

AN OVERVIEW OF THE GULF OF MEXICO PROGRAM INITIATIVES IN RELATION TO SEAFOOD

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Gulf of Mexico Program Background

In the summer of 1984, the U. S. Environmental Protection Agency (EPA) held a public meeting in Brownsville, Texas on the subject of incineration of toxic waste at sea. The large turnout of concerned citizens made it clear that the public was interested in the well-being of the Gulf of Mexico. The response of these citizens, coupled with indications of environmental degradation in the Gulf, prompted the EPA, Region 4, to propose a Gulf-wide strategy termed "the Gulf Initiative." The intent of this initiative was to identify Gulf-wide problems and set goals and research needs while developing a strategy to respond to those problems. During an initial Gulf Initiative Workshop held in Gulf Shores, Alabama in August of 1986, 59 persons, representing a broad spectrum of organizations concerned with marine pollution, identified critical issues and activities causing problems in the Gulf, made recommendations for a program management structure, and provided a strong consensus that such a program was needed.

In August of 1988, the Gulf of Mexico Program was established as an intergovernmental program at Stennis Space Center, Mississippi under the sponsorship of the EPA.

On December 10, 1992, eleven federal agencies, the governors of all five Gulf Coastal states and the Citizens Advisory Committee (CAC) chairman, signed an agreement for cooperation to build the support and obtain the resources necessary to meet nine environmental challenges within five years and to attain the long-term goal of protecting the Gulf of Mexico. Those federal agencies included the EPA; Soil Conservation Service (SCS); National Oceanic and Atmospheric Administration (NOAA); Fish and Wildlife Service (FWS); National Park Service (NPS); Food and Drug Administration (FDA); National Aeronautical and Space Administration (NASA); U.S. Army; Department of the Navy; U.S. Air

Force. and the U.S. Coast Guard. This symposium signatory document was termed "A Partnership for Action."

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 well-being of the region.

Program Purpose

The main purpose of the Program is to develop and implement an agenda for protecting, restoring, and maintaining the health and productivity of the Gulf and ensure that the waters and products of the Gulf are safe for use. Such a strategy should achieve a balance between the impacts and demands of human-related activities and the preservation and enhancement of the marine resources of the Gulf.

Program Framework and Implementation

By building on, enhancing, and coordinating existing programs and missions the Gulf of Mexico Program serves as a catalyst for change. As stated in the first Five-Year Strategy the framework for action provides

- * 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, resulting 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.

Implementation is directed through a Policy Review Board (PRB), a Citizen's Advisory Committee (CAC), and a Management Committee with guidance from a Technical Advisory Committee (TAC).

The PRB consists of 22 senior level representatives of state and federal agencies. **The PRB is now assisted** by a smaller 12 person MC in guiding and reviewing activities of the Program. **The MC** assists the PRB in carrying out its mission. The PRB is still

the final approval body for the Program.

The CAC is made up of five citizens, one from each Gulf coast state, appointed by the state governor. They represent environment, agriculture, business/industry, development/tourism, and fisheries. The CAC provides public input and assistance in disseminating information relevant to the goals and results of the program. The chairman of the CAC also sits on the PRB and MC. Also sitting on the MC is the CAC co-chair.

With approximately 65 members, the TAC is made up of representatives of state and federal agencies, academia, and private and public sectors, appointed by governors or by the PRB. The TAC provides technical support to the PRB and directs and receives input from the ten issue committees.

The ten issue committees listed below have representation similar to that of the TAC, but do not require governor or PRB appointment. The issue committees are those entities that develop the action items and projects that address the goals and challenges assigned to the program. Eight of those committees address specific Gulf issues. The other two (*) are not issue-specific but are of importance to all other committees as well as the Program in general.

1. Habitat Degradation
2. Public Health
3. Nutrient Enrichment
4. Coastal and Shoreline Erosion
5. Marine Debris
6. Toxic Substances and Pesticides
7. Freshwater Inflow
8. Living Aquatic Resources
- * Public Education and Outreach
- * Data and Information Transfer

Projects are implemented through the Program office, the committees, or the agencies and organizations involved with the program. The primary tools for identification of environmental problems and implementation of projects to remediate the associated adverse impacts are the committee action agendas.

Symposium Signatory Document

Endorsed by the five Gulf states as well as by key federal agencies, this document increases the level of awareness and commitment from these groups to the issues that threaten the Gulf of Mexico. As the document itself states, it helps to harmonize the diverse interests focused on the Gulf. Entitled "A Partnership For Action," this agreement lays out nine five-year environmental challenges, which will be a major driving force for program activities for the next five years. It is a landmark document

for the program, showing that state and federal agencies can work together as a team and agree upon a common set of challenges aimed at improving the environmental status of the Gulf. It also underscores the commitment of these agencies to continue to work as a team to meet these challenges. The nine challenges are as follows:

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

A tenth challenge was added following the signing which was: Reduce critical Coastal and shoreline erosion.

The first five-year strategy set out two goals. The first is to establish an effective infrastructure for resolving complex environmental problems associated with human use of the Gulf of Mexico, and the second is to establish a framework-for-action for implementing management options for pollution controls, remedial and restoration measures for environmental losses, and for research direction and research direction and environmental monitoring protocol. The second five year strategy set out the environmental goals resulting in the development of what is termed second generation action agenda,

Action Agendas

Each subcommittee has produced an action agenda delineating action items that must be taken to address the challenges and goals. There are three primary purposes for each of the issue specific action agendas: (1) reflect the public input with regard to addressing the issue; (2) communicate what activities are planned or that need to be

planned for corrective action, and (3) provide baseline information from which success can be measured and refined. Each issue specific action agenda sets forth a structured set of strategies, objectives, and action items to achieve these purposes. Their current status is provided as follows:

- | | |
|---|----------------------|
| 1. Marine Debris; completed, one year status | report now available |
| 2. Public Health; finalized in 1993 and currently | in print |
| 3. Habitat degradation; final working draft | |
| 4. Coastal and Shoreline Erosion; final working | draft |
| 5. Nutrient Enrichment; under committee review | |
| 6. Toxic Substances and Pesticides; under | committee review |
| 7. Freshwater Inflow; first draft submitted to | committee |
| 8. Living Aquatic Resources; under committee | review |

International Activities

The Program participates in the cooperative effort between EPA and Mexican Federal agencies in the development of the U.S./Mexico border operating plan and provides technical assistance for several United Nations Caribbean Environmental Program (CEPPOL) activities as they address the complex problems of land based sources of pollution and water quality in the Caribbean region. Ongoing efforts to complete Gulf of Mexico Special Area Designation will prevent the dumping of garbage from ships under an international treaty for the "Prevention of Pollution From Ships" (MARPOL Annex V). Collaboration and information exchange has been established with EPOMEX (the Gulf of Mexico Ecology, Fisheries, and Oceanography Program), a Mexican program that supports and coordinates regional research of the marine environment. EPOMEX is geared towards the optimum exploitation and preservation of the marine environment.

Program Inertia

Gulf Coast problems are often very complex and thus solutions are not straightforward. With over 1600 miles of linear coastline and 17,000 miles of tidal shoreline, the Gulf Coast is an immense geographical region. The variability of both the natural and anthropogenic influences on the system presents a large number of issues that need to be addressed. Given the size of the area, priorities must be set so that resources can be used where they are most needed. Setting priorities can be difficult when so many parties with very diverse and often unique interests are involved. Public education and outreach activities for such a large and diverse geographical region is an immense task. The five states that border the Gulf agree on many issues, but disagree on others because of major differences in the driving forces of the economies of each state. There are also numerous state organizations and agencies to coordinate with in addition to the federal agencies that are involved, and conflicting interests, such as development versus habitat preservation, recreational versus commercial fishing interests, and freshwater consumption versus ecological use

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such as diversion. The latter issue is important because many marine organisms depend on specific salinity ranges for reproduction or survival.

Interagency Cooperation

In addition to my position as FDA liaison, there are currently liaisons for NOAA/National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and the Soil Conservation Service (SCS). The Corps of Engineers has a representative dedicated to Program activities who spends some time in the Program Office. These representatives provide guidance and support from their agencies on the ten issue areas (mentioned under Action Agendas), and their assistance has been invaluable in the success of this Program. SCS has had particularly strong involvement and provided a great deal of support to the Nutrient Enrichment committee; NOAA has similarly assisted with the Living Aquatic Resources committee, and the Corps has taken the lead with the Coastal and Shoreline Erosion committee. I have provided similar support as the federal co-chair of the Public Health committee.

Two state representatives are located within the office, one from the Mississippi Cooperative extension Service and the other, who represents all Gulf States Soil and Water Conservation agencies, comes from the Mississippi Soil and Water Conservation Commission.

Seafood and Public Health

Of the nine short term environmental challenges, six deal predominantly with sealife or 'the water itself and three deal with seafood and public health. Although all directly or indirectly effect seafood quantity or quality, these three interrelate:

**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**

**EXPAND PUBLIC EDUCATION/OUTREACH TAILORED FOR EACH
GULF COAST COUNTY OR PARISH**

The four goals of the public health subcommittee are

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.
4. PREVENT EXPOSURE TO PATHOGENS IN COASTAL WATERS OF THE GULF OF MEXICO.

The prioritized categories of concern are: (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; and (4) exposure to pathogens in Gulf waters from recreational or occupational contact.

Four strategies have been designed to meet the challenges of the program: (1) research and demonstration; (2) monitoring/assessment; (3) standards/enforcement; and (4) public outreach. Objectives are grouped according to these strategies and are the specific short-term targets for attaining the goals. Each objective is followed by action items that identify those actions to be taken to meet the goals and objectives of public health,

1. RESEARCH AND DEMONSTRATION (R&D) (action items 1-6)

OBJECTIVES

- a. 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.
- b. Identify and characterize marine biotoxins and progenitors that have not been investigated and continue to develop and improve methods for the identification and management of marine biotoxins.

2. MONITORING/ASSESSMENT (M&A) (action items 7-18)

OBJECTIVES

- a. Determine the extent of human fecal pollution of shellfish growing areas in the Gulf of Mexico.

- b. Establish a formal database on the occurrence of seafood-borne disease.
- c. Determine Gulf Coast residents at risk from consumption of potentially contaminated seafood.
- d. Survey Gulf Coast bathing beaches for the presence of human fecal wastes and other pathogens (i.e., *Vibrio* sp.)
- e. Assess the public health significance of marine biotoxins in the marine environment.
- f. Implement remote-sensing technologies for the identification of phytoplankton blooms/red tides in the early stages of development.

3. STANDARDS AND ENFORCEMENT

(action items 19-36)

OBJECTIVES

- a. Reduce the level of human wastes in the coastal waters of the Gulf of Mexico.
- b. Establish a Gulf Coast Fish Contaminants Group.
- c. Encourage states to adopt compatible policies for management of public health hazards.
- d. Standardize methods for marine biotoxin identification and analysis from phytoplankton producers and seafood vectors.
- e. Organize a Gulf-wide marine biotoxins management and consulting group.

4. PUBLIC OUTREACH (PO)

(action items 37-44)

OBJECTIVES

- a. 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 high risk patients, and to transmit information to these patients and encourage the reporting;
 - (3) help legislative and judicial members understand the seriousness of violations of shellfishing regulations related to public health,
 - (4) inform enforcement officials about public health aspects of shellfishing regulations.
- b. Help the public understand 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 risks.

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

d. 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.

In FY 1994, projects were accepted through interagency agreements among federal agencies. Some of the projects were further meted out to academia through grant programs by those designated federal agencies. In FY 95 preproposals are being sent out and may be awarded directly to academia, states, other federal agencies, or to non-profit organizations depending on the projects developed and the degree of partnering cited.

There have been developed 44 specific action items aligned under the four strategies. The top priority action items have been highlighted for project development.

(R&D)

1. Methods for Identification of Indicator Organisms Originating From Human Fecal Sources (1995); goal 1; ISSC, NOAA, FDA, EPA, academia, industry)

2. Identification of sources of chemical contaminants and pathogens (1994; goals #1, 3 & 4; EPA, states, Toxic Substances and Pesticides Subcommittee, GoMPPHC)

3. State ambient water quality assessment and monitoring needs (1993; goal 4; EPA, states)

4. Atmospheric deposition research (1994; goal 3; EPA)

5. Discussion meeting- Coordination of Marine Biotxin Research (1993; goal 2; GoMPPHC)

6. Coordination of Marine Biotoxins Research (1995; goal 2; FDA, NMFS, EPA, NIH)

(M&A)

7. Survey and classification of shellfish growing areas (1993; goal 1; states, FDA)

8. Standard reporting for seafood-borne disease (1993; goals 1, 2, 3; CDC)

9. Regular reporting of seafood-borne diseases (1993; goals 1, 2, 3; states)

10. Seafood consumption patterns study (1993; goal 3; NMFS, EPA)

11. Seafood contamination data collection (1993; goal 3; states)

12. Evaluation of seafood contamination and consumption information (1995; goal 3; GoMPPHC)

13. Comprehensive seafood contamination data monitoring program (1993; goal 3; FDA, states)

14. Survey of current practices for monitoring bathing beaches (1993; goal 4; GoMPPHC)

15. State bathing beach monitoring plans (1995; goal 4; states)

16. Toxigenic phytoplankton monitoring program for inshore waters (1994; goal 2; FDA, GoMPPHC, NMFS)

17. Monitoring program for marine biotoxin residues in shellfish and finfish (1994; goal 2; FDA, GoMPPHC, NMFS)

18. Remote sensing technologies for the identification of phytoplankton blooms/red tides (1993; goal 2; NMFS, GoMPPHC)

(S&E)

19. Reopening of Gulf coast areas currently closed due to poor water quality (1996; goal 1,4; states)

20. No discharge areas in state waters (1995; goal 1,4; states)

21. Gulf Coast Fish Contaminants Group (GCFCG) (1993; goal 1,3; GoMPPHC)

22. Consistent interagency policies and procedures relative to seafood contamination and public health (1993; goal 1,3; GCFCG)

23. GCFCG Workshops (1994; goal 1,3; GCFCG)

24. Review of state applications of developed guidelines (1995; goal 1, 3; GCFCG)
25. State review, evaluation & adoption of new bacteriological criteria for recreational waters (1994; goal 4; states)
26. State ballast exchange guidelines (1995; goal 1,4; states, EPA, USCG)
27. **Minimum criteria for septic systems in critical areas** (1993; goal 1,4; **states**)
28. **Adoption and implementation of state standards for septic systems (1994; goal 1,4; states)**
29. **Alternatives to septic tank systems (1994; goal 1,4; states)**
30. Microbiological and chemical standards for POTW permits in shellfish areas (1995; goal 1; EPA or states)
31. Limits on microorganisms in NPDES permits for POTWs near bathing beaches (1994; goal 4; EPA or states)
32. State adoption of new indicators of fecal pollution (1996; goal 1; FDA, states, ISSC)
33. Marine biotoxin identification and analysis manual (1993; goal 2; FDA)
34. Distribution of Marine Biotoxin Manual (1993; goal 2; FDA, GoMPPHC, NMFS)
35. Update/adoption of Marine Biotoxin Action Levels (1993, goal 2; FDA, NMFS)
36. Investigations for Biotoxin outbreaks (1993, goal 2; FDA, CDC)

(PO)

37. **Educational materials on risks associated with consumption of raw molluscan shellfish (1993; goal 1; GoMPPHC, PEOC, CAC)**

38. Education effort/materials on benefits & risks from consumption of seafoods (1993; goal 3; GoMPPHC, PEOC, CAC)
39. Recreational and subsistence fishing guide (1994; goal 1, 3; NOAA, Sea Grant, GCFCG)
40. Assessment of signs & warnings in limiting consumption of contaminated sports fish species (1993; goal 3; GoMPPHC)
41. Educational program on impacts of boat discharges on seafood (1993; goal 1,3; USCG, GoMPMDC)
42. Marine water contact advisories related to recreational and occupational exposure (1993; goal 4; GoMPPHC, PEOC)
43. Educational materials for physicians (1993; goal 4; GoMPPHC)
44. Public information releases on the effect of Marine Biotoxins on Public Health (1993; goal 2; GoMPPHC, PEOC, CAC)

ACTION ITEMS were prioritized by using the following criteria:

- 0 Action contributed to one or more of the environmental challenges
- 0 Likelihood of success is high and the impact on the issue is substantial
- 0 Completion of the action is critical to the initiation of other important actions
- 0 Action can be sufficiently initiated/completed in time to support reaching the environmental challenge in five years
- 0 Success of the action can be defined or measured

This prioritization resulted in a list of top ten action items:

19. Reopening of Gulf coast areas currently closed because of poor water quality
APPROVED BY POLICY REVIEW BOARD 2/94
2. Identification of sources of chemical contaminants and pathogens
APPROVED BY POLICY REVIEW BOARD 2/94
29. Alternatives to septic tank systems

28. Adoption and implementation of state standards for septic systems
 21. Gulf Coast Fish Contaminants Group (GCFCG)
APPROVED BY POLICY REVIEW BOARD 2/94
 5. Discussion meeting- Coordination of Marine Biotoxin Research
 27. Minimum criteria for septic systems in critical areas
 37. Educational materials on risks associated with consumption of raw molluscan shellfish
 1. Methods for identification of indicator organisms originating from human fecal sources
- 10&13. Seafood consumption patterns study; Comprehensive seafood contamination data monitoring program

GULF OF MEXICO PROGRAM 1995 PRIORITY PROJECTS

The second generation action agenda resulted in development of priority projects for action items addressing the ten challenges. There are five objectives in the call for preproposals:

- To seek the most technically sound and cost-effective proposals available to address the Gulf of Mexico Program's 1995 priority projects.
- To solicit participation from federal, state, and local governments throughout the Gulf region, as well as research, academic, nongovernmental, business, and industry participants in the Gulf of Mexico Program.
- To specifically address the Program's 1995 priority projects.
- To accomplish the objectives specified in the projects within one year.
- To encourage, to the maximum extent possible, the development of organizational partnerships between federal, state, and local governments, and research, academic, non-governmental, business, and industry stakeholders in the Gulf of Mexico's future ecological and economic viability.

ELIGIBILITY:

Federal, state, and local government agencies, academic institutions, and/or nonprofit groups are eligible to respond directly. Due to the restrictions on federal funding,

regional business and industry may not respond directly, but are encouraged to develop partnerships with eligible academic and nonprofit organizations.

Preproposals will be evaluated and ranked by a process administered by the Gulf of Mexico Program. Those submitting preproposals which are selected for award will be contacted by the Gulf of Mexico Program Office in February 1995, and will be asked to work with Program staff to develop more complete proposals of the work to be accomplished.

Examples of these preproposals with projects for FY 95 are:

PROJECT CODE: 95/PH/A5/P1

PROJECT DESCRIPTION: Develop reference and instructional materials for the training of technical/research and management personnel in handling toxic algal bloom phenomena. This is an effort to develop a well trained and consistent infrastructure to deal with toxic algal bloom phenomena in the Gulf states.

Type: Independent

Geography: Gulf State region

Statement of Product: A manual and accompanying video covering the elements of how to identify toxic algal blooms, how to identify the causative species, strategies for field sampling and monitoring, determination of toxins in water and seafood, and management strategies for dealing with exposure to toxins (closure of shellfish areas, monitoring for fish and other seafood products, etc.).

Cost: \$75K

Start Date: Fall 1995

Completion Date: 12- 18 months after initiation of project

TASK 1: **Develop the** full text for the manual and accompanying video.

Start Date: Fall 1995

Completion Date: 12 months after project initiation

Statement of Product: A manual and accompanying video

TASK 2 Evaluate materials through a review process, improve where necessary and prepare for publication and distribution.

Start Date: 1 month after completion of draft materials

Completion Date: 3 months after project initiation

TASK 3: Implement use of materials in training sessions. (**Note:** outside the scope of current proposal.)

PROJECT CODE: 95/PH/A10,13/P1

PROJECT DESCRIPTION: Conduct a workshop with seafood consumption model developers and selected Gulf of Mexico Program participants to ensure that state public health needs are incorporated into the model, and begin familiarizing Gulf of Mexico users with the model.

Type: Dependent

Geography: Gulf States

Statement of Product: Workshop

Cost: 7.5 K

Start Date: June 1995

Completion Date: October 1995

TASK 1: Complete a Plan of Operations (Planops) which details specifically how the project is to be planned, conducted, and completed. The Planops will include the designation of project leader, independent QA reviewer, all extramural cooperators, as well as a description of the background of the issue, methods to be used in conducting the project, schedules, and specific criteria for measuring performance.

TASK 2: Conduct workshop and evaluate performance.

TASK 3: Modify model if necessary to meet Gulf of Mexico needs.

PROJECT CODE: 95/PH/A10,13/P2

PROJECT DESCRIPTION: Train scientists to recognize that, regardless of the precision of scientific estimates, public issues of equity including the dimension of “outrage” need to be thoroughly understood and incorporated into risk management solutions. This project follows an FY94 project which familiarizes state managers with a new paradigm, Interactive Risk Communication, so that the techniques can be pilot tested and employed in the Gulf of Mexico. This process seeks to proactively involve an affected public in describing risks and seeking solutions for risk management strategies.

Type: Dependent on Action Item 21, Project 1 (FY94)

Geography: Gulfwide

Statement of Product: Workshop and report

cost: \$75K

Start Date: 1995

Completion Date: 1996

- TASK 1:** Complete a Plan of Operations (Planops) which details specifically how the project is to be planned, conducted, and completed. The Planops will include the designation of project leader, independent QA reviewer, all extramural cooperators, as well as a description of the background of the issue, methods to be employed in conducting the project, schedules, and specific criteria for measuring performance.
- TASK 2:** Conduct and evaluate workshop.
- TASK 3:** Submit a report which evaluates the concept and recommends where the technique can be applied in the Gulf of Mexico.

PROJECT CODE: 95/PH/A10,13/P3

PROJECT DESCRIPTION: Compile and evaluate existing data and information on the occurrence and factors associated with VIBRIO VULNIFICUS in the Gulf of Mexico, and make recommendations to support appropriate control strategies and management plans.

Type: Independent

Geography: Gulfwide

Statement of Product: Report and data base

Cost \$200K

Start **Date:** 1995

Completion **Date: 1996**

TASK 1: Compile existing data on occurrence and virulence of VIBRIO VULNIFICUS in the Gulf of Mexico, and identify any data gaps.

TASK 2: Identify and evaluate factors associated with occurrence and virulence (i.e., populations and loading information, temperature, time of year, water quality, nutrient loading, salinity, etc.).

TASK 3: Analyze data and information and make recommendations to fill data gaps and develop public health management strategies.

PROJECT CODE: 95/PH/A28/P1

PROJECT DESCRIPTION: Develop educational materials related to the problems, effects, and solutions of on-site sewage disposal system usage in coastal areas. Develop minimum criteria for such systems. Develop fact sheets to inform citizens of the need for improved regulation of on-site sewage systems in coastal areas and seek changes in state laws in the five Gulf states to incorporate these criteria.

Type: Independent

Geography: Coastal states

Statement of Product: Model code with criteria for septic system installation in coastal areas, fact sheets describing problems and benefits of septic system installation, display for citizens describing benefits and problems of different septic systems.

Cost: \$40K (\$4k for booth; plus resources for development of model legislation, fact sheets, and distribution of information within the five Gulf States by non-governmental organizations)

Start Date: Spring 1995

Completion Date: October 1995

- TASK 1:** Develop model legislation containing minimum criteria for new and existing on-site sewage disposal systems in coastal areas. This could be developed through an existing organization of regulators in the Southeastern states.
- TASK 2:** Produce fact sheets targeted to the public and legislators that describe problems, effects, and solutions for inadequately regulated on-site sewage disposal systems in coastal areas.
- TASK 3:** Procure and make available to citizen groups a display booth showing information on the problems, effects, and solutions for inadequately regulated on-site sewage disposal systems in coastal areas.
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PROJECT CODE: 95/PH/A29/291

PROJECT DESCRIPTION: Evaluate composting toilets, incineration toilets, and aerobic systems under intermittent use conditions. The objective of this project is to evaluate the treatment efficiency of representative types of composting toilets and aerobic sewage treatment devices under intermittent use conditions that would be applicable to the Gulf Coast climatic conditions. The tests should be conducted in order to meet the specifications of the National Sanitation Foundation (NSF Standard 40) if possible, since this is a requirement for approval of alternative on-site sewage treatment devices in some Gulf Coast states. If standard conditions for these evaluations do not exist, the conditions used should be determined in conjunction with the Public Health Issue Committee and included in the final report

Type: Independent

Geography: Louisiana

Statement of Product: A report that can be used by state health departments in rule making and permitting of on-site sewage treatment systems in situations where conventional septic tanks and leach fields will not provide adequate treatment and disposal.

Cost: \$100K

Start Date: Spring 1995

Completion Date: Spring 1996

PROJECT CODE: 95/PH/A29/P2

PROJECT DESCRIPTION: Enhance public awareness through demonstration projects.

Type: Dependent

Geography: Gulf States

Statement of Product: Project report on benefits of alternative systems

Cost: \$500K

Start Date: Spring 1996

Completion Date: Fall 1996

TASKS: One demonstration project on an alternative system should be conducted in each state.

PROJECT CODE: 95/PH/A29/P3

PROJECT DESCRIPTION: Conduct public outreach activities.

Type: Independent

Geography: Gulf States

Statement of Product: Pamphlets and outreach implementation.

Start Date: 1996

Completion Date: Ongoing

PROJECT CODE: 95/PH/A29/P4

PROJECT DESCRIPTION: Evaluate the potential for a revolving fund with low interest loans (three percent) to upgrade on-site sewage treatment systems. Conduct a demonstration project in one community or a pilot project in one state to test criteria for qualifying homeowners for funding.

PROJECT CODE: 95/PH/A37/P1

PROJECT DESCRIPTION: Develop and implement a judicial and legislative educational program concerning the public health risks associated with the consumption of illegally harvested molluscan shellfish and how to avoid, control, or minimize those risks.

Type: Independent

Geography: Gulfwide

Statement of Product: Written material with possible video and oral presentations

Cost \$65K

Start Date: 1995

Completion Date: 1996

TASK 1: ISSC Education Committee develops material for presentation.

Start Date: 1995

Completion Date: 1995

Statement of Product: Educational material may consist of video and/or printed material that outlines recent cases of illnesses that resulted from consumption of shellfish illegally harvested from closed shellfish growing waters. Material will also outline all possible illnesses that may be caused by consumption of illegally harvested shellfish and relate the history of the shellfish program and how shellfish water are classified. The Gulf of Mexico Program project officer will be informed of the type of material to be presented and a copy will be sent to the Gulf Program office.

TASK 2: State Shellfish Sanitation Program personnel will identify a proper time and date for delivery of material to the judiciary and legislators, and coordinate with Sea Grant and FDA Shellfish Specialists to arrange meetings to deliver materials.

Start Date: 1995

Completion Date: 1995

Statement of Product: A coordinated calendar that specifies who, what, when, and where material will be delivered to appropriate Gulf State members of the judiciary and legislators. The events should be timed for maximum participation by all parties. Copies of each calendar will be sent to the GMPO project officer.

TASK 3: Education materials will be delivered by respective State Shellfish Sanitation Program personnel, Sea Grant, and FDA Shellfish Specialists as indicated in the calendar.

Start Date: 1995

Completion Date: 1996

Statement of Product: Delivery of educational material to appropriate

PROJECT CODE: 95/PH/A37/P2

PROJECT DESCRIPTION: Develop an innovative public outreach program which explains the public health risks associated with the consumption of raw oysters and **VIBRIO VULNIFICUS** and how to control or minimize those risks. Certain activities should be targeted to potential high risk individuals.

Type: Independent

Geography: Gulfwide

Statement of Product: An outreach strategy and associated products, which could include a video, written materials, etc.

Cost: \$50K

Start Date: 1995

Completion Date: 1996

The Gulf of Mexico Program is a “must” program. The federal and state agencies, industry and concerned citizens must work together to reach the lofty goal of protecting, restoring, and enhancing 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 safe recreational usage of its waters and beaches. We must have total confidence in its seafood and we must accomplish this with efficiency and enthusiasm.

ISSC UPDATE

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Good morning, it is a pleasure to be here in New Orleans. I am David Heil, Chairman-Elect of the Interstate Shellfish Sanitation Conference (ISSC). I want to thank Dr. Steve Otwell for inviting me to speak to you today.

I was asked to present an update of current ISSC activities. Many of you are probably not familiar with the ISSC, and before updating you on ISSC activities, I would like to explain what the ISSC is, who is involved, why the organization was formed, and how it functions.

The ISSC is a molluscan shellfish regulatory development organization comprised of participants from state shellfish control agencies, the shellfish industry, members of the academic community, and federal regulatory agencies (most notably the U.S. Food and Drug Administration and National Marine Fisheries Service Branch of the National Oceanic and Atmospheric Administration–NOAA). Simply stated, that is the “what” and “who” of the ISSC.

The “why” is more complicated. Regulatory control governing the sanitary quality of shellfish dates back to 1658 when the Dutch Council of New Amsterdam (later renamed New York) passed an ordinance regulating the harvesting of oysters from the East River. Similar measures have occurred in the United States and eventually the U.S. Food and Drug Administration (FDA) established the National Shellfish Sanitation Program (NSSP) in 1924 as a voluntary state and industry program. A **Manual of Operations** was published at that time outlining the procedures that would govern the program.

The NSSP functioned well for approximately 50 years, but changes in state and federal governmental organizations and challenges to the federal portion of the program made participation by state regulatory officials and the shellfish industry ineffective. State programs began to diverge from the NSSP, and the federal program appeared unable to maintain the uniformity necessary to ensure the safety of shellfish as a food source. Faced with this deteriorating situation, representatives of fifteen shellfish producing states met in October, 1979, in Ocean City, Maryland, to

investigate the problem. The ISSC was established with the purpose of providing a formal structure whereby state regulatory authorities, industry, and federal agencies could establish and periodically update guidelines and procedures which could be applied uniformly and would ensure sanitary control of the shellfish industry.

On March 4, 1984, the ISSC and FDA signed a memorandum of understanding which recognized the ISSC as the forum for establishing guidelines and FDA as the evaluator of state programs. During the first four years, the conference reviewed and updated part I and part II of the NSSP *Manual of Operations*.

One of the keys to the success of the ISSC is “how” the conference functions. Anyone who has an interest in molluscan shellfish may submit issues for consideration by the conference. These issues outline suggested changes and include rationale for the changes. The issues are reviewed by appropriate task forces at the annual meeting:

Task force I - growing areas
Task force II - processing and distribution
Task force III - administration

These task forces are comprised of state regulatory, federal regulatory, and industry representatives.

Upon review of the issues, the task forces make recommendations to a voting general assembly made up of state regulatory representatives with each shellfish producing state having one vote in all task forces and each non-producing state having one-half vote in task force I and a full vote in task forces II and III. Complex issues are referred to special committees for detailed review and recommendations. These committees pool expertise from regulatory agencies, industry, and the academic community.

The ISSC has a 22-member executive board which manages the affairs of the conference. ISSC executive board representatives for the Gulf Coast and South Atlantic regions are:

Region 4 (NC, SC, GA, FL)
Regulatory - David Heil (FL)
Industry - Oscar Reksten (FL)
Region 5 (MS, AL, LA, TX)
Regulatory - Joe Gill, Jr. (MS)
Industry - Al Sunseri (LA)

That is a summary of the “what”, “who”, “Why”, and “how” of the ISSC. Now I will update you concerning current ISSC activities.

As some of you may be aware, we held our twelfth annual meeting August 6-12, 1994, in Tacoma, Washington. Attendance was the largest ever. The meeting had representation from 28 states, 3 federal agencies, and 6 foreign countries: Canada, Mexico, United Kingdom, Australia, New Zealand, and Republic of South Korea.

Noteworthy Accomplishments Of the Meeting

- (1) ***Vibrio vulnificus*** has been a topic of concern and discussion by the ISSC for many years. The FDA submitted an issue at this year’s annual meeting which, if adopted, would require that all oysters from states known to be affected by ***Vibrio vulnificus*** be tagged at time of harvest for shucking by a certified dealer. Oysters so identified would be required to be shucked and packed into containers that were clearly labeled “this product should be fully cooked and not consumed raw.” This difficult issue received unprecedented attention and debate which extended into State Legislative Assemblies, Governors’ offices, and the United States Congress. The conference voted not to impose the recommended requirement but did direct:
 - (A) The appointment of a committee to work jointly with FDA to develop manual language necessary for 1995 conference consideration of fFDAs proposed requirement. In addition, the committee was charged with development of proposed additional manual revisions which identify other harvesting and handling practices which may be considered an acceptable alternative to the harvest limitations provided for in fda’s proposed requirement. The proposed alternative practices must provide comparable levels of protection to public health. Development of alternative harvesting practices should be based on a review of all available information and may include but not be limited to such considerations and at-harvest temperature controls, restrictions on shelf-life, tagging, and labeling procedures.
 - (B) In the interim, FDA and ISSC, utilizing funds made available from the National Marine Fisheries Service, will develop a more aggressive and effective education plan.
 - (C) The ISSC will work jointly with FDA and the conference for food protection to develop uniform language for consumer education advisories.

This issue presents a difficult challenge for the ISSC, and a meeting is scheduled for Thursday of this week in Charleston, South Carolina, to develop a

strategic plan for conference action. We have begun appointing the committee and notifications will be mailed immediately following the Charleston meeting.

- (2) At this year's annual meeting, the voting delegates endorsed FDA's seafood HACCP initiative, and an ISSC committee will soon begin a series of activities which include:
 - (A) Preparation of issues for the 1995 annual meeting which would ensure consistency between the NSSP manual of operations language and final language of the seafood haccp regulation and the "fish and fishery products hazards and controls guide".
 - (B) Development, in consultation with FDA, of model shellfish haccp plans.
 - (C) Development of haccp training courses targeted for the shellfish industry and state regulatory agencies.
 - (D) Development of a schedule for ISSC actions regarding the proposed regulations.
- (3) The conference established a committee to review "critical", "key", and "other" designations associated with the standardized processing plant inspection form.
- (4) The conference endorsed the FDA retail food code requirement for providing consumer information messages on all potentially hazardous foods.
- (5) The conference established a non-voting position of the executive board for the Indian treaty tribes of Western Washington.
- (6) The executive board supported the development of a petition to FDA for an irradiation process for molluscan shellfish.

The 1994 summary of actions which includes all recommendations adopted at this year's annual meeting will be submitted for FDA review in early October. There will not be a 1994 printing of the **Manual of Operations**. All 1994 manual changes will become effective with the printing of the 1995 manual unless otherwise specified.

The conference referred several issues to committees for recommendations. The 1995 committees will include:

Biotoxin
Certification
Depuration
Education

Epidemiological Investigation Criteria
Foreign Relations
Haccp Review
Identity of Origin

Irradiation	Shellfish Restoration
Issue Review	shipping
Laboratory Checklist	Standardization of Growing Areas
Patrol	Strategic Planning
Plant Standardization Advisory	Survey
Procedures	Tagging
Research Guidance	Thermal Processing
Resolutions	Time/Temperature
Shellfish Container	<i>Vibrio Vulnificus</i>
	Wet Storage

The ISSC has several ongoing efforts that I want to update.

- (1) On October 1, 1993, the FDA implemented a revised state evaluation program referred to as "Focus '94". FDA invited ISSC comments prior to finalizing Focus '94, and ISSC recommendations were incorporated into the program. For many years the ISSC executive board has been encouraging a more effective compliance effort with ISSC involvement in state non-compliance issues. This compliance initiative provides for both. The safety of molluscan shellfish should not be judged by the least effective state shellfish control program, and I am very encouraged by this effort. I believe that consistent, uniform evaluations and sanctions are critical to ensuring the safety of molluscan shellfish and instilling consumer confidence. FDA invited ISSC executive Director, Ken Moore, to attend their Focus '94 workshop which was held in October, 1993. The meeting involved all shellfish regional specialists and focused on implementation of the initiative. Ken indicated he was impressed with the cooperative attitude of everyone present. The ISSC believes this effort will resolve many of the long-standing problems which have been associated with state evaluations.
- (2) In 1994, the conference adopted a formal procedure for FDA to issue NSSP manual interpretations. FDA and ISSC jointly agreed to discontinue the issuance of formal manual interpretations approximately six years ago; however, the shellfish processing plant standardization and compliance initiatives require a mechanism for obtaining guidance and clarification regarding NSSP guidelines. The procedure, which is available to anyone involved in molluscan shellfish, became effective April 26 and has been provided to all members and participants of ISSC. If the responses received on the first three drafts are any indication, this is going to be a very helpful and productive process.
- (3) The standardization of shellfish processing plant inspection became effective January 1, 1994. Standardization is a major step, and it has not come without problems. The ISSC executive board has established a plant standardization

advisory committee, and all concerns regarding plant standardization will be forwarded to the committee which will make recommendations to the executive board. This process should be helpful in fine tuning processing plant standardization.

- (4) The ISSC education committee has developed a directory of shellfish education information which can be used by states in advising medically compromised individuals of the risk of consuming raw shellfish. In 1988 the conference recommended that states begin educational efforts of this type. To date, with a few isolated exceptions, very little has been accomplished. The education committee is being asked to assess the objectivity of available information and develop additional information for an educational package which ISSC will make available to states and to other groups to facilitate effective public health education.
- (5) In an effort to establish better communication with state regulatory agencies and industry, the ISSC has developed a periodical newsletter. Those interested in receiving the newsletter should contact the ISSC executive office.
- (6) The ISSC is continuing to assist National Marine Fisheries Service and the northeastern states in the development of a marine biotoxin dockside testing protocol to allow harvesting of shellfish from Georges Bank. The conference, with financial assistance from NMFS and FDA, held a workshop on June 28-29 in Boston. Conference staff was successful in mediating differences which have previously prevented implementation of this program.
- (7) The ISSC is managing the development of the shellfish management information system (SMIS) which is an Outgrowth of the ***Shellfish Register of Classified Estuarine Waters***. This project was formerly managed by National Marine Fisheries Service. It is the goal of the conference to develop an on-line data base which will be periodically updated to provide current and accurate harvest area information. It is our intent to make the information available to states, federal agencies, and industry. The project is expected to eventually include other seafoods and provide critical support to the FDA HACCP initiative. The ISSC has established a steering committee to provide project guidance. The committee includes FDA, NMFS, National Ocean Service (NOS), EPA, State Regulatory, and Industry Representatives.
- (8) ISSC will be assisting FDA in providing training and technical assistance to states. This is an area which is going to require considerable attention with the present budget situations of state and federal agencies.
- (9) ISSC will be assisting FDA in resolving issues of state non-compliance with the NSSP. ISSC has recently been involved with FDA in addressing several state non-compliance issues, and our joint efforts have been quite effective.

FDA's proposed seafood haccp regulations have received considerable attention. The ISSC provided comments on the proposed regulations. Those comments are available and can be obtained upon request.

In closing, I want to talk about the future of the national shellfish sanitation program. Twenty years from today, those of us who are still involved in molluscan shellfish will look back and be amazed at the duplication of food safety effort that occurred at the federal, state, county, and municipal levels in the "big government era" of the sixties, seventies, and eighties. In saying this I am suggesting that in twenty years there will be a noticeable reduction of duplicated effort. This financially driven reduction will be the result of 1990's financial consciousness which is occurring throughout government. The FDA-proposed HACCP regulation is a by-product of that financial consciousness. Effective integration of HACCP in molluscan shellfish, seafood in general, and all foods must include every level of government involved in food safety. The potential for mandatory introduction of HACCP into seafood has created a unique opportunity for those of us involved in molluscan shellfish. The size, structure, and process of the National Shellfish Sanitation Program gives the ISSC the opportunity to shape the future of food safety.

The sharing of public health responsibilities, which is the cornerstone of the NSSP, will soon be the rule rather than an exception called a cooperative program. The Food and Drug Administration is requesting that ISSC provide leadership in establishing this new way of doing business. As discussions occur regarding HACCP, reinventing government, and how best to regulate food, I ask that each of you give consideration to the unique opportunity before us, and I encourage your participation in the ISSC. We have a choice. We can shape the future, or the future will shape us.

The thirteenth annual ISSC meeting will be held August 19-25, 1995, at the Sheraton Hotel in Orlando, Florida. I urge each of you to attend and support our efforts.

IRRADIATION TO ENSURE HYGIENIC QUALITY OF FRESH AND FROZEN SEAFOOD

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INTRODUCTION

There is clearly a significant increase in awareness of the risks from food-borne diseases among consumers in western countries in the past decade. The concern about the quality and safety of food appears to be driven by increased affluence, new scientific discoveries, by more sophisticated measurements and analyses, by new information about linkages between diet and health, by new food technologies and by mass communication (Kinsey, 1993). No doubt, growing demand for higher quality and safer food leads, also, to higher demand for effective government regulations of food quality and safety.

The outbreaks of E. coli 0157:H7 during the past year which claimed several children's lives and hospitalized hundreds of adults and children alike in the USA is a good case in point. The initial outbreak in the west coast of the USA in early 1993 attracted wide media attention as it not only caused fatalities in children but involved consumption of undercooked hamburgers served at a well known restaurant chains. It taught consumers that there are health risks associated with food of animal origin which, if not properly prepared, could lead to hazards or even death. It also provides a confirmation that raw foods of animal origin often harbour pathogenic bacteria which are dangerous for consumption if the food is not properly processed or prepared. Because of the serious outbreaks of this bacteria, policy makers and legislators are calling for a tighter control of national food protection programmes by introducing public statements and legislative bills (Anonymous, 1994; Lee, 1994). In the USA, warning labels of the risks of pathogenic bacteria in or on food have been mandated on some foods of animal origin.

Fresh and frozen seafood, although not widely implicated in incidences of food-borne diseases, are not without problems. Vibrio parahaemolyticus, a natural microflora of seawater and a common contaminant of fresh fish and shellfish, was responsible for 27 outbreaks in the USA from 1973 to 1991, 22 of which were attributed to contaminated shellfish (Potter, 1994). A survey conducted in shellfish growing areas in 9 States in the USA in mid-1980's showed that mean density of V. parahaemolyticus was 100 times greater in oysters than in water (DePaola et.al., 1990). In the past few years, oysters and clams, often consumed raw, from US States neighbouring the Gulf of Mexico were responsible for deaths of dozens of consumers, most of whom were immuno-compromised. The culprit of the fatality was Vibrio vulnificus which is part of the natural microflora of seawater in the ocean, especially during summer months. This species of bacteria cannot be cleaned up by routine depuration. The negative impact of media publicity of the incidences attributable to consumption of raw oysters and clams has devastated trade in these delicious and nutritious seafoods in the USA, especially in the Gulf States. Large retail buyers entirely stopped purchasing oysters in 1988; demand and resultant production of oysters dropped 41% nationwide; and per head consumption of domestic eastern oysters dropped 60% (Kilgen, 1993). The estimated added cost of US\$0.05-0.08/lb for large volume commercial irradiation was considered a cost-beneficial value-added processing step to the oyster industry in the USA (Roberts, 1992).

Pre-cooked frozen shrimp can be mishandled and resulted in infection to consumers (Beckers et.al., 1981). This product, often consumed without further heating, represents a high risk if contaminated by pathogens during processing. In the Netherlands, shrimp cocktails served to elderly people in a pension home during Christmas of 1983, claimed 14 lives because of shigellosis. The pre-cooked frozen shrimp used for the preparation of shrimp cocktail, purported to originate from an Asian country, were found to be contaminated with a drug resistant strain of Shigella flexneri (Mossel and Stegeman, 1985). The Dutch authorities ordered a ban on importation of all Asian shrimp for 3 months following the incident. It was later discovered that the shrimp were caught in the North Sea, cooked on-board, frozen, exported to an Asian country for hand peeling, refrozen and imported back to the Netherlands. Shigella contamination was believed to occur during the hand-peeling process.

Economic losses because of food-borne diseases can be enormous. The U.S. Center for Disease Control and Prevention estimates that 6.5 to 33 million cases of food-borne diseases occur each year in the USA (Kvenberg and Archer, 1987). Salmonellosis alone accounts for about 2 million of these cases and is estimated to cost the US economy \$2,540 million annually (Roberts, 1988). The incidences of contamination of V. vulnificus in oysters mentioned above have resulted in the loss of 50% of wholesale business and two-thirds of retail sales to the Louisiana oyster industry (Kilgen, 1993). The recent outbreaks of E. coli 0157:H7 will undoubtedly prove extremely costly to the responsible retailers and wholesaler of the implicated

food. Often, food manufacturers have to absorb the cost of recalling if their products were found to be contaminated by pathogenic microorganisms. For example, a potato chip product glazed with paprika had to be recalled by a large food manufacturers in Germany in 1993 because the paprika was found to be contaminated by Salmonella. Although no illness was involved, such a recall costs the company 30-40 million Marks (Anonymous, 1993).

IRRADIATION AS A COLD PASTEURIZATION PROCESS

While thermal pasteurization of liquid foods such as milk and fruit juices is a well established and satisfactory means of terminal decontamination/ disinfection of such commodities, this process is not suitable for solid foods such as meat, poultry, seafood and dry ingredients such as spices. Irradiation is instead a more efficient method, both from technological and economic points of view, to “pasteurize” these solid food to avoid changes in the physico-chemical and sensory quality of the product. Irradiation acts through changes induced in the DNA structure of the microbial cells, which results in prevention of replication or function. The energy level used for food irradiation to achieve any technological purpose is normally extremely small. At the maximum energy level or dose of irradiation recommended by the Codex Alimentarius Commission (which sets worldwide standards for food trade) for treating food, i.e. 10 kGy, this energy level is equivalent to the heat energy needed to increase the temperature of water by only 2.4° C (calculated on the basis that 10 kGy of ionizing energy is equivalent to a heat energy of 10 J/kg and the heat capacity of water is 4.2 J/kg; $10 \text{ J/kg} / 4.2 \text{ J/kg} = 2.4^\circ \text{ C}$). The dose of irradiation to ensure hygienic quality of fresh or frozen seafood is in the range of 1-5 kGy depending on the product and its state. Thus, the increase in heat energy in such products is in the range of 0.24 - 1.2° C. Irradiated food, therefore, remains at essentially the original natural state after the treatment.

Being a cold process with penetrating power, irradiation is unique in its ability to “pasteurize” fresh and frozen food products including seafood without changing product quality. Irradiation therefore provides a new “critical control point” for eliminating pathogenic bacteria in these food.

In 1986, FAO, IAEA and WHO through their International Consultative Group on Food Irradiation (ICGFI) convened a Task Force on Use of Irradiation to Ensure Hygienic Quality of Food to evaluate the role of irradiation for this purpose. The Task Force concluded that at that time and for the foreseeable future, no technology was available to produce raw food of animal origin in which the absence of certain pathogenic microorganisms such as Salmonella, Campylobacter, etc., can be guaranteed. These foods, therefore, pose a significant threat to public health. Thus, the Task Force believed that where such food are important in the epidemiology of food-borne diseases, radiation disinfection must be seriously considered (WHO, 1987).

EFFECTIVENESS OF IRRADIATION AS A METHOD TO ENSURE HYGIENIC QUALITY OF FRESH AND FROZEN SEAFOOD

Irradiation is an effective method to ensure hygienic quality of fresh and frozen food of animal origin including seafood. Its use, however, should not be a substitute for good manufacturing practices (GMPs) required for such products.

A. Irradiation of Fresh Seafood

The primary objective of irradiation of fresh seafood is for shelf-life extension under refrigeration or melting ice and to inactivate any non-spore forming pathogenic bacteria which may be present. The optimum radiation dose levels for various seafoods is generally in the range of 1.0 to 2.5 kGy according to Table 1.

Irradiation of fresh seafood at these optimum dose levels does not significantly affect quality but reduces significantly the microbial content of the product, thereby increasing the shelf-life. The quality and shelf-life of radiation pasteurized seafood is a function of many variables such as:

- initial quality (post-mortem age or microbial counts)
- qualitative/quantitative composition of the microbial flora
- packaging atmosphere
- absorbed dose
- presence or absence of microbial inhibitors such as sorbate, etc.
- biochemical composition of the seafood product
- post-irradiation storage temperature.

Fresh fish and shellfish can be contaminated with certain non-spore forming bacteria such as enteropathogenic *E. coli*, *Salmonella*, *Shigella*, *Vibrio parahaemolyticus*, *V. vulnificus*, *V. cholerae*, faecal streptococci, *Staphylococcus aureus* and viruses if caught from polluted waters or through post-harvest handling. Viruses are generally resistant to radiation at the dose levels required for pasteurization or shelf-life extension. Other means of disinfection of viruses such as depuration would have to be considered in addition to irradiation. Non-spore forming pathogenic bacteria are, however, relatively radiation sensitive. *Vibrio* spp., in particular, is sensitive to radiation with D-value in various seafood ranged from 0.03 to 0.16 kGy depending on salt concentration and serotype (Loaharanu, 1972; Grodner and Andrews, 1991; Kilgen, 1993). Quinn et al (1967) estimated radiation resistance of various pathogens or non-pathogenic members of genera containing pathogenic species in different seafood as follows:

<u>BACTERIA</u>	<u>D-VALUE (kGy)</u>
<u>E. coli</u>	0.15 - 0.35
<u>Proteus vulgaris</u>	0.10 - 0.20
<u>Shigella</u>	0.25 - 0.40
<u>Salmonella</u> (7 serotypes)	0.50 - 1.0
<u>Streptococcus faecalis</u>	0.75 - 1.0
<u>Staph. aureus</u>	0.80 - 1.90.

The storage temperature of seafood following irradiation is of critical importance not only from the shelf-life point of view but also because of the risk from botulinum toxin. Clostridium botulinum, strain A-G, are spore-forming bacteria which are resistant to low dose irradiation. Types E and F are of particular concern as they occur in marine environments and could grow and produce toxin at refrigeration temperature. Similar to food sub-sterilized by other means, e.g. thermal pasteurization, modified atmosphere packaging, prevention of botulinum toxin in irradiated fresh seafood can be achieved by a storage temperature of 3 °C or below.

Of more recent interest is the possible use of irradiation to disinfect Vibrio spp. in live oysters and clams which are often consumed raw. This species of bacteria cannot be depurated from these live mollusks and could pose health problems to consumers, especially those immuno-compromised. Vibrio spp. are natural inhabitant of seawater especially in warm areas and can contaminate live fish and shellfish. Live mollusks are, however, relatively resistant to low dose irradiation. A dose of 2 kGy which is more than sufficient to inactivate Vibrio spp in the live mollusks, appears to have little affect on mortality of the shellfish during the first week of storage (Mallet et.al., 1987; Kilgen, 1993). Irradiation therefore appears to be the only known method for pasteurizing live mollusks of Vibrio spp. without significantly affecting their mortality.

B. Irradiation of Frozen Seafood

The primary reason for irradiating frozen seafood is to ensure its hygienic quality from pathogenic microorganisms such as Vibrio spp. which naturally contaminate the product, and Enterobacteriaceae which may contaminate product during handling and processing. With regard to the former species of bacteria, good manufacturing practices including HACCP employed pre-, during and post- freezing can only reduce but not eliminate the contamination. GMPs and HACCP are important tools to avoid contamination of the latter group of bacteria, however. Human handling of products such as peeled and de-veined shrimp prior to freezing can increase the risk of contamination by Salmonella and related group of bacteria as well as Staphylococcus spp.

Frog-legs are often processed and traded by the seafood industry. Live frogs are naturally contaminated by Salmonella and related bacteria. GMPs employed

during butchering and processing including chlorination do not eliminate this group of pathogenic bacteria from frog-legs. Frozen frog-legs are, therefore, often contaminated with Salmonella and cannot gain access to markets in countries which have strict hygienic standards

Irradiation is unique in inactivating non-spore forming pathogenic bacteria in frozen food without changing physico-chemical and sensory characteristics of the product. The dose levels of radiation required to “pasteurize” frozen food including seafood are slightly higher than that for comparable fresh products because of low water activity of the former. A minimum dose of 3kGy is normally required for pasteurizing frozen seafood and frog-legs to ensure hygienic quality from Salmonella and related bacteria.

C. Irradiation of Ready-To-Eat Seafood

In addition to contamination by Salmonella and related microorganisms because of human handling as mentioned above, a number of ready-to-eat foods including seafood have been found to be contaminated by Listeria monocytogenes. The U.S. Food and Drug Administration and the USDA introduced zero tolerance for L. monocytogenes in ready-to-eat foods in 1989 (Tompkin et.al., 1992). Ready-to-eat foods such as cheeses, sausages, pate, cooked meat and Cole slaw have been implicated in human listeriosis (Tompkin et.al., 1992, McLaughlin, 1991). L. monocytogenes is ubiquitous in nature and can resist heat, nitrite, salt, and acidity better than many other pathogenic microorganisms. It can multiply slowly at temperature as low as 1° C. Some strains of L. monocytogenes have developed resistance to antibiotics such as tetracycline, erythromycin, co-trimoxazole, and clindamycin (Barbuti et.al, 1992).

Although data are limited, surveys suggested that cooked fish and other seafood may also be contaminated with L. monocytogenes. About 4-8% of cooked crabmeat and 3-4% of shrimp samples may yield the organism on analysis. One study on frozen, butterfly shrimp using a genetic probe suggested that 200 organisms per gramme may be present (WHO, 1988).

L. monocytogenes has a relatively high sensitivity to irradiation. Its D-values have been reported to range from 0.27 to 1.0 kGy depending on strains, growing media, and irradiation conditions (Patterson, 1989; Huhtanen et.al., 1989). In most cases, however, the D-values are similar to those reported for Salmonella spp. irradiated under similar conditions. Thus, L. monocytogenes in ready-to-eat seafood may be controlled by the same dose required for Salmonella and related pathogenic bacteria.

ECONOMICS OF IRRADIATION OF FISH AND SEAFOOD

Economics of food irradiation facilities is best characterized as capital intensive but low operating cost. It requires an economy of scale to justify investment in an irradiation facility. i.e. large quantities of food must be treated to achieve reasonable average unit costs. Factors which are important to determine the cost of operation of irradiation facility and consequent treatment cost include type of radiation, efficiency of radiation source, minimum throughput capacity, dose absorbed, number of hours the facility is operated over a given time period, types of product and their packaging configuration, etc. (Urbain, 1993).

A number of cost estimates on irradiation of fish and seafood have been made using a number of assumptions. These estimates together with actual cost charged by a commercial irradiation facility in France are listed below:

<u>Product</u>	<u>Absorbed Dose (kGy)</u>	<u>Treatment Cost/kg</u> (US\$)
Frozen shrimp	2	0.08 - 0.10 ¹
Frozen froglegs	4	0.10 - 0.12 ¹
Fish fillet	1.75	0.06 - 0.15 ²
Live oysters	1	0.10 - 0.15 ³

- Source:
1. Y. Henon. Gammaster-Provence, France (Personal Communication)
 2. Ref.: R. Morrison. 1985.
 3. Ref.: K. Roberts. 1992.

CONSUMER ACCEPTANCE OF IRRADIATED FOOD

A. Consumer Attitude Surveys

As food irradiation is perceived to be associated with nuclear technology, any introduction of irradiated food can be erroneously connected with radioactive materials. Thus, it comes as no surprise that there appears to be a widely held opinion among national authorities and the food industry that consumers would be apprehensive about food treated by irradiation because of the perceived association with radioactivity.

Because of the controversy and public debate on food irradiation during the 1980's, a number of consumer attitude surveys were conducted in several advanced countries during this decade to ascertain whether consumers would be willing or prepared to accept irradiated food (Anonymous, 1984; Anonymous, 1986; Titlebaum

et.al., 1983; Weise, 1984, Bruhn et.al., 1986a). Most of these surveys were conducted through telephone interviews, home interviews or mailed questionnaires in countries such as Canada, U.K. and USA at the time when irradiated food were not available for retail sale. The outcomes of these surveys were far from conclusive and led to further debate as to whether or not consumers will accept irradiated food. An interesting outcome of these surveys showed that professional organizations gained a better understanding of the technology and often made positive statements about it. From these surveys, Bord and O'Connor (1989) concluded that the extent to which the public will accept or reject irradiated food depends on the presence or absence of information about the topic. Interviews with those who knew something about irradiation and responded correctly to information about the technology were significantly more willing to accept irradiated food.

Following the outbreaks of E. coli 0157:H7 in the west coast of the USA in early 1993 and the increasing interest in the use of irradiation to ensure hygienic quality of food of animal origin, the American Meat Institute funded a nation wide three-part-study conducted by the Gallup Organization, Abt Associates and the Center for Food Safety and Quality Enhancement, University of Georgia, to measure consumer attitude on irradiation in relation to food safety (AMI Foundation, 1993). The Gallup survey found that while most consumers were aware of food irradiation, few were knowledgeable of the process. After the benefits of irradiation were explained and endorsements by health organizations such as the American Medical Association, Food and Drug Administration and World Health Organization were mentioned, 54% of those interviewed said they were more willing to purchase irradiated meat rather than non-irradiated meat. Sixty percent of the survey participants said they would be willing to pay a 5% premium for hamburger with the bacteria count greatly reduced by irradiation. It was interesting to note from this survey that consumers viewed irradiation as more necessary for food of animal origin such as meat, poultry and seafood than for fruits and vegetables.

In a simulated supermarket selling study conducted by the University of Georgia, 50% of consumers tested chose irradiated ground beef over non-irradiated. After the consumers tested learned more about the process and how it affects raw meat, those choosing irradiated beef increased to 70% of the sample size.

The conclusion from various consumer attitude surveys, conducted mainly in advanced countries, showed that consumers at-large are still not knowledgeable about food irradiation. They need accurate information about the safety, benefits and limitation of the process to be able to make an informed decision whether they will accept irradiated food or not. Similar conclusions could be made about consumers in developing countries. A seminar jointly organized by the International Consultative Group on Food Irradiation (ICGFI), established under the aegis of FAO, IAEA and WHO since 1984, and the International Organization of Consumer Unions (IOCU), in the Netherlands in September 1993 showed that credible consumer organizations do not oppose the use of food irradiation for specific applications (ICGFI, 1993).

B. Market Testing of Irradiated Food

The opinion of consumers about irradiated food is quite different when they are given the opportunity to select and purchase the food. During the past decade a number of market trials on several irradiated food items, with clear labelling indicating the treatment, were carried out in both advanced and developing countries. A variety of irradiated food, e.g. onions, garlic, potatoes, mangoes, papaya, strawberries, dried fish fermented pork sausages, etc. were put on sale, often alongside the non-irradiated. In none of these trials, carried out in market places where consumers could make their own choice whether to buy irradiated food or not, was there any evidence to indicate that informed consumers will not accept irradiated food (Loaharanu, 1993).

COMMERCIAL APPLICATION OF FOOD IRRADIATION

The number of countries which use irradiation for processing food for commercial purpose has increased steadily from 19 in 1987 to 28 at present. The majority of the increase in recent years is in developing countries which either need irradiated food for their domestic market or see an opportunity to develop market overseas. Spices and vegetable seasonings are the most common products which have been irradiated in some 20 countries. After the European Union issued a Directive which prohibits the use of ethylene oxide in food and food ingredients in January 1991, the use of irradiation to ensure hygienic quality of spices and vegetable seasonings has increased significantly, to over 30,000 tonnes in 1993.

The most significant event which created an awareness of food irradiation among the governments, food industry, and the media was the opening of the first commercial food irradiator in the USA, at Mulberry, near Tampa, Florida in early 1992. The successful sale of several fruits and vegetables both in Florida and other States was widely publicized by the media (Marcotte, 1992; Pszczola, 1992). In the Chicago area, a small grocery called "Carrot Top" reported that irradiated strawberries outsold non-irradiated ones by a margin of 10 to 1 to 20 to 1 depending on the time of sale. Apparently, the consumers were attracted by the premium quality of "natural field ripe" irradiated berries as compared to half- to-three-quarter ripe non-irradiated ones normally available. This retail store also reported significant saving by reducing spoilage losses from about 10% for non-irradiated strawberries to about 2% for irradiated ones. This reduction not only provided them with additional profit but enabled them to compete with larger retailers by offering better quality products at the same price charged by other store for lower quality products (Corrigan, 1993). The successful sale of irradiated produce has led to the sale of irradiated chicken at the retail level in the USA in late 1993 which was also successful.

A number of countries have approved the use of irradiation for extending shelf-life/ensuring hygienic quality of fresh and frozen seafood as well as frog-legs

(Table 2). Irradiation of fresh and frozen seafood in the USA is still not permitted although two companies submitted petitions to the US Food and Drug Administration to authorize commercial irradiation of these products in 1992. Currently, no country is using this technology for shelf-life extension or ensuring hygienic quality of fresh seafood. There is little potential in using irradiation on fresh seafood as long as regulatory authorities do not recognize health risks from consumption of this product which is naturally contaminated by Vibrio spp. which can cause illness and even death.

Irradiation is used commercially, however, to ensure hygienic quality of frozen seafood and frog-legs in Belgium, France and the Netherlands. Because of strict microbiological standards in France, frozen frog-legs and cooked, peeled and deveined shrimp are routinely irradiated for this purpose. The quantities of frozen seafood and frog-legs irradiated commercially in these three countries are relatively small, i.e. a few thousand metric tonnes per annum.

IMPLICATION FOR INTERNATIONAL TRADE IN IRRADIATED SEAFOOD

According to FAO (1992), the world trade in fresh/chilled/frozen fish and shellfish has increased steadily to over 10 million tonnes at the value of almost US\$ 30 billion in 1992. Fish and shellfish are important export commodities from developing countries. In 1992, developing countries exported about 3.5 million tonnes of these commodities at the value of US\$ 13.6 billion. The demand for seafood consumption in western countries has increased recently for health and nutrition reasons. To satisfy increasing demand for seafood especially shrimp in western countries, developing countries including China, Ecuador, Indonesia, and Thailand have increased the shrimp production for export through shrimp farming with increasing outputs. Such farming practices could increase the risk from contamination of Salmonella and related pathogenic bacteria because of the close proximity to human and animals in the vicinity. The contamination by these bacteria could be detrimental to the export market of this high value commodity. Shrimp, regardless of whether caught from the open sea or shrimp farms are naturally contaminated by Vibrio spp., however.

To ensure hygienic quality of seafood from non-spore forming pathogenic bacteria, terminal treatments such as irradiation which do not significantly affect the characteristics of the product must be considered. The treatment is critically important for seafood to be consumed raw or minimally cooked, to protect consumer health. There is already a worldwide standard, i.e. Codex General Standard for Irradiated Foods recommended by the Codex Alimentarius Commission of the FAO/WHO Food Standards Programme, since 1983. Such a standard recognizes the safety and effectiveness of irradiation as a method of food processing/preservation of any food commodities treated with a maximum overall average dose of 10 kGy.

The Agreement on the Application of Sanitary and Phytosanitary Measures, adopted during the Uruguay Round of GATT Multilateral Trade Negotiations in 1993 and to enter into force in 1995, should facilitate trade in seafood which have been processed according to a recognized international standard. Under this Agreement, governments which are signatories to GATT or a member of the World Trade Organization (about to be established) will have to justify the reason for denying entry of food (including irradiated food) which have been processed according to standards and recommendations of the following international organizations:

- A. Codex Alimentarius Commission (food safety and human health)
- B. International Office of Epizootics (animal health)
- c. International Plant Protection Convention (plant health).

An exception is made if the importing country can provide scientific proof that the importation of such food could endanger health of their citizens, animals or plants.

Since there is a Codex General Standard for Irradiated Foods recommended by the Codex Alimentarius Commission in 1983, then represented by over 130 governments, non-tariff trade barriers by importing countries solely because of irradiation treatment can no longer be accepted under the GATT procedures. International trade in irradiated food, including seafood, is likely to increase based on their technical merits in the near future.

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Table 1. Optimum radiation dose levels and shelf-life at 0.6 C (33 F) for fish and shellfish aerobically packed in hermetically sealed cans (87).

Seafood	Optimum dose (kGY)	Shelf-life (weeks)
Oysters (shucked)	2.0	3-4
shrimp	1.5	4
Smoked chubs	1.0	6
Yellow perch fillets	3.0	4
Petrale sole fillets	2.0	2-3
Pacific halibut steaks	2.0	2
Ring crab meat (cooked)	2.0	4-6
Dungeness crab meat (cooked)	2.0	3-6
English sole filets	2.0-3.0	4-5
Soft-shell clam meats	4.5	4
Haddock fillets	1.5-2.5	3-4
Pollock fillets	1.5	4
Cod fillets	1.5	4-5
Ocean perch fillets	1.5-2.5	4
Mackerel fillets	2.5	4-5
Lobster meat (cooked)	1.5	

Source: Ref. Quinn et.al, 1967.

Table II

CLEARANCE OF IRRADIATED FISH AND SHELLFISH

February 2, 1995

ITEM NAME	COUNTRY	TYPE OF CLEARANCE	DATE	DOSEMAX
DRIED FISH	BANGLADESH	UNCONDITIONAL	28/12/83	1
	BRAZIL	UNCONDITIONAL	08/03/85	2 . 2
	CHILE	UNCONDITIONAL	29/12/82	2 . 2
	SYRIA	UNCONDITIONAL	02/08/86	2 . 2
	THAILAND	UNCONDITIONAL	04/12/86	1
	UNITED KINGDOM	UNCONDITIONAL	01/01/91	3
	VIETNAM	CONDITIONAL	03/11/89	1
FISH	BANGLADESH	UNCONDITIONAL	28/12/83	2 . 2
	BRAZIL	UNCONDITIONAL	07/03/85	2 . 2
	CHILE	UNCONDITIONAL	29/12/82	2 . 2
	SOUTH AFRICA	CONDITIONAL	09/03/87	2
	SYRIA	UNCONDITIONAL	01/01/91	2 . 2
	THAILAND	UNCONDITIONAL	04/12/86	3 . 2
	UNTIED KINGDOM	UNCONDITIONAL	01/01/91	3
FISH PRODUCTS	BRAZIL	UNCONDITIONAL	07/03/85	2 . 2
	CHILE	UNCONDITIONAL	29/12/82	2 . 2
	THAILAND	UNCONDITIONAL	04/12/86	3 . 2
	BANGLADESH	UNCONDITIONAL	28/12/83	2 . 2
FROZEN SEAFOOD	INDIA	UNCONDITIONAL	02/03/91	6
	UNITED KINGDOM	UNCONDITIONAL	01/01/91	3
SHELLFISH	UNITED KINGDOM	UNCONDITIONAL	01/01/91	3
SHRIMPS	BANGLADESH	CONDITIONAL	28/12/83	5
	BELGIUM	UNCONDITIONAL	30/11/88	5
	FRANCE	UNCONDITIONAL	02/10/90	5
	INDIA	UNCONDITIONAL	02/03/91	6
	NETHERLANDS	UNCONDITIONAL	01/08/92	4 . 5
	THAILAND	UNCONDITIONAL	04/12/86	5
	UNITED KINGDOM	UNCONDITIONAL	01/01/91	3

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