percent of costs (excluding construction) to assist in implementation.

Coastal Zone Management Act of 1972 (CZMA), as amended

Under CZMA, states receive federal assistance grants to maintain federally-approved planning programs for enhancing, protecting, and utilizing coastal resources. These are state programs, but the Act requires that federal activities must be consistent with the respective states' CZM programs. Depending upon the individual state's program, the Act provides the opportunity for considerable protection and enhancement of fishery resources by regulation of activities and by planning for future development in the least environmentally damaging manner.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or "Superfund")

CERCLA names NMFS as the federal trustee for living and nonliving natural resources in coastal and marine areas under United States jurisdiction. It could provide funds for "clean-up" of hazardous waste in coastal habitats in the event of an oil spill or other pollution spill.

Federal Food, Drug, and Cosmetic Act (FFDCA), as amended (21 U.S.C. 301 et seq.)

FFDCA authorizes FDA 1) to regulate food (except meat and poultry products) production and manufacturing to ensure that food is safe, clean, and wholesome and 2) establish reasonable standards of identity, quality, and fill of containers for food products. The Act also prohibits the interstate commerce of adulterated foods and false or misleading labeling of food products. A food is adulterated if it contains substances that may render it injurious to health. A food is misbranded if information required by law does not clearly appear on the label. In many instances FFDCA also requires FDA approval for distribution of certain products. The Act directly affects the harvest, handling, sale, and packaging of fish and shellfish.

Federal Water Pollution Control Act of 1972 (FWPCA) and MARPOL Annexes I, II, and V

Discharge of oil and oily mixtures into the navigable waters of the United States is governed by the FWPCA and 40 Code of Federal Regulations (CFR), part 110. Discharge of oil and oily substances by foreign ships or by U.S. ships operating or capable of operating beyond the U.S. territorial sea is governed by MARPOL Annex I.

MARPOL Annex II governs the discharge at sea of noxious liquid substances primarily derived from tank cleaning and deballasting. Most categorized substances are prohibited from being discharged within 12 nautical miles of land and at depths of less than 25 meters.

MARPOL Annex V requires that ships which dispose of garbage contaminated with foreign food wastes do so in an Animal/Plant Health Inspection Service (U.S. Department of Agriculture) approved facility.

Fish and Wildlife Coordination Act of 1958

Under the Fish and Wildlife Coordination Act, FWS and NMFS review and comment on fish and wildlife aspects of proposals for work and activities sanctioned, permitted, assisted or conducted by federal agencies that take place in or affect navigable waters, wetlands or other critical fish and wildlife habitat. The review focuses on potential damage to fish and wildlife and their habitat and therefore serves to provide some protection to fish resources from activities that may alter critical habitat in nearshore waters. The Act is important because federal agencies must give due consideration to the recommendations of FWS and NMFS.

Interjurisdictional Fisheries Act of 1986 (Title III, Public Law 99-659)

The Interjurisdictional Fisheries (IJF) Act was established by Congress to: 1) promote and encourage state activities in support of the management of interjurisdictional fishery resources; and 2) promote and encourage management of interjurisdictional fishery resources throughout their range. Congress also authorized federal funding to support state research and management projects that were consistent with these purposes. Additional funds are authorized to support development of interstate fishery management plans (FMPs) by the Gulf States Marine Fisheries Commission and other marine fishery commissions.

Lacey Act, as amended (16 U.S.C. 3371 et seq.)

The Lacey Act, administered by NMFS, makes it unlawful to deliver, carry, transport, or ship by any means for commercial or noncommercial purposes or sell in interstate or foreign commerce any fish or wildlife that was taken, transported, or sold in violation of any federal, state, or foreign law or regulation. NMFS investigates alleged violations of the Act.

Magnuson Fishery Conservation and Management Act (MFCMA)

The Magnuson Fishery Conservation and Management Act, administered by NMFS, requires fishery resources to be used to the greatest overall benefit to the United States, with specific reference to the use of the nation's fishery resources as food. The Act includes a mandate for NMFS programmatic activities to, among other things, maximize the quality of seafood products to ensure the greatest economic return for harvested resources.

With the passage of MFCMA, the federal government assumed responsibility for fishery management within the Exclusive Economic Zone (EEZ), a zone contiguous to the territorial sea and whose inner boundary is the outer boundary of each coastal state. (The outer boundary of the EEZ is a line 200 miles from the (inner) baseline of the territorial sea.) Management of the EEZ is to be based on fishery management plans developed by regional fishery management councils. MFCMA sets national standards to be met by such plans. Each plan attempts to define, establish and maintain the optimum yield for a given fishery. Each council prepares plans with respect to each fishery requiring management within its geographical area of authority and amends such plans as necessary. Plans are implemented as federal regulation through the Department of Commerce (DOC).

Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA), Titles I and III and Shore Protection Act of 1988 (SPA)

MPRSA provides protection of fish habitat through the establishment and maintenance of marine sanctuaries. MPRSA and SPA regulate ocean transportation and dumping of dredged materials, sewage sludge and other materials. Criteria for issuing such permits include consideration of effects of dumping on the marine environment, ecological systems, and fisheries resources.

National Environmental Policy Act of 1970 (NEPA)

NEPA requires that all federal agencies recognize and give appropriate consideration to environmental amenities and values in the course of their decision-making. In an effort to create and maintain conditions under which man and nature can exist in productive harmony, NEPA requires that federal agencies prepare an environmental impact statement (EIS) prior to undertaking major federal actions that significantly affect the quality of the human environment. Within these statements, alternatives to the proposed action that may better safeguard environmental values are to be carefully assessed.

National Ocean Pollution Research, Development, and Monitoring Planning Act of 1978

The Act requires NOAA to develop the necessary base of information to protect public health and provide for the rational, efficient, and equitable conservation and development of ocean and coastal resources.

Public Health Service Act, as amended (42 U.S.C. 201 et seq.)

The Public Health Service Act provides for federal/state cooperative assistance in preventing the interstate transmission of disease, and thus establishes FDA's authority for its programs for shellfish, restaurant and retail market operations, and interstate travel conveyances.

Involved Federal Agencies

Food and Drug Administration (FDA)

The regulation and control of contaminated food stuffs is a joint federal and state responsibility. FDA shares the federal regulatory role with EPA. FDA has direct enforcement responsibility over all contaminated food including fish and shellfish, that are shipped in interstate commerce. FDA is responsible for establishing safe levels for poisonous or deleterious substances (other than pesticide residues which EPA establishes) that contaminate food. Under ideal conditions, FDA will attempt to establish a formal tolerance or maximum permissible level. However, when toxicological data are scanty or conflicting, when additional data are being developed or when other conditions are rapidly changing, FDA may consider developing an action level. Action levels meet the same criteria as tolerances except they are intended for interim periods and can be instituted and changed more quickly than tolerances. The agency also has the task of seafood inspection, distributed among the following four responsibilities: (1) general plant and product inspection, (2) import control inspection, (3) routine and periodic surveys for residual chemicals, and (4) compliance inspection for the National Shellfish Sanitation Program.

The Center for Food Safety and Applied Nutrition carries out FDA's Food and Cosmetics Program. The Center 1) conducts and supports food safety research, 2) develops and oversees enforcement of food safety and quality regulations, 3) coordinates and evaluates FDA's surveillance and compliance programs relating to foods, 4) coordinates and evaluates federal/state cooperative programs relating to foods, and 5) develops and disseminates food safety and regulatory information to consumers and industry.

The Office of Regulatory Affairs consists of a headquarters staff and FDA field offices. The headquarters staff oversees field office activities--investigational and laboratory functions for all of FDA's major product areas including foods. Field office food safety and quality responsibilities include those relating to research, investigation, inspections, compliance, enforcement, and laboratory analyses. For example, enforcement actions for toxic constituents are based upon FDA action levels--the only available criteria on contaminants in fisheries products.

FDA provides assistance to states and advises the states on matters pertaining to the preservation and improvement of public health as they relate to shellfish in the Public Health Services Act, as amended. Additionally, the Code of Federal Regulation (21 CFR 1240.610) prohibits the interstate sale of shellfish that are likely to spread disease.

The Division of Seafood Research, within FDA's Office of Seafood, originates, plans, and conducts research on marine parasites, natural toxins, chemicals, and microbiological organisms that may contaminate seafood and/or harvest waters. In addition to numerous responsibilities, this Division provides scientific support to other FDA components in sanitary surveys of seafood harvesting waters and develops and evaluates methods to determine the presence and concentration of contaminants in seafood and/or harvest waters.

FDA Action Levels

The focus of recent controversy, action levels have been widely used in lieu of formal tolerances in setting regulatory guidelines for seafood. Such levels are allowed under Sections 306, 402(a) and 406 of the Food, Drug, and Cosmetic Act (FDCA). For FDA, action levels provide the advantage of not requiring formal notice-and-comment rule making. In addition, they prove useful as substitutes to formal tolerance levels in the absence of consistent and abundant toxicological data. Because there was no functional difference between an action level and a tolerance in practice, however, the U.S. Court of Appeal for the District of Columbia Circuit was forced to refine and clarify the legal status of FDA action levels in 1987. In 1990, FDA proclaimed that action levels were not binding on the agency or industry. Nevertheless, action levels are valuable to FDA because of the significant guidance and focus they provide to field personnel who direct monitoring and inspection programs that contribute to the identification of adulterated seafood products. Indeed, specific action levels have been developed for several contaminants in seafood products. Examples of established action levels include: *Escherichia coli* in fresh and frozen crabmeat, parasites in finfish, and paralytic shellfish poison in clams, mussels, and oysters. Additional action levels have been established for residual chemical contaminants, including pesticides.

National Shellfish Sanitation Program (NSSP)

In 1925, NSSP was established as a joint effort between FDA, federal, state, and municipal authorities, and the shellfish industry to set forth guidelines for the management of state shellfish programs. In each participating state, one or more regulatory agencies manage the local shellfish sanitation program. As part of NSSP, FDA provides technical assistance to states in studying specific pollution problems; provides data to establish closure levels for shellfish harvesting; conducts applied research on various contaminants to assist in developing standards and criteria; and evaluates the effectiveness of state shellfish sanitary control programs (see Table 3.1). The criteria of NSSP are applied to both domestic and imported fresh and fresh-frozen shellfish. In addition, since 1966, data have been compiled periodically by FDA and NOAA on classification by states of coastal and estuarine waters with regard to suitability for shellfishing activities.

Table 3.1 *National Shellfish Sanitation Program (NSSP) State Program Evaluations*

Administrative & Legal Authority	Laboratory	Plant Sanitation	Growing Water Classification	Patrol
Effective state laws and regulations	Follows American Public Health Association (APHA) procedures or other established procedures	Certify and inspect interstate shippers	Water sampling and classification program	Prevention of shellfish harvest from closed areas
Seizure/embargo powers	Bacteriological / toxicological proficiency	Participates in joint FDA/state inspections	Necessary measures are taken to make classifications available to the public	Enforcement of harvesting restrictions
	Participates in FDA quality control programs	Regulates shipping and labeling		
	Qualified state laboratory evaluation officer	Provides supervision of depuration and wet storage facilities		

(Source: GSMFC, 1991)

NSSP is designed to prevent human illness associated with the consumption of fresh and fresh-frozen oysters, clams, and mussels through sanitary control over all phases of growing, harvesting, shucking, packing, and interstate transportation. Its purpose is to develop strict guidelines covering the quality of growing waters, harvesting techniques, record keeping, tagging, processing, and shipping. NSSP develops guidelines for classifying shellfish growing waters, inspecting shellfish shippers and plants (certification), and preventing shellfish harvesting in areas that are not approved for harvesting (*e.g.*, waters contaminated with chemicals or sewage). These guidelines and criteria for the program are contained in the NSSP Manual of Operations (1990). The Interstate Shellfish Sanitation Conference (ISSC) is the organization of industry and state officials that FDA has recognized as the primary group to make recommendations to NSSP.

FDA's Cooperative Programs

In some food and drug areas, state agencies have more direct control of regulatory activities. These areas include milk, shellfish, retail food stores, and food service (restaurants). FDA's role is to provide technical guidance, training, and evaluation of these state programs at the state's request through associations, such as the Interstate Shellfish Sanitation Conference (ISSC). FDA sets standards with the states, evaluates the states against those standards, and rates state officials for their competency, familiarity with, and uniformity in applying those national standards within an individual state. FDA, however, is generally in no position to approve or disapprove of a state program.

Through Cooperative Programs, FDA, with a small investment of its own resources, promotes and hopes to ensure maintenance of a uniform system of state control over an inventory of about 750 shellfish processors, 1,100 shellfish shippers, and 850 shellfish-growing areas.

FDA's State Contract Program

This program is designed to obtain state assistance in inspecting firms that are FDA's responsibility but that would not be covered by FDA employees. This program includes such projects as investigating pesticide residues in foods and toxins in shellfish.

Contact: Dr. Merrill McPhearson
U.S. Food and Drug Administration
Fishery Research Branch
P.O. Box 158
Dauphin Island, AL 36528

Environmental Protection Agency (EPA)

EPA strives to achieve the objectives of the Clean Water Act. CWA directs EPA to develop criteria for water quality that accurately reflect the latest scientific knowledge about the effects of pollutants on aquatic life and human health. In developing criteria to protect water quality, EPA examines the effects of specific pollutants on plankton, fish, shellfish, wildlife, plant life, aesthetics, and recreation in any body of waters. This includes specific information on the concentration and dispersal of pollutants through biological, physical, and chemical processes as well as the effects of pollutants on biological communities as a whole.

EPA periodically publishes the results of these examinations to help states determine the levels of pollutants that can exist in the water column and the sediment without harming human and aquatic life. These levels are called "water quality criteria." Criteria can also describe the biological and physical characteristics that a lake, river, or estuary must have to support a healthy environment for fish and wildlife. States then use these criteria to help set water quality standards that protect the uses of their waters.

EPA is responsible for establishing ambient marine water quality criteria and for developing the framework for the issuance of NPDES permits for municipal and industrial storm water discharges. EPA establishes standards for oil and hazardous substances discharges from boats into federal waters and promulgates performance standards for marine sanitation devices. EPA administers the National Estuary Program. EPA is responsible for establishing tolerances for residues of pesticides that may be anticipated to appear in fish, or recommending appropriate action levels to FDA.

EPA's Office of Research and Development is responsible for the Environmental Monitoring and Assessment Program (EMAP). The Estuarine component of this program is designed, over the long term, to provide a quantitative assessment of the regional extent of coastal environmental problems by measuring status and change in selected ecological condition indicators. A demonstration project began in the Louisianian Province (Gulf of Mexico) in the summer of 1991. One of the assessment endpoints addresses whether fish contain contaminants. Annual statistical summaries will be produced and shared with Gulf of Mexico program managers.

Contact: Dr. Frederick C. Kopfler
U.S. Environmental Protection Agency
Gulf of Mexico Program Office
Building 1103, Room 202
Stennis Space Center, MS 39529

Chuck V. Pietrosewicz
Waste Management Division
U.S. Environmental Protection Agency--Region 4
345 Courtland St. NE
Atlanta, GA 30365

Carl R. Hickam
Office of Health Response
U.S. Environmental Protection Agency--Region 6
First Interstate Tower
1445 Ross Ave.
Dallas, TX 75202

National Oceanic and Atmospheric Administration (NOAA)

National Marine Fisheries Service (NMFS)

NMFS is responsible for establishing programs to protect and conserve fishes, marine mammals, and critical aquatic, estuarine, and marine habitats. NMFS is also authorized to inspect seafood harvested for commercial use. NMFS has an advisory role in coastal development permit processes; conducts or supports research and education; promotes federal marine fisheries (both sport and commercial); provides funding to develop state Coastal Zone Management Plans; and advises the Secretary of Commerce on establishing marine sanctuaries.

The Secretary of Commerce, acting through NMFS, has the ultimate authority to approve or disapprove all fishery management plans prepared by regional fishery management councils. Where a council fails to develop a plan, or to correct an unacceptable plan, the secretary may do so. NMFS also collects data and statistics on fisheries and fishermen. It performs research and conducts management authorized by international treaties. NMFS has the authority to enforce the Magnuson Act and Lacey Act and is the federal trustee for living and nonliving natural resources in coastal and marine areas under Section 107(f) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund"), Section 311 (f) (5) of the Clean Water Act (CWA), Executive Order 12580 of January 23, 1987, and Subpart G of the National Oil and Hazardous Substances Pollution Contingency Plan.

NMFS's Office of Trade and Industry Services administers two programs dealing with food safety and quality activities--the voluntary National Seafood Inspection Program and the Product Safety, Quality and Identity Research Program. The National Seafood Inspection Program is a voluntary, fee-based fish and shellfish products inspection and grading program. Division employees inspect and certify plants and seafood products and issue certification marks, including the Packed Under Federal Inspection mark and/or U.S. Grade A mark.

The Product Safety, Quality and Identity Research Program provides services and information on impediments to the full utilization of fishery resources. Activities include the collection, interpretation, publication, and dissemination of information and research results to facilitate optimum use of living marine resources. Safety research includes activities that address the continuing concern about the impact of environmental and process-induced contamination of seafood on consumers and the fishing industry. NMFS's quality research efforts are directed to improving the overall quality of U.S. seafood marketed domestically and internationally.

NMFS is currently involved with a number of projects regarding shellfish and oyster sanitation. Studies regarding methods to depurate and eliminate pathogens are underway, and an indicator study is proposed. Also, NMFS has completed and tested a model for hazard analysis critical control point (HACCP) inspection.

Contact: Dr. G. Malcolm Meaburn
National Marine Fisheries Service
Model Seafood Surveillance Program
Charleston Laboratory
P.O. Box 12607
Charleston, SC 29412

National Status and Trends Program (NS & T), National Ocean Service (NOS)

NOAA's NS & T Program is an extensive federal program under the direction and management of the Ocean Assessments Division of NOAA (OAD) that monitors levels of toxicants annually (routine surveillance) in shellfish (Mussel Watch) and finfish (Benthic Surveillance) from approximately 150 coastal and estuarine sites in the continental U.S., Alaska, and Hawaii (NOAA, 1989). The objectives of the program are: 1) to determine toxic contaminants as a basis for the identification of potential geographic differences; 2) to identify areas where environmental quality may be significantly compromised; 3) to determine significant temporal trends in toxic contaminant levels on a national basis; and 4) to evaluate and synthesize existing sources of information pertinent to the status of contaminants in selected areas and to augment the basic monitoring program as needed. NOAA's Mussel Watch Program to assess chemical contamination and various cooperative enforcement efforts with FDA and states are ongoing programs. A joint voluntary inspection system is being developed between NOAA and FDA which uses the HACCP concepts and will be offered first to the processors. Pilot testing of this approach is being completed in both the processing and retail sectors of the seafood industry.

Contact: Dr. Daniel J. Basta
NOAA/Strategic Assessment Branch
National Ocean Service
Rockville, MD 20852

Office of Ocean and Coastal Resource Management (OCRM)

OCRM asserts authority through the National Marine Sanctuaries Program pursuant to Title III of the Marine Protection, Research, and Sanctuaries Act (MPRSA). The OCRM Estuarine Sanctuary Program has designated Looe Key, Rookery Bay, and the Apalachicola River and Bay in Florida, and Weeks Bay in Alabama as estuarine sanctuaries.

OCRM may influence fishery management indirectly through administration of the Coastal Zone Management Program and by setting standards and approving funding for state coastal zone management programs. Some states in the Gulf utilize a portion of these monies in their habitat protection and enhancement programs including reef maintenance and enhancement.

Proposed Coastal Zone Act Reauthorization, Section 6217 Guidance

On October 16, 1991, NOAA and EPA jointly issued a proposed development and approval guidance for state coastal nonpoint pollution control programs. When the final guidance is issued, it will assist states in designing programs to combat the growing problem of nonpoint source impacts on the nation's coast.

The proposed program guidance identifies and explains provisions state coastal nonpoint programs must include in order to be approved by EPA and NOAA under section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA). Four of the many requirements for state programs are: 1) identify critical coastal areas adjacent to coastal waters which are impaired or threatened by nonpoint source pollution; 2) implement additional management measures for land uses or critical coastal areas as necessary to achieve and maintain water quality standards; 3) establish mechanisms to improve coordination among state and local agencies responsible for land use programs and permitting, water quality permitting and enforcement, habitat protection, and public health and safety; and 4) modify coastal zone boundaries as the state determines is necessary to implement NOAA's recommendations under Section 6217(e) of the CZARA. This section requires NOAA and EPA to determine whether the landward coastal zone of each coastal state extends far enough inland to control significant upland sources of nonpoint source pollution.

Contact: Ms. Marcella Jansen
NOAA/Office of Ocean and Coastal Resource Management
1825 Connecticut Ave. NW, Suite 724
Washington, D.C. 20235

Centers for Disease Control (CDC)

The Centers for Disease Control is charged with protecting the nation's public health by providing leadership and direction in preventing and controlling diseases and other preventable conditions and responding to public health emergencies. CDC is responsible for researching, monitoring, and controlling outbreaks of food-borne diseases. CDC coordinates its food-borne disease activities with FDA, USDA, and NMFS.

CDC operates a passive reporting system for food-borne illness that relies on the submission of reports from local health authorities. Because of voluntary reporting, different food-borne illnesses are reported at different rates depending on the difficulties associated with linking illness to specific causes. This phenomenon can make a higher risk food appear to be safer and a safer food appear to be a higher risk when data on two or more foods are compared.

Contact: Dr. Morris Potter (C-09)
Division of Bacterial Disease
Centers for Disease Control
1600 Clifton Road NE
Atlanta, GA 30333

U.S. Coast Guard (USCG)

USCG is responsible for enforcing the Clean Water Act prohibitions on discharges of oil, hazardous substances, and sanitary wastes from marine vessels and for enforcing the provisions of the MPPRCA regarding disposal of garbage from ships. USCG establishes regulations for marine sanitation devices (MSDs) to meet federal performance standards.

Contact: Lt. Cdr. William Prosser
U.S. Coast Guard
Eighth Coast Guard District
500 Camp Street
New Orleans, LA 70130-3396

Department of the Interior (DOI)

U.S. Fish and Wildlife Service (FWS)

FWS is responsible for protecting and conserving fishes, wildlife, and critical habitats. FWS provides technical assistance regarding these resources; has an advisory role in coastal development permit processes; and conducts research on man's impact to fish and wildlife resources.

Contact: U.S. Fish and Wildlife Service
75 Spring St, SW, Room 1276
Atlanta, GA 30303

U.S. Fish and Wildlife Service
3530 Pan American Highway NE, Suite D
Albuquerque, NM 87107

National Park Service (NPS)

NPS under DOI may regulate fishing activities within park boundaries. Such regulations may affect fish harvests within specific parks. NPS has authority to manage fisheries primarily through the establishment of coastal and nearshore national parks and national monuments. Everglades National Park in Florida and the Mississippi District of Gulf Islands National Seashore are two examples of areas where oyster populations are managed by NPS.

Contact: Ms. Gail Bishop
National Park Service
Gulf Islands National Seashore
3500 Park Road
Ocean Springs, MS 39564

Agency for Toxic Substances and Disease Registry (ATSDR)

ASTDR's mission is to prevent or mitigate adverse human health effects and diminished quality of life resulting from exposure to hazardous substances in the environment. ASTDR is authorized by the following federal statutes: Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, Superfund), Superfund Amendments and Reauthorization Act of 1986 (SARA), Resource Conservation and Recovery Act Amendments of 1984 (RCRA), Medical Waste Tracking Act of 1988, and Clean Air Act of 1991.

ASTDR conducts Public Health Assessments (PAHs) to evaluate data and information on the release of hazardous substances into the environment; assess any impact on human health, past, present or future; develop health advisories or

other health recommendations; identify actions necessary to evaluate and mitigate or prevent human health effects. PHAs are conducted for all National Priority List (NPL) sites and in response to petitions from individuals or groups.

Health investigations are conducted to increase understanding, through various studies, of the relationship between exposure to hazardous substances and adverse human health effects. ATSDR provides health-related support to state and local agencies, health providers, and emergency event first responders in emergencies involving exposure to hazardous substances. ATSDR is in the initial stages of a study on the toxic effects of a suite of chemicals present in the waters of the Great Lakes. This list includes: PCBs, DDT and its metabolites, dieldrin, toxaphene, mirex, mercury, benso[a]pyrene, hexachorobenzene, furans, dioxins, and lead. It has been demonstrated that there are associations between the consumption of contaminated fish from the Great Lakes and long term adverse health effects in certain populations (especially Native Americans, sport anglers, and the fetuses and nursing infants of mothers). There is convincing evidence that persistent toxic substances affect the survival, growth, and reproduction of some aquatic and wildlife species in the Great Lakes.

ATSDR establishes and maintains a registry of persons exposed to hazardous substances and a registry of serious diseases and illnesses in persons exposed to hazardous substances in the environment. ATSDR summarizes and makes available to the public data on the health effects of hazardous substances, identifies significant gaps in knowledge, and initiates research in toxicology and health effects where needed. Toxicological Profiles are being developed for hazardous substances which are found at NPL sites.

ATSDR makes available to health care providers materials on the health effects of toxic substances. An inventory is maintained of hazardous substances and of sites closed or restricted to the public because of hazardous substances contamination. ATSDR also conducts or sponsors applied research to increase scientific knowledge on the effects on human health of hazardous substances released from waste sites or from other releases into the environment.

Contact: Jeff Kellam
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Mail Stop E - 56
1600 Clifton Road
Atlanta, GA 30333

Interagency Coordination

Federal agencies typically enter into memoranda of understanding and cooperative agreements with each other. During fiscal year 1989, FDA had 27 memoranda of understanding relating to food safety and quality with other federal agencies, primarily USDA, and NMFS had seven cooperative agreements with other federal agencies. Examples of these include:

- Regulatory Activities Concerning Residues of Drugs, Pesticides, and Environmental Contaminants in Food--agreement between FDA, EPA, and USDA's Food Safety and Inspection Service (FSIS) and Agricultural Marketing Service (AMS) that establishes the working relationships for promoting more effective, efficient, and coordinated federal regulatory activities concerning residues of drugs, pesticides, and environmental contaminants that may adulterate food.

- Inspection of Fishery Products--an FDA memorandum of understanding with NMFS that covers fishery products plants that are under NMFS voluntary inspection contracts and also subject to FDA inspection.

- NMFS agreement with USDA to establish NMFS and USDA responsibilities relating to the research and development of standardization documents for fishery products purchased by federal agencies.

- NMFS agreement with FDA concerning the enforcement of laws against illegal commerce in molluscan shellfish. NMFS advises FDA when investigations reveal illegal shellfish harvesting that would endanger public health by harvesting shellfish from polluted waters. Both NMFS and FDA coordinate their activities under the memorandum of understanding with the public health and fisheries agencies of interested and affected states.

Regional Level

Gulf States Marine Fisheries Commission (GSMFC)

GSMFC is an interjurisdictional fisheries management program established by the Gulf States Marine Fisheries Compact under Public Law 81-66, approved May 19, 1949. Its charge is to promote better management and utilization of marine resources in the Gulf of Mexico. One of the most important functions of GSMFC is to serve as a forum for discussion of various problems and needs of marine management authorities, commercial and recreational industries, researchers and others. GSMFC also plays a key role in implementation of the Interjurisdictional Fisheries (IJF) Act.

GSMFC initiated the development of a fishery management plan (FMP) planning and approval process. The Commission decided to pattern its plans after those of the Gulf of Mexico Fishery Management Council under the Magnuson Act of 1976. This decision ensured compatibility in format and approach to management among states, federal agencies and the council. In March 1991, GSMFC released its oyster fishery management plan, *The Oyster Fishery of the Gulf of Mexico, United States: A Regional Management Plan.*

Contact: Mr. Larry B. Simpson
Gulf States Marine Fisheries Commission
P.O. Box 726
Ocean Springs, MS 39564

Interstate Shellfish Sanitation Conference (ISSC)

In 1982, ISSC was established by state regulatory officials (state officials from 22 states including all five Gulf States). Other participants at the conference included FDA, NMFS, DOC, and members of the shellfish industry. The state officials established a constitution, by-laws, and procedures for the operation of ISSC.

The purpose of ISSC is to promote conformity within the National Shellfish Sanitation Program by providing for a formal structure within which regulatory authorities can establish updated guidelines, procedures for the uniform application of those guidelines and for sanitary control of the shellfish industry.

A memorandum of understanding (MOU) between FDA and ISSC was signed in 1984, and established a basis upon which FDA and the states can work cooperatively to foster and improve the sanitary quality of shellfish in the U.S.

Contact: Mr. Ken B. Moore
Interstate Shellfish Sanitation Conference
2600 Bull Street
Columbia, SC 29201

Gulf and South-Atlantic States Shellfish Sanitation Conference

The Gulf and South-Atlantic States sponsor an annual meeting, primarily for state shellfish regulators, to discuss current issues and problems associated with molluscan shellfish. This meeting provides an opportunity for the sharing and exchange of information, as well as a forum for seeking regional solutions to identified problems.

Contact: Mr. Richard Thompson, R.S.
Division of Shellfish Sanitation Control
Texas Department of Health
1100 W. 49th Street
Austin, TX 78765

State Level

To protect human health and aquatic life in its waters, states set standards on the level of protection for each water body within its boundaries. To develop standards, a state first determines a designated use for each water body--as a drinking water supply, a fishery, a source for agricultural irrigation, or for boating, swimming, or ship navigation. Then using EPA's national criteria or other scientific data, a state establishes standards which include limits for each pollutant in the water column, the sediment column, or in fish tissues. States may also establish limits based on the biological diversity of that water body.

State water quality standards form the basis of state programs that control the amount of pollutants entering waters from such sources as industrial plants, wastewater treatment plants, storm sewers, and runoff from rural and urban areas. State water quality standards are maintained by the judicious issuing of permits.

Monitoring for pathogenic microorganisms is currently conducted by state environmental and human health agencies in shellfish harvesting areas and ambient waters. National Pollution Discharge Elimination System (NPDES) pathogen monitoring programs are underway, at selected locations, in order to assess both the condition of water in the vicinity of discharges and surrounding areas and to assess relative pathogen contributions from these permitted effluent discharges.

Each Gulf State has various agencies responsible for the management of fishery resources. Table 3.2 outlines the state fishery management institutions in the Gulf of Mexico, including their responsibilities, administrative policy-making bodies, and legislative involvement in management regulations (please note that in addition to the agencies listed in Table 3.2, there may be others that also exercise authority over fishery resources).

Shellfish sanitation is largely regulated by the individual states in the Gulf of Mexico. Minimum standards are, however, promulgated and recommended to the states for adoption through the cooperative efforts of the states, the federal government, and the industry. Enforcement of regulations is primarily a state function with the possible exception of the use of the Lacey Act and the Food, Drug and Cosmetic Act. State Shellfish Sanitation Control Agencies (SSCA) are the state agency or agencies having legal authority to classify shellfish growing areas and issue permits for the interstate shipment of shellfish in accordance with the provisions of the NSSP Manual of Operations (see Table 3.3). SSCA's conduct inspections and maintain records of those inspections, with such frequency as to ensure that sanitary conditions of operations are maintained.

Table 3.2 State Fishery Management Institutions in the Gulf of Mexico

State	Administrative Body and Its Responsibilities	Administrative Policy-making Body and Decision Rule	Legislative Involvement in Management Regulations
Florida	Department of Natural Resources • administers management programs • enforcement • conducts research • makes recommendations to legislature and Marine Fisheries Commission	Marine Fisheries Commission • creates rules that must be approved by the governor and cabinet • seven-member commission	• can override any rule of the commission • responsible for licensing, management of fishing in man-made canals and limited entry
Alabama	Department of Conservation and Natural Resources • administers management programs • enforcement • conducts research	• Commissioner of department has authority to establish management regulation • Conservation Advisory Board is a thirteen-member board and advises the commissioner • has authority to amend and promulgate regulations	• authority for detailed management regulations delegated to commissioner • statutes concerned primarily with licensing
Mississippi	Department of Wildlife, Fisheries and Parks • administers management programs • enforcement • conducts research	Commission on Wildlife, Fisheries and Parks • five-member board • establishes ordinances on recommendation of deputy director (BMR)	• authority for detailed management regulations delegated to commission • statutes concern licenses and taxes with some specific restrictions on oysters
Louisiana	Department of Wildlife and Fisheries • administers management programs • enforcement • conducts research • makes recommendations to legislature	Wildlife and Fisheries Commission • seven-member board establishes policies and regulations based on majority vote of a quorum (four members constitute a quorum) consistent with statutes	• detailed regulations contained in statutes • authority for detailed management regulations delegated to commission
Texas	Parks and Wildlife Department • administers management programs • enforcement • conducts research • makes recommendations to Texas Parks & Wildlife Commission (TPWC)	Parks and Wildlife Commission • nine-member body establishes regulations based on majority vote of quorum (five members constitute a quorum) • granted authority to regulate taking, possession, purchase and sale of oysters (authority expires September 1, 1991 if not extended by the legislature)	• licensing requirements and penalties are set by legislation

(Source: GSMFC, 1991)

In some states the agency responsible for promulgation of regulations regarding shellfish sanitation and the agency responsible for enforcing such regulations are different. Some sanitation agencies do not have enforcement authority and must work with other agencies. Cooperation and understanding of the separate needs and responsibilities of the agencies involved is necessary in order to implement management regulations in the most enforceable manner.

In addition to classifying waters as to their suitability as shellfish harvesting areas, states also issue beach closures. These closures are typically based on water quality criteria developed by the federal government.

Table 3.3 *State Authorities Responsible for NSSP Evaluation Segments*

State	Administrative Legal Authority	Laboratory	Plant Sanitation	Growing Water Classification	Patrol
Florida	Florida Department of Natural Resources	Division of Marine Resources, Bureau of Marine Resource Regulation and Development, FDNR	Division of Marine Resources, Bureau of Marine Resource Regulation and Development, FDNR	Division of Marine Resources, Bureau of Marine Resource Regulation and Development, FDNR	Florida Marine Patrol, Division of Law Enforcement, FDNR
Alabama	Alabama Department of Public Health	Alabama Department of Public Health	Alabama Department of Public Health	Alabama Department of Public Health	Alabama Department of Conservation and Natural Resources, Division of Marine Resources
Mississippi	Department of Wildlife, Fisheries & Parks; Bureau of Marine Resources	Bureau of Marine Resources, Gulf Coast Research Laboratory	Bureau of Marine Resources	Bureau of Marine Resources	Bureau of Marine Resources
Louisiana	Louisiana Department of Health and Hospitals, Office of Public Health	Louisiana Department of Health and Hospitals, Office of Public Health	Louisiana Department of Health and Hospitals, Office of Public Health	Louisiana Department of Health and Hospitals, Office of Public Health	Louisiana Department of Wildlife and Fisheries
Texas	Fisheries and Wildlife Division - Coastal Branch; Texas Parks and Willife Department	Seabrook Marine Laboratory	Texas Department of Health	Texas Department of Health	Law Enforcement Division, Texas Parks and Wiildlife Department

(Source: GSMFC, 1991)

Highlights of Current State Programs, Standards & Activities

Alabama

Alabama's antidegradation policy hinges on the allowable propagation of fish, shellfish, wildlife, and recreation in and on the water. General conditions applicable to all criteria depend on the quantity and composition of influent sewage, industrial wastes, and other harmful debris. Toxic pollutant levels are determined based on a number of chemical criteria, including the pH levels of cadmium, copper, and lead for freshwater and marine aquatic life. For non-carcinogenic pollutants, a series of equations governing consumable water and fish are provided. These criteria indicate Alabama's move toward a much more comprehensive water quality plan, as they are heavily contingent on the potential impact on aquatic life and human health. The existing criteria are based on fecal coliform and are 100/100 ml in coastal waters and 200/100 ml in other waters. Consideration of the new indicators will likely be addressed in the next triennial review in 1993. Before changes are proposed however, additional information in the form of comparative studies, costs, etc. will be necessary.

The Division of Food and Lodging Protection of the Alabama Department of Public Health has the responsibility of monitoring shellfish for pathogens. The Division also has the authority to seize and destroy shellfish not in compliance. This Division cooperates with the U.S. Food and Drug Administration at Dauphin Island, AL, to monitor the water in shellfish growing areas for fecal coliforms. Monitoring is conducted once a week when the shellfish growing areas are open for harvesting and twice a week when the areas are closed as a result of past bacteriologic testing. The Division of Food and Lodging Protection also has the authority to close shellfish growing areas if warranted by its water monitoring efforts.

The Division of Food and Lodging Protection has, in the past, monitored for biotoxins in shellfish and water twice a month. However, this program has been discontinued due to budget constraints.

Currently, there is no routine monitoring for toxic substances in fish and shellfish. The Division of Food and Lodging Protection assayed for heavy metals in shellfish in 1990, but no additional monitoring is expected.

The Alabama Department of Environmental Management, rather than the Alabama Department of Public Health, monitors for fecal coliforms at their trend monitoring stations for water quality once a month in the coastal and near coastal waters of Alabama. However, the Alabama Department of Public Health has the authority to close down beaches for recreational use because of public health concerns.

The Division of Epidemiology in the Alabama Department of Public Health has the authority to investigate disease outbreaks concerning the consumption of pathogens from contaminated shellfish, the consumption of toxic substances or biotoxins in fish or shellfish, and exposure to pathogens from recreational or occupational use of the waters.

Contact: Dr. Charles Woernle
Director of Epidemiology
Alabama Department of Public Health
434 Monroe St., Room 900
Montgomery, AL 36130-1701

Florida

The Florida Department of Environmental Regulation uses the fecal coliform criterion as its water quality standard for bacteria. The Florida Department of Health and Rehabilitative Services has authority for bathing beach standards and would use the new criteria organisms recommended by EPA, if these are indeed implemented. However, the Department is concerned about the potential implementation of these new standards because Florida's water quality classification has a broader scope than the bathing beach category and other applications must be considered as well. Florida is currently funding a small study to examine the new indicators and is developing a side-by-side data base.

The U.S. Food and Drug Administration, Florida Department of Agriculture and Consumer Services, and Florida Department of Natural Resources have closed oyster harvesting in the Suwannee area due to the presence of salmonella, which has been partially linked to faulty septic tanks. The State has revised public health laws to now require: 1) operating permits for types of septic systems currently used in coastal areas; 2) operating permits for septic systems that may be used by industry to ensure that they are not used for industrial waste waters and; 3) more restrictive siting standards for septic systems along floodways.

Florida's State Health Officer, during 1991, issued fish consumption advisories for mercury in sharks and dioxin in some estuarine fish below pulp mills.

Contact: Dr. Richard Hunter
Florida Department of Health and Rehab. Services
1317 Winewood Blvd.
Tallahassee, FL 32399

Louisiana

Louisiana is currently using the fecal coliform criterion as its water quality standard for bacteria. A large number of water bodies are out of compliance with this standard. Louisiana is reviewing the 1986 EPA criteria for adoption into the state water quality standards.

Louisiana's Department of Health and Hospitals (DHH) is responsible for the development and provision of health and medical services for the citizens of Louisiana and the protection of public health. One duty of DHH is the development of the State Sanitary Code, which among other things regulates discharges of sewage and controls the oyster and shellfishing industries. The State Sanitary Code is administered through the Office of Public Health which addresses issues concerning the general health of the people, including, but not limited to, the preparation and supervision of the sanitary code, local health units, sewerage treatment and disposal, and oyster harvest closures. The Office also performs those public health functions related to environmental quality and pollution control that are specifically assigned to DHH, with the exception of those duties assigned to the Department of Environmental Quality. The Environmental Epidemiology Program in the Office investigates and characterizes risks to human health from known or suspected environmental contaminants in the Gulf and its environs. The Office has jurisdiction over the conduct of studies, surveys, and hearings on sanitary considerations throughout the state. As a result of this research, the Office can make recommendations for improving conditions within Louisiana.

DHH has comment responsibility on Section 404 applications to the U.S. Army Corps of Engineers. When a project is intended for human occupancy, DHH determines whether the site is served or will be served by a public sewerage system or an approved private or industrial system.

DHH administers the "State Food, Drug, and Cosmetic Law" dealing with adulteration, substitution, misbranding, or false advertising. The State of Louisiana Food, Drug, and Cosmetic Regulations cover shellfish depuration, certification requirements for shellfish shippers, and shrimp for freezing. Louisiana has adopted the federal regulations for Tolerances for Pesticides in Food as administered by the EPA.

The Louisiana Department of Environmental Quality (DEQ), through the Office of Water Resources, develops and promulgates the state's surface water quality standards in accordance with the Clean Water Act. In setting water quality standards for Louisiana, DEQ develops water uses and criteria to protect public health, aquatic life, and outstanding resource waters. DEQ also serves as the state's Nonpoint Source Program. Other responsibilities of the Department include permitting of municipal and industrial wastewater dischargers, certification of Section 404 permits, surveillance and assessment of coastal surface waters, and enforcement of all permits, rules, and regulations. DEQ works with DHH in issuing fish advisories

to protect seafood consumers in coastal waters and cooperates with DHH and the Department of Wildlife and Fisheries in assessing bacterial contamination of shellfish grounds.

While the responsibility for protecting public health, safety, community well-being, and enjoyment of that portion of the Gulf of Mexico that is within Louisiana's border is assigned to numerous agencies, the *primary* responsibility for protection of public health rests with the Louisiana Department of Health and Hospitals.

Contact: Mr. Bobby Savoie
Louisiana Department of Health and Hospitals
1201 Capitol Access-East Ent.
Bin 2
Baton Rouge, LA 70802

Mississippi

The Mississippi Department of Environmental Quality (DEQ), Bureau of Pollution Control, is the agency responsible for classifying waters and adopting water quality criteria for the State of Mississippi. By ordinance, the Mississippi Department of Wildlife, Fisheries, and Parks annually classifies marine waters for shellfish harvest according to NSSP guidelines. DEQ is currently conducting a triennial review of water quality criteria, however, adoption of the proposed bacteriological criteria is not currently being considered. Mississippi is interested in adopting a criterion which will more accurately reflect public health risks. However, a review of the data comparing the existing fecal coliform criterion with the new proposed indicators must be completed before taking action.

The Mississippi Department of Wildlife, Fisheries, and Parks, in conjunction or consultation with the Mississippi Departments of Environmental Quality and Health, has issued fish consumption advisories in estuarine areas of the Gulf based on water quality criteria. The Bureau of Marine Resources in the Department of Wildlife, Fisheries, and Parks conducts routine coliform sampling of shellfisheries. Shellfish areas are managed based on an ongoing sampling program using fecal coliforms as an indicator organism and rainfall and/or river stages as predictive models.

Contact: Mr. Bruce Brackin
Mississippi State Department of Health
P.O. Box 1700
Jackson, MS 39215-1700

Texas

Texas water quality standards remain based on fecal coliform bacteria, with a criterion of 200/100 ml for contact recreation (geometric mean) and a criterion of 14/100 ml for oyster waters (applied as a median). Contact recreation criteria are designated for virtually all coastal waters (Houston Ship Channel excepted); and fecal coliform bacteria are sampled at 174 fixed stations in tidal waters. Texas has recently adopted toxics criteria for the protection of human health (1991 standards revision). The next standards revision is scheduled for 1994. The Texas Water Commission establishes water quality standards and regulates pollution sources.

The Texas Department of Health is initiating, on a small scale, a fish contamination program. Although this is largely in the evaluation and assessment stage, there has been action resulting in two closed fisheries and there are five fish consumption advisories in place. The Texas Department of Health also has the authority to close areas to shellfishing.

Contact: Mr. Richard Thompson, R.S.
Division of Shellfish Sanitation Control
Texas Department of Health
1100 W. 49th Street
Austin, TX 78765

IV. THE UNFINISHED AGENDA

Goals

This Public Health Action Agenda for the Gulf of Mexico sets forth a framework for conserving, protecting, and restoring Gulf waters that will minimize public health risks thereby allowing the use and enjoyment of its resources. The Gulf of Mexico Program has established four specific goals for addressing public health concerns:

- Prevent adverse health effects resulting from consumption of raw shellfish harvested from the Gulf of Mexico (1).
- Prevent illness resulting from exposure to marine biotoxins in coastal waters of the Gulf of Mexico (2).
- Reduce long term health risks from exposure to toxic substances in Gulf of Mexico seafood while maintaining the beneficial effects of seafood consumption (3).
- Prevent exposure to pathogens in coastal waters of the Gulf of Mexico (4).

The Gulf of Mexico Program hopes to accomplish these goals primarily by addressing four categories of public health concerns. These categories were developed by the Public Health Subcommittee during the course of its characterization research on public health issues in the Gulf of Mexico. This work, discussed in Chapter II, resulted in the following prioritization of concerns:

- Exposure to pathogens in Gulf waters via consumption of raw molluscan shellfish (1);
- Marine biotoxins and their effect on human health (2);
- Toxic substances in the food chain, the potential for biomagnification and human health effects caused by consumption (3); and
- Exposure to pathogens in Gulf waters from recreational or occupational contact (4).

Strategies, Objectives, and Action Items

Four strategies have been designed to meet the goals: 1) research and demonstration, 2) monitoring/assessment, 3) standards/enforcement, and 4) public outreach. Specific objectives are grouped according to these areas. Objectives are the specific, short-term targets for attaining the goals.

Each objective is followed by action items that describe specific tasks to meet the goals and objectives for public health. Each action item is presented under an appropriate objective and is referenced to the goal or goals to which it most directly contributes. Each action item includes a target date, which is, in the Subcommittee's judgment, the date by which the action could be initiated. Some action items are cross referenced to other action items and are designated with a "➡" sign. This signals a close relationship among those actions and a need for coordination. Some of the activities listed may already be underway; these items will be highlighted and will contain a short "status" update on the progress of the activity in future Action Agendas.

The Public Health Subcommittee has identified a lead agency for each action item--the agency with the most authority or jurisdiction over the particular issue. *This does not necessarily mean that the agency has agreed to carry out the activity or that the agency has the necessary funding. The Public Health Subcommittee understands these action items will require commitments by agencies and organizations that are dependent on budget decisions.* However, the Subcommittee members hope this document provides the rationale and support for such commitments and that future revisions of this document will include additional specific commitments.

The Gulf of Mexico Program recognizes the need to identify indicators of environmental progress relative to this Action Agenda for public health. Many of the action items specified in Chapter IV of this document will aid the Program in developing a baseline for measuring success in the future. For the time being, however, acceptance and completion of action items specified in this Action Agenda will be considered a measure of success. As future Action Agendas are written, and current action items are completed, new action items will be developed to better measure environmental progress. The Gulf of Mexico Program will coordinate among the ten Gulf of Mexico Program Subcommittees to eliminate overlap and duplication of efforts, as well as to integrate goals and activities across environmental issue areas.

Research and Demonstration

To protect human health from the threats posed by the introduction of or naturally-occurring contaminants, more complete knowledge is needed concerning the behavior and effects of such materials. In addition to improving scientific knowledge, research is also integral to developing more accurate, practical, and cost-effective methods and technologies for monitoring and sample analyses. Most research funds are administered by federal agencies or state program offices in support of specific missions, with only limited funding going to research that examines the cumulative effects of decisions on the ecosystem as a whole. This action planning process provides the necessary mechanism to enable the producers, consumers, and funders of research to agree on priorities. A closer connection should be established between the research agenda of the scientific community and the information needs of managers, regulators, and those involved in decisions for the management of the Gulf of Mexico. Once a research agenda is developed and implemented, the research results should be used to understand the underlying processes and relationships and make appropriate decisions regarding management of Gulf waters.

Specific objectives and action items under this strategy include:

OBJECTIVE: Conduct scientific studies designed to contribute new empirical information pertinent to the prevention of illness in those exposed to Gulf waters or from consumption of products harvested from Gulf waters.

ACTION ITEM 1 - Methods for Identification of Indicator Organisms Originating From Human Fecal Sources

Develop and evaluate methods for identification of indicator organisms that originate from human fecal sources.	
Lead Agency	Interstate Shellfish Sanitation Conference and National Oceanic and Atmospheric Administration, in coordination with Food and Drug Administration, Environmental Protection Agency, the academic community, and industry
Target Date	1995
Goal: 1	→ 32

ACTION ITEM 2 - Identification of Sources of Chemical Contaminants and Pathogens

Identify major sources of chemical contaminants and pathogens related to public health concerns from consumption of Gulf seafood and/or contact with Gulf waters.	
Lead Agency	Environmental Protection Agency, in coordination with Gulf States, Toxic Substances and Pesticides Subcommittee, and Public Health Subcommittee
Target Date	1994
Status	The Public Health Subcommittee characterization report is scheduled for completion in May 1993. The Toxic Substances & Pesticides Subcommittee characterization reports are scheduled for completion in 1993.
Goal: 1, 3 & 4	

ACTION ITEM 3 - State Ambient Water Quality Assessment and Monitoring Needs

Describe the existing quality of fresh, marine and estuarine ambient waters of the five Gulf Coast States. The resulting report will include an assessment of the adequacy of the monitoring schemes employed to collect the data. This will be accomplished by conducting a side-by-side analysis of selected marine/estuarine bathing beaches in each of the five Gulf States during 1992. Each state will include in its monitoring plan new assays for enterococci or *E. coli.* to determine the state's abilities to successfully enumerate the new bacteria and to improve monitoring frequency. The Gulf of Mexico Program will serve as the coordinator of the project and assist in evaluation of the results.	
Lead Agency	EPA's Office of Research and Development, in coordination with Gulf Coast States (agencies with responsibility for monitoring ambient microbiological water quality)
Target Date	1993
Goal: 4	→ 14, 15, 25

ACTION ITEM 4 - Atmospheric Deposition Research

Complete research on potential air to water transfers of pollutants by continuing to site atmospheric deposition monitoring stations within the Gulf region and analyze the results.	
Lead Agency	Environmental Protection Agency's Office of Air Quality Planning and Standards (OAQPS)
Target Date	1994
Goal: 3	

OBJECTIVE: Identify and characterize marine biotoxins and progenitors that have not been investigated and continue to develop and improve methods for the detection and management of marine biotoxins.

ACTION ITEM 5 - Discussion Meeting--Coordination of Marine Biotoxins Research

Convene a meeting of appropriate academic, state, and federal organizations to discuss the need for and a mechanism/process to coordinate marine biotoxins research.	
Lead Agency	Gulf of Mexico Program Public Health Subcommittee
Target Date	1993
Goal: 2	→ 6

ACTION ITEM 6 - Coordination of Marine Biotoxins Research

Initiate new coordination mechanisms for marine biotoxins research by contingent upon the results of Action Item 5.	
Lead Agency	Food and Drug Administration, National Marine Fisheries Service, Environmental Protection Agency, and National Institute of Health
Target Date	1995
Goal: 2	→ 5

Monitoring/Assessment

The occurrence, distribution, and types of human illness resulting from consumption of Gulf of Mexico seafoods and direct contact with Gulf of Mexico waters is currently reported on a limited basis. The ability to link water pollution with public health problems and take corrective action is thus hindered. Establishing an adequate baseline is very important for monitoring these conditions and for measuring the success of this action plan. Current information should be used to develop a statistically valid baseline from which to monitor changing conditions in the rates and distribution of public health issues related to the Gulf of Mexico. Future activities and information collection can then be incorporated into the data base. Gulf-wide priorities need to be set and procedures established to improve the inventorying and monitoring of this information among agencies and programs.

Specific objectives and action items under this strategy include:

OBJECTIVE: Determine the extent of human fecal pollution of shellfish growing areas in the Gulf of Mexico.

ACTION ITEM 7 - Survey & Classification of Shellfish Growing Areas

Survey and classify all shellfish growing areas in Gulf Coast States and in federal waters in accordance with the National Shellfish Sanitation Program (NSSP).	
Lead Agency	State Shellfish Control Agencies, in conjunction with Food and Drug Administration
Target Date	1993
Status	The Mississippi Department of Wildlife, Fisheries and Parks is currently accomplishing this. Louisiana is currently accomplishing this through their Oyster Water Monitoring Program.
Goal: 1	**→ 13, 19**

OBJECTIVE: Establish a formal database on the occurrence of seafood-borne disease.

ACTION ITEM 8 - Standard Reporting for Seafood-borne Disease

Establish minimum data sets and standard reporting formats, as well as case definitions, for use by states in reporting the occurrence of seafood-borne disease. CDC should also prepare an annual report on the occurrence of seafood associated diseases for the Gulf region and other regions of the country.	
Lead Agency	Centers for Disease Control
Target Date	1993
Status	While all seafood-borne diseases are considered reportable, there are currently no specific report requirements. Reports are initiated at the county level and then reported to the state. If the disease is shellfish-related, the state then reports to FDA. Individual states have specific report requirements and these requirements vary from state to state.
Goal: 1, 2 & 3	

ACTION ITEM 9 - Regular Reporting of Seafood-borne Diseases

Establish a mechanism for regularly reporting and compiling data on the occurrence of seafood-borne disease. This effort should accommodate and improve upon any existing data.	
Lead Agency	Gulf States
Target Date	1993
Status	This is currently being done by the Louisiana Department of Health and Hospitals Epidemiology Section through data supplied from various sources (hospitals, consumers, parish health units, etc.).
Goal: 1, 2 & 3	

OBJECTIVE: Determine Gulf Coast residents at risk from consumption of potentially contaminated seafood.

ACTION ITEM 10 - Seafood Consumption Patterns Study

Conduct a study of the seafood consumption patterns of residents of the Gulf Coast States. This study should have a region-wide focus, include a determination of the consumption patterns of subsistence and recreational fishermen, other potentially sensitive subpopulations, as well as the general public in the Gulf States, and identify the most common species consumed.	
Lead Agency	National Marine Fisheries Service, in coordination with Environmental Protection Agency
Target Date	1993
Goal: 3	→ 12, 13, 19

ACTION ITEM 11 - Seafood Contamination Data Collection

Collect and summarize all existing data on incidence of seafood contamination by toxic substances, trace metals, and pesticides.	
Lead Agency	Gulf States
Target Date	1993
Status	EPA Region 4 has been surveying the eight southeastern states to determine the status of fish/shellfish tissue contamination data, as well as consumption advisories which have been issued or lifted over the years.
Goal: 3	→ 12

ACTION ITEM 12 - Evaluation of Seafood Contamination and Consumption Information

Evaluate seafood contamination and consumption information to determine any additional data needs.	
Lead Agency	Gulf of Mexico Program Public Health Subcommittee
Target Date	1995
Goal: 3	→ 10, 11, 13, 24

ACTION ITEM 13 - Comprehensive Seafood Contamination Data Monitoring Program

Develop a comprehensive monitoring program to provide seafood contamination data for risk assessment and to track long-term trends in contaminant levels of Gulf waters. A systematic sampling program should be developed for relevant seafood species for the purpose of human health assessments. The program should include many species and locations and should be designed for providing health advisories in specific locations.	
Lead Agency	Food and Drug Administration, in coordination with Gulf State laboratories
Target Date	1993
Goal: 3	→ 7, 10, 12, 13, 16, 19

OBJECTIVE: Survey Gulf Coast bathing beaches for the presence of human fecal wastes and other pathogens (*i.e.*, vibrio).

ACTION ITEM 14 - Survey of Current Practices for Monitoring Bathing Beaches

Conduct a survey of Gulf States to determine current practices and regulations concerning monitoring of coastal bathing beaches for bacterial contamination by human waste. In addition, GMP should evaluate the available data to determine its suitability for judging the bacterial contaminant levels at Gulf Coast bathing beaches.	
Lead Agency	Gulf of Mexico Program Public Health Subcommittee
Target Date	1993
Goal: 4	→ 3, 15, 25

ACTION ITEM 15 - State Bathing Beach Monitoring Plans

Implement ongoing bathing beach monitoring plans (contingent upon results of Action Item 14).	
Lead Agency	Gulf States
Target Date	1995
Goal: 4	→ 3, 14, 25

OBJECTIVE: Assess the public health significance of marine biotoxins in the Gulf of Mexico.

ACTION ITEM 16 - Toxigenic Phytoplankton Monitoring Program for Inshore Waters

Initiate a program to monitor inshore waters for the frequency, duration, and impact of toxic phytoplankton blooms which affect human health (through consumption of seafood and/or contact via aerosols and skin). Phytoplankton should be collected, identified, and analyzed for toxin production. Based on this information, the degree of public health significance should be assessed.	
Lead Agency	Food and Drug Administration, in coordination with Gulf of Mexico Program Public Health Subcommittee and National Marine Fisheries Service
Target Date	1994
Goal: 2	**→ 13, 17, 19**

ACTION ITEM 17 - Monitoring Program for Marine Biotoxin Residues in Shellfish and Finfish

Monitor shellfish and finfish, concurrently with Action Item 16, from inshore waters for the origin of marine biotoxin residues present in the Gulf of Mexico. Based on this information, the degree of public health significance should be assessed.	
Lead Agency	Food and Drug Administration, in coordination with Gulf of Mexico Program Public Health Subcommittee and National Marine Fisheries Service
Target Date	1994
Goal: 2	**→ 13, 16**

OBJECTIVE: Implement remote-sensing technologies for the detection of phytoplankton blooms/red-tides in the early stages of development.

ACTION ITEM 18 - Remote-Sensing Technologies for the Detection of Phytoplankton Blooms/Red-Tides

Determine the current capabilities for remote-sensing technologies for the detection of phytoplankton blooms/red-tides in the early stages of development and distribute this information to responsible/interested parties.	
Lead Agency	National Marine Fisheries Service, in coordination with Gulf of Mexico Program Public Health Subcommittee
Target Date	1993
Goal: 2	

Standards/Enforcement

The effective prevention of human illness resulting from consumption of Gulf seafood or direct contact with Gulf of Mexico waters will require cooperation from many federal, state, and local governments, and private and public user groups, as well as a long-term commitment of financial and organizational resources.

The setting of standards is an essential component of pollution prevention. Standards determine enforceable limits and provide a measure for improving environmental quality. The development of compatible standards among federal agencies and Gulf Coast States is crucial in order to reduce public health concerns in the Gulf of Mexico.

Laws designed to prevent and reduce public health concerns are difficult to enforce. Inadequate enforcement usually results from competing priorities among programs, inadequate funding, or lack of expertise in developing needed ordinances or programs.

Specific objectives and action items under this strategy include:

OBJECTIVE: Reduce the level of human fecal wastes in the coastal waters of the Gulf of Mexico.

ACTION ITEM 19 - Reopening of Gulf Coast Areas Currently Closed Due to Poor Water Quality

Based on the findings of related Action Items 7, 13, and 16, reopen areas along the Gulf Coast that are currently closed due to poor water quality. Shellfish beds and bathing beaches should be targeted specifically, thus reducing the likelihood of illness.	
Lead Agency	Gulf States
Target Date	1996
Status	The Mississippi Department of Wildlife, Fisheries and Parks is currently accomplishing this.
Goal: 1 & 4	→ 7, 13, 16, 30, 31

ACTION ITEM 20 - "No Discharge" Areas in State Waters

Adopt "no discharge" areas for all wastes from boats in state waters.	
Lead Agency	Gulf States
Target Date	1995
Goal: 1 & 4	→ 4 1

OBJECTIVE: Establish a Gulf Coast Fish Contaminants Group (GCFCG).

ACTION ITEM 21 - Gulf Coast Fish Contaminants Group

Facilitate the formation of a Gulf Coast Fish Contaminants Group (GCFCG) to develop consistent interagency policies and procedures relative to seafood contamination and public health, to conduct workshops, and to review state applications of developed guidelines.	
Lead Agency	Gulf of Mexico Program Public Health Subcommittee
Target Date	1993
Goal: 1 & 3	

ACTION ITEM 22 - Consistent Interagency Policies and Procedures Relative to Seafood Contamination and Public Health

Encourage EPA and FDA to develop consistent policies and procedures relative to seafood contamination and public health and update action levels for all pollutants of concern that are found in fish and shellfish in the Gulf of Mexico.	
Lead Agency	Gulf Coast Fish Contaminants Group
Target Date	1993
Goal: 1 & 3	

ACTION ITEM 23 - GCFCG Workshops

Conduct workshops to develop sampling and laboratory protocols, procedures for public health risk assessment and risk management, and consumption advisory procedures.	
Lead Agency	Gulf Coast Fish Contaminants Group, in coordination with Gulf State laboratories
Target Date	1994
Goal: 1 & 3	

OBJECTIVE: Encourage states to adopt compatible policies for management of public health hazards.

ACTION ITEM 24 - Review of State Applications of Developed Guidelines

Review state application of developed guidelines to determine whether Gulf States have adopted compatible polices for management of public health hazards related to consumption of seafoods.	
Lead Agency	Gulf Coast Fish Contaminants Group
Target Date	1995
Goal: 1 & 3	→ 1 2

ACTION ITEM 25 - State Review, Evaluation & Adoption of New Bacteriological Criteria for Recreational Waters

Review and evaluate EPA's newly recommended bacteriological criteria for protection of Gulf bathing beaches and other recreational waters. Each Gulf State should then initiate appropriate administrative procedures to adopt and implement new recreational criteria as state standards. To the extent practicable, Gulf States should work among themselves to adopt compatible bacteriological standards with regard to bathing beaches and recreational waters that are adjacent or common to bordering states.	
Lead Agency	Gulf States
Target Date	1994
Goal: 4	→ 3, 14, 15

ACTION ITEM 26 - State Ballast Exchange Guidelines

Adopt ballast exchange guidelines, patterned after the International Maritime Organization guidelines in effect for the Great Lakes area, to prevent the discharge of contaminated ballast from ships in critical productive estuaries. This action should be supported by a sampling program because of the recent detection of cholera in Mobile Bay.	
Lead Agency	Gulf States, in coordination with Environmental Protection Agency and U.S. Coast Guard
Target Date	1995
Goal: 1 & 4	

ACTION ITEM 27 - Minimum Criteria for Septic Systems in Critical Areas

Develop minimum criteria for septic systems in critical areas (such as estuarine watersheds). To accomplish this, a working group consisting of septic system regulators from the Gulf Coast States should be convened. Examples of criteria which may be developed include: 1) operating permit requirements, 2) mandatory use of aerobic systems in new installations, and 3) prohibition of new systems within flood-prone areas.	
Lead Agency	Gulf State regulatory agencies
Target Date	1993
Status	A meeting has been tentatively scheduled for February 1993.
Goal: 1 & 4	**→ 28**

ACTION ITEM 28 - Adoption & Implementation of State Standards for Septic Systems

Initiate adoption and implementation of recommended criteria for septic systems as state standards through the appropriate process in each state by 1994. The Gulf of Mexico Public Health Subcommittee will transmit recommended criteria to the governor and appropriate state agencies of each Gulf Coast State by 1993 with the recommendation that they be adopted as state standards.	
Lead Agency	Gulf States
Target Date	1994
Goal: 1 & 4	**→ 27**

ACTION ITEM 29 - Alternatives to Septic Tank Systems

Explore opportunities for alternatives to septic tank systems in low lying coastal areas. The potential for requiring alternative systems, such as composting and incinerator toilets, for new development in coastal areas should be investigated.	
Lead Agency	Gulf States
Target Date	1994
Goal: 1 & 4	

ACTION ITEM 30 - Microbiological & Chemical Standards for POTW Permits in Shellfish Areas

Incorporate microbiological and chemical standards into the NPDES and/or state permits of POTWs discharging in the vicinity of shellfish growing areas. These standards should be sufficiently stringent to prevent negative effects except in extreme rainfall conditions.	
Lead Agency	Environmental Protection Agency or delegated Gulf States
Target Date	1995
Goal: 1	→ 19, 31

ACTION ITEM 31 - Limits on Microorganisms in NPDES Permits for POTWs Near Bathing Beaches

Modify NPDES permits for POTWs in coastal areas to include limits on microorganisms that will allow bathing beach ambient water quality standards to be achieved.	
Lead Agency	Environmental Protection Agency or delegated Gulf States
Target Date	1994
Goal: 4	→ 19, 30

ACTION ITEM 32 - State Adoption of New Indicators of Fecal Pollution

Adopt new indicators of fecal pollution developed by the National Indicator Study during 1995 as the standard for shellfish growing waters.	
Lead Agency	Food and Drug Administration, Gulf States, and Interstate Shellfish Sanitation Conference
Target Date	1996
Goal: 1	→ 1

OBJECTIVE: Standardize methods for marine biotoxin recovery and analysis from phytoplankton producers and seafood vectors.

ACTION ITEM 33 - Marine Biotoxin Recovery & Analysis Manual

Assemble all pertinent information regarding marine biotoxin recovery and analysis from phytoplankton producers and seafood vectors into a manual format which should be reviewed/edited by appropriate marine biotoxin specialists.	
Lead Agency	Food and Drug Administration
Target Date	1993
Goal: 2	

ACTION ITEM 34 - Distribution of Marine Biotoxin Manual

Disseminate the marine biotoxin manual to Gulf Coast laboratories (academic, state, and federal) and encourage their compliance with the methods when engaged in marine biotoxin investigations. Further, GMP, FDA, and NMFS should solicit their participation in a Gulf-wide monitoring and assessment program.	
Lead Agency	Food and Drug Administration, in coordination with Gulf of Mexico Program Public Health Subcommittee and National Marine Fisheries Service
Target Date	1993
Goal: 2	

ACTION ITEM 35 - Update/Adoption of Marine Biotoxin Action Levels

Update or adopt action levels for all known marine biotoxins.	
Lead Agency	Food and Drug Administration and National Marine Fisheries Service
Target Date	1993
Goal: 2	

OBJECTIVE: Organize a Gulf-wide marine biotoxins management and consulting group.

ACTION ITEM 36 - Investigations for Biotoxin Outbreaks

Solicit participation of a limited number of marine biotoxin specialists from academic, state, and federal organizations to provide assistance in the management and conduct of marine biotoxins investigations when outbreaks occur and to develop a manual that discusses ways to deal with outbreaks and marine biotoxin investigations.	
Lead Agency	Food and Drug Administration, in coordination with Centers for Disease Control and National Marine Fisheries Service
Target Date	1993
Goal: 2	→ 44

Public Outreach: Education and Involvement

People living in two-thirds of the United states ultimately affect the environmental quality of the Gulf of Mexico. Alternatively, the entire population of the U.S. can potentially be affected by the environmental quality of the Gulf either from products harvested from the Gulf of Mexico or from contact with Gulf waters. Therefore, effective public health policy requires an ongoing commitment from an informed citizenry. Public outreach nurtures such a commitment. Public information, education, and involvement are three components of an effective outreach strategy, which can reap significant benefits both for the Gulf of Mexico and for citizens utilizing its resources. More and more, public outreach is recognized as an effective resource management tool to address problems resulting from individual actions and to create a sense of stewardship within the community. A committed citizenry presents both a supplement and an alternative to enforcement programs.

Public outreach can foster recognition of the Gulf as a regional and national resource; stimulate civic, governmental, and private sector support for changing lifestyles; and develop the financial commitments necessary to preserve the resource. Because the general public can play an important role in the policy making process, an essential aspect of an effective outreach program is education about the sources and causes of contamination of the Gulf of Mexico. Also, an extensive public education and awareness program can reduce the incidence of illness resulting from exposure to Gulf waters or products harvested from the Gulf of Mexico. A strong outreach program showing the effects human activities have upon the health of the Gulf must enable all individuals, whether living on the coast or along the upper stretches of the Mississippi, to see themselves as caretakers of a vital, shared resource.

Specific objectives and action items under this strategy include:

OBJECTIVE: Undertake an educational campaign to: 1) help the public understand and control or minimize potential risks associated with the consumption of raw molluscan shellfish; 2) help health care professionals understand the potential risks associated with the consumption of raw molluscan shellfish, especially for high risk patients, and to transmit information to those patients; and encourage the reporting of shellfish-associated illness; 3) help legislative and judicial members understand the seriousness of violations of shellfishing regulations related to public health; and 4) inform enforcement officials about public health aspects of shellfishing regulations.

ACTION ITEM 37 - Educational Materials on Risks Associated with Consumption of Raw Molluscan Shellfish

Ensure the development of appropriate educational materials about the risks associated with consumption of raw molluscan shellfish, and how to avoid, control or minimize those risks. A specific educational package should be developed for each of the following groups: 1) the public (especially high risk individuals), 2) the medical community, 3) judicial and legislative members, and 4) enforcement officials. Where appropriate, materials should be printed in Vietnamese, French, and Spanish, in addition to English. To accomplish this, GMP should evaluate and integrate current efforts by groups such as FDA, ISSC, NFI, FMI, Sea Grant Universities, state health departments, and the Southeastern Fisheries Association (SFA).	
Lead Agency	Gulf of Mexico Program Public Health Subcommittee, in coordination with the Public Education and Outreach Subcommittee and Citizens Advisory Committee
Target Date	1993
Goal: 1	

OBJECTIVE: Help the public understand both the nutritional/health benefits and the potential risks from consumption of seafood, other than raw molluscan shellfish, as well as how to maximize those benefits while avoiding, controlling, or minimizing the risks.

ACTION ITEM 38 - Educational Effort/Materials on Benefits & Risks From Consumption of Seafoods

Evaluate and integrate current educational efforts to develop Gulf of Mexico Program materials to inform the public of both the nutritional/health benefits and the potential risks from consumption of seafood, other than raw molluscan shellfish, as well as how to maximize those benefits while avoiding, controlling, or minimizing the potential risks.	
Lead Agency	Gulf of Mexico Program Public Health Subcommittee, in coordination with the Public Education and Outreach Subcommittee and Citizens Advisory Committee
Target Date	1993
Goal: 3	

ACTION ITEM 39 - Recreational & Subsistence Fishing Guide

Develop a guide for recreational and subsistence fishermen to: 1) identify popular Gulf of Mexico fishing sites, and 2) provide consumption advice on different fish species at specific locations.	
Lead Agency	National Oceanic and Atmospheric Administration, Sea Grant, and Gulf Coast Fish Contaminants Group
Target Date	1994
Status	Currently, NOAA Status & Trends conducts limited testing of oysters and EMAP tests for selected trace metals and organic compounds in specific fish species in the Gulf of Mexico.
Goal: 1 & 3	

ACTION ITEM 40 - Assessment of Signs & Warnings in Limiting Consumption of Contaminated Sports Fish Species

Integrate ongoing efforts to assess the effectiveness of signs and warnings in limiting consumption of contaminated sports fish species by recreational and subsistence fishermen in the Gulf.	
Lead Agency	Gulf of Mexico Program Public Health Subcommittee
Target Date	1993
Goal: 3	

ACTION ITEM 41 - Educational Program on Impacts of Boat Discharges on Seafood

Develop a program, in coordination with the Boater's Pledge Program, to educate the boater community about the potential impacts of discharges from boats on seafood. As part of this program, information concerning the potentially harmful effects of boat discharges on seafood should be included in existing boating safety and training programs.	
Lead Agency	U.S. Coast Guard, in coordination with Gulf of Mexico Marine Debris Subcommittee
Target Date	1993
Status	USCG will publish information on the impacts of boating discharges and distribute it to all Coast Guard Auxiliary Squadrons on the Gulf Coast. This information will also be made available to the boating community through the outreach efforts of the Auxiliary and the Fishing Vessel Safety Program.
Goal: 1 & 3	→ 20

OBJECTIVE: Help the public, especially high risk populations, understand the risks associated with recreational and occupational exposure to naturally occurring pathogens (*i.e.*: vibrio) in marine waters.

ACTION ITEM 42 - Marine Water Contact Advisories Related to Recreational & Occupational Exposure

Develop a standardized public information message for marine water contact advisories related to recreational and occupational exposure. Health care professionals and especially high risk populations should be targeted for this advisory message.	
Lead Agency	Gulf of Mexico Program Public Health Subcommittee, in coordination with Public Education and Outreach Subcommittee
Target Date	1993
Goal: 4	

ACTION ITEM 43 - Educational Materials for Physicians

Develop educational materials to increase the awareness of physicians about the importance of reporting illnesses and infections resulting from recreational and occupational contact with marine waters.	
Lead Agency	Gulf of Mexico Program Public Health Subcommittee
Target Date	1993
Goal: 4	

OBJECTIVE: Help the public understand the risks associated with consumption of seafood contaminated with marine biotoxins and the risks associated with direct exposure to marine biotoxins.

ACTION ITEM 44 - Public Information Releases on the Effect of Marine Biotoxins on Public Health

Solicit advice from appropriate state and federal organizations, the public, and the academic community concerning the form and content of public information releases on the effect of marine biotoxins on public health. Based on these findings, appropriate public education materials should be developed.	
Lead Agency	Gulf of Mexico Program Public Health Subcommittee, in coordination with the Public Education and Outreach Subcommittee and Citizens Advisory Committee
Target Date	1993
Goal: 2	→ 3 6

V. CONCLUSION

We intend this document to be a beginning, not an end. Our hope is that this Action Agenda will serve as an inspiration and a call to action for the thousands who live and work in the Gulf of Mexico region. Through purposeful and coordinated action we hope to eliminate public health threats from contaminated seafood and bathing beaches within Gulf of Mexico waters.

Through the implementation of the action items highlighted in this Action Agenda, we *can* control and eventually eliminate public health threats in the Gulf of Mexico.

The Gulf of Mexico Program
Public Health Subcommittee

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ACRONYM GUIDE

AGI	Acute Gastroenteritis
AMS	Agricultural Marketing Service, USDA
APHIS	Animal and Plant Health Inspection Services
ASP	Amnesic Shellfish Poisoning
CAC	Citizens Advisory Committee, Gulf of Mexico Program
CDC	Centers for Disease Control
COE	Corps of Engineers, Army
CWA	Clean Water Act
DHH	Department of Health and Hospitals (Louisiana)
DOD	Department of Defense
DOE	Department of Energy
DSP	Diarrheic Shellfish Poisoning
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
FDA	Food and Drug Administration
FFDCA	Federal Food, Drug, and Cosmetic Act
FMI	Food Marketing Institute
FMP	Fishery Management Plan
FSIS	Food Safety and Inspection Service
FWS	U.S. Fish and Wildlife Service
GCFCG	Gulf Coast Fish Contaminants Group
GMP	Gulf of Mexico Program
GSMFC	Gulf State Marine Fisheries Commission
HACCP	Hazard Analysis Critical Control Point
IJF	Interjurisdictional Fisheries Act of 1986
ISSC	Interstate Shellfish Sanitation Conference
MARPOL	International Convention for the Prevention of Pollution from Ships
MMS	U.S. Minerals Management Service
MOU	Memorandum of Understanding
MPRSA	Marine Protection, Research and Sanctuaries Act
MSD	Marine Sanitation Device
NASA	National Aeronautics and Space Administration
NFI	National Fisheries Institute
NIH	National Institute of Health
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NSP	Neurotoxic Shellfish Poisoning
NSSP	National Shellfish Sanitation Program
NS&T	National Status & Trends, NOAA
OAD	Oceans Assessment Division, NOAA
OSDS	On-site Sewage Disposal Systems

PHS	Public Health Service
POTW	Publicly-Owned Treatment Works
PRB	Policy Review Board, Gulf of Mexico Program
PSP	Paralytic Shellfish Poisoning
SCS	Soil Conservation Service
TSC	Technical Steering Committee, Gulf of Mexico Program
TFP	Tetraodon Fish Poisoning
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
USPHS	U.S. Public Health Service

GLOSSARY

action levels

Levels set to provide regulatory guidance to FDA field personnel to determine whether or not a product should be deemed adulterated and an appropriate enforcement action imposed.

amnesic shellfish poisoning (ASP)

Syndrome caused by domoic acid. Severe disease that has only been identified in Canada during November and December 1988; this series of outbreaks involved 103 people. The toxin is present in some varieties of the diatom *Nitzschia pungens* and accumulates in mussels and clams during periods of blooms. Symptoms include: vomiting, abdominal cramps, diarrhea, disorientation, and memory loss. Short term memory loss was the most persistent symptom and lasted over a year in several cases. The disease is particularly severe among older people, some of whom died in the Canadian outbreak. *Nitzschia pungens* and *N. pseudodelicatissima* reportedly occur in northern U.S. and Canadian waters, and there is a potential for development of toxicity in shellfish growing in these areas. States in the northeastern U.S. are now testing for domoic acid.

bacteria

A group of procaryotic single-celled microorganisms. Most bacteria naturally live in, or can survive in, aquatic environments. Most marine bacteria associated with seafood are not harmful to man. However, some vibrio species are pathogenic and specific subpopulations, such as immuno-compromised persons, are more susceptible. The primary pathway is consumption of raw or partially cooked molluscan shellfish.

bioaccumulation

The process of compounded concentration of substances in species whereby a substance enters an aquatic organism, either directly from the water through gills or epithelial tissue, or indirectly through consumption of other organisms.

biomagnification

The process of compounded concentration of substances resulting from bioaccumulation whereby tissue concentrations of bioaccumulated substances increase as the material is passed up through more than one trophic level in the food chain.

chemically contaminated

Presence of significant levels of undesirable (usually toxic) chemicals derived from the natural environment or from anthropogenic sources. Deep sea species are not generally susceptible, with the exceptions of mercury in swordfish, halibut, and some minor use species such as sharks. Fresh water species, especially non-migratory bottom feeders, are generally the most exposed. Chemical contaminants include industrial chemicals, heavy metals (some from natural sources), and pesticides. Some chemicals, at sufficiently high concentrations and if ingested for a long period of time, may be toxic to a variety of human organ systems. Some chemicals are suspected of causing cancer. Strict limits are set for these, and for most chemicals, there is a level below which there is no cause for concern.

ciguatera

A natural toxin originating from microorganisms that can accumulate in predatory reef fish in subtropical to tropical waters. Primarily associated with sport and subsistence fishing in tropical areas. Problem species include grouper, snapper, barracuda, Spanish mackerel, and hog fish.

Crustacea

A class of chiefly aquatic arthropods with segmented bodies and paired jointed limbs, including lobsters and crabs.

depuration

Removal of biotoxins and pathogens from shellfish. Depuration is a potential management consideration that could increase shellfish production through a cleansing process. Depuration may also be a form of processing. By placing shellfish in depuration systems, they are being stored alive; thus the highest quality is maintained. Since depuration reduces bacterial content, there is potentially a greater assurance of product wholesomeness and consumer acceptance. Consequently, depurated shellfish may command higher prices and be in greater demand.

diarrheic shellfish poisoning (DSP) A toxin first isolated from mussels and scallops in 1976 in Japan. The toxin is fat-soluble and was extracted from the hepatopancreas of shellfish. Epidemiological data indicate that 12 mouse units (mu) will induce a mild form of poisoning in humans. The dominant symptoms are diarrhea, nausea, vomiting, and abdominal pain occurring within 30 minutes to a few hours after ingestion. The agent responsible for the production of this toxin is a marine dinoflagellate, *Dinophysis fortii*. Other *Dinophysis* species, as well as certain *Prorocentrum* species, have been implicated as DSP producers.

domoic acid A marine toxin produced by certain species of the diatom genus *Nitzschia*. This toxin is responsible for human Amnesic Shellfish Poisoning.

E. coli A species of bacteria frequently found in the intestinal tract of warm blooded animals and whose presence indicates a degree of fecal contamination.

enterococci A group of bacteria whose presence indicates a degree of fecal contamination.

enzyme immunoassay A method for detecting foreign substances which employs the natural affinity and sensitivity of isolated antibodies generated against the foreign substance of interest.

epiphytic dinoflagellates Dinoflagellates whose life cycle involves close association or attachment to the surfaces of larger macrophytic algae (*e.g.*, seaweeds).

fecal coliform A group of bacteria whose presence indicates a degree of fecal contamination.

hazard An organism, substance, or condition having the potential to cause disease.

hazardous seafood Fish or shellfish, the consumption of which can lead to disease.

Hepatitis A An acute infectious disease that ranges from subclinical infection to sever jaundice, liver degeneration, and death. Onset ranges from 15 to 50 days after exposure. Convalescence may be prolonged (several weeks to months).

marine biotoxins Poisonous compounds accumulated by shellfish feeding upon toxic microorganisms. The poisons may come from dinoflagellates such as *Alexandrium spp.* (formerly *Protogonyaulax* and *Gonyaulax catenella* and *G. amarensis*) and *Ptychodiscus brevis* (formerly *Gymnodinium breve*).

marine dinoflagellates A group of microscopic algae which share common morphological characteristics.

minamata disease (mercury poisoning) Chronic intoxication from organic mercury begins with paresthesia in extremities and leads to total nervous system involvement. The disease was named for Minamata Bay, Japan, where the disease as found in abundance.

molluscan shellfish Marine bivalve invertebrates belonging to the phylum Mollusca, especially oysters, clams, mussels, and scallops.

neurotoxic Substances which are detrimental to nerve cells.

Neurotoxic Shellfish Poisoning (NSP) Symptoms of this poisoning are numbness and tingling around the mouth and face progressing to involvement of the hands and feet and sometimes accompanied by difficulty in walking. Deaths from this type of poisoning have not been reported. The causative agent is *Gymnodinium breve*, a marine dinoflagellate.

Norwalk & Norwalk-like agents Unclassified viruses. Outbreaks of viral gastroenteritis due to Norwalk agents have been associated with swimming in waters contaminated with human sewage, eating food or drinking water that is fecally contaminated, and consuming uncooked or partially cooked shellfish harvested from estuaries contaminated with human fecal material.

order of magnitude One order of magnitude is ten-fold; two orders of magnitude is 100-fold, etc.

Paralytic Shellfish Poisoning (PSP) This shellfish-associated neurotoxin causes paralysis that may progress from numbness and slight tingling around the lips, mouth, and face to death by respiratory failure. There is no known antidote and the only therapy is supportive, artificial respiration. The toxin-producing agents are marine dinoflagellates of the *Gonyaulax* genus.

pathogen An agent, especially a microorganism, such as a bacterium or virus, that causes disease.

point source Any discernible confined and discrete conveyance that carries pollution, including but not limited to a pipe, ditch, channel, tunnel, or conduit.

Pyrrhophyta The scientifically correct name for the division of dinoflagellates.

red tide A massive proliferation of microscopic marine algae such that vast expanses of the ocean are discolored by their presence. This dinoflagellate "bloom" can affect shellfish and some finfish. The primary problem species are molluscan shellfish (oysters, clams, mussels, and scallops).

risk Probability that a person will become ill from a hazard.

safety Probability that harm will not occur under specified conditions.

scromboid poisoning This poisoning is caused by a histamine produced by bacteria multiplying on fish that are mishandled after capture. The disease is generally mild and self-resolving, and symptoms can be ameliorated by antihistamine drugs. It is widely distributed geographically, but specifically associated with consumption of specific species: tuna, mackerel, mahi mahi (game dolphin), and bluefish. The disease can be prevented by rapidly cooling fish after capture and maintaining cooling at all times before cooking and eating.

shellfish All edible species of oysters, clams, mussels, crabs, shrimp, whelks, conch, and scallops, either shucked, in the shell, fresh or fresh-frozen, whole or in part.

shigelloides *P. shigelloides* is a common environmental isolate, which is widespread in nature and is implicated as a cause of human gastroenteritis. It is specifically associated with consumption of raw oysters. Should be considered in any program to limit exposure to bacterial pathogens in shellfish, but there is a need to establish its pathogenicity for humans before initiating any specific control measures.

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