Proceedings of the

INTERSTATE SEAFOOD SEMINAR '77

PROCEEDINGS OF THE INTERSTATE SEAFOOD SEMINAR
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Edited by

William R. Hess, Jr.

Virginia Polytechnic Institute and State University
Extension Division
and
Department of Food Science and Technology
Seafood Processing Research and Extension Unit
Hampton, Virginia 23669

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The Transcript of the Proceedings of the Interstate Seafood Seminar is being published for the first time with this edition. Many people were involved incompleting this publication. Mary Holliman gave valuable advice in preparation of this text. John Long and Elaine Ingram made important contributions in proofreading the copy. Elaine Ingram and Yvonne Holmes typed the manuscript. Jackolyn Richards designed the cover.

This is an edited version of the proceedings that took place in October 1977. The only changes in the transcript were made to turn an oral delivery into a written publication. Two talks were unavailable for publication: Keith Hay of the American Petroleum Institute, who spoke on "Development of Offshore Petroleum Resources"; Richard Skeppstrom, of the Citizens Against the Refinery's Effects. Also James B. Macy, Jr. presented a film on "Key Electro Sonic Mechanization in the Crab Industry" prepared by Key Electro Sonic Corporation; and finally, William J. Meyer of the Virginia State Health Department, presented a film "Water Movement in Soils."

INTERSTATE SEAFOOD SEMINAR HISTORY

CLUYDE WILEY

Tha National Shellfish Sanitation Program (NSSP) recommends that regional meetings or seminars be held for the discussion of problems at the regional and national level. The seminar for Region III is known as the Interstate Seafood Seminar. The first seminar was held in 1946. Subsequently this meeting has been held almost annually. Only 2-3 years have been missed.

This seminar is comprised of representatives from a number of federal agencies, shellfish regulatory agencies, Shellfish Institute of North American, shellfish industry members and numerous research organizations. The success of this program is obvious from its 30 years existence. In addition, it has become an inter-regional meeting attended by the above representatives from the entire Atlantic and Gulf coasts. Maryland, Delaware, North Carolina and Virginia serve as the host states on a rotational basis.

The purpose of the seminar is to improve the shellfish and crab meat sanitary control program. Each participant is privileged to improve his knowledge and efficiency by listening to experts in sanitation and other related fields; to learn from the association of others who do the same or similar work in other states; to come to the realization that our problems are not exclusively local, but are encountered and have to be dealt with by counterparts in other states in the district and even in other parts of the country and Canada; and to discuss freely problems and accomplishments.

The Interstate Seafood Seminar is not and was never intended to be one for the establishment of policy. It is an informal organization without elected officers. It has been and continues to be slanted toward the edification of all concerned and particularly those in day-to-day contact with the shellfish industry.

The Interstate Seafood Seminar has been designated by the U.S. Food and Drug Administration in the Federal Register as an official consulting organization.

ENVIRONMENTAL PROBLEMS AND NECESSARY CONTROLS TO PROTECT THE SHELLFISH INDUSTRY

Donald H. Noren

Ladies and gentlemen, good morning. I am delighted to be here and to be able to share some thoughts on problems encountered in pollution abatement and on controls which may be necessary to protect the shellfish industry, as well as ideas on what is being done and could be done.

Somewhat facetiously, I could sum things up by suggesting that my experience has shown that industry believes there are more controls than problems and that we bureaucrats believe the problems outnumber controls. But, as Director of an agency whose total reason for being is to protect the public health, I am daily reminded -- and very poignantly so -- that we wage a constant battle to keep the environment from being further degraded. Moreover, we are engaged in a never ending program to restore the environment from the sorry state to which man has reduced it.

In order to accomplish our public health goals, it often becomes necessary to impose controls. Controls generally are established only when conditions dictate that they are the only alternative. They should be constantly reviewed to determine if conditions have changed and then modified to meet those changes.

I firmly believe that controls may work two ways; that is, they may be restrictive, but they can also be protective. For example, controls placed on the methods of processing shellfish meats may restrict the industry's use of certain types of equipment or certain processes.

Simultaneously, these controls establish basic sanitary standards increasing consumer confidence and product credibility.

First, let us examine some of the problems associated with water pollution affecting the seafood industry and some controls to alleviate these problems.

In order to do this, I shall use Maryland as an example, for it is there that I am obviously most familiar with the programs we undertake to discover and deal with pollution.

The public health laws contained in Article 43 of the Annotated Code of Maryland assign supervision and control of the waters of the State, insofar as their condition affects public health to the Department of Health and Mental Hygiene and directs the Department to take steps to correct or prevent pollution.

In order to accomplish this legislative mandate, the Environmental Health Administration was established and charged with developing a multiplicity of approaches to prevent and correct pollution.

I am sure that Maryland is no different than any other state, in that by the time the whole ecology-"Mother Earth"-"Save-the-Bay" syndrome was in full force, we were faced with many outdated sewage treatment plants. Many were totally inadequate to serve the populations connected to them - the post war baby-boom and the rush to exurbia had outstripped our treatment capacity; many had frequent breakdowns with concomitant difficulty in obtaining repair parts; and many were being run by unskilled, untrained and uncertified operators. Simply stated, poorly treated sewage effluent was being discharged into Maryland waterways.

In 1973, the Environmental Health Administration, at the personal direction of Dr. Neil Solomon, Secretary of Health and Mental Hygiene, began an ambitious program to address and correct the problems associated with sewage treatment plants. These plants are now routinely inspected on a monthly basis for operation and maintenance by qualified personnel. Major plants having the greatest impact on water quality are inspected more often. All sewage treatment plant effluents are sampled at least twice monthly for all chemical and bacteriological parameters. This close surveillance program has been successful in the early identification of sewage treatment plants with faulty operation. Treatment plants in violation are notified and are given a specific time-table for correction. (Secretarial Orders permitted under statutory authority supported by courts.)

Some figures here would be pertinent as we examine what has been done. In 1973, there were 1,205 inspection and enforcement procedures undertaken against poorly operating sewage treatment plants. In 1977, there were 4,706 (an increase of 390 percent).

Sewage treatment plants are under constant evaluation to determine maximum allowable hydraulic and organic loading. Plants are prohibited from receiving flows in excess of maximums. Local health departments have been directed to become involved in building permit issuance procedures and are further directed to deny approval of permits where treatment facilities cannot satisfactorily treat projected flows.

Under Article 43, Section 406A, Health Laws of Maryland, the Department of Health and Mental Hygiene, through the Environmental Health Administration, requires all waterworks, wastewater works, and industrial wastewater works to be operated under supervision of certified superintendents. A nine member Board of Certification is empowered to review and evaluate applications and prepare and schedule examinations appropriate for plant classifications A through D.

The Environmental Health Administration is also charged with providing training which will lead to certification of operators. Academic training in Sanitary Technology Course for Sewage Treatment Plant Operators is provided through selected community colleges with tuition paid by the State. Approximately $19,000 was spent for tuition expenses in Fiscal Year 1975. Additional training is available through short courses, seminars and workshops developed and presented on a continuous basis by the Environmental Health Administration. These programs have been successful in promoting a more responsible operation of wastewater works.

Of 385 active sewage treatment plants in 1973, 131 did not have certified operators. In 1977, only 39 plants do not have certified operators. Many of these, however, are federal plants over which we have no jurisdiction.

Under the National Pollutant Discharge Elimination System, as administered by the Department of Natural Resources, the Environmental Health Administration reviews new and existing effluent sources. The Environmental Health Administration requires all new effluent sources of health significance to provide emergency safeguards as recommended by the Federal Food and Drug Administration and the Environmental Protection Agency for protection of shellfish waters. Effluents are required to meet bacteriological standard of less than 3 Coliforms MPN. Emergency holding ponds, auxiliary power sources for uninterrupted operation, dual chlorination units and other protective measures are required for each and every sewage treatment plant discharging to shellfish-producing waters. Sewage treatment plants discharging to shellfish waters are being required to provide the safeguards mentioned above by 1978.

The whole idea behind these safeguards is that they are designed to prevent unnecessary restriction of shellfish waters due to sewage treatment plant operating difficulties, which have been proven in the past to have a prejudicial effect upon the integrity of our shellfish producing waters.

Another approach to combating shellfish water pollution is to anticipate, identify and alleviate problems through responsible planning. In 1974, the Environmental Health Administration, together with other involved State agencies, conducted a Survey of Needs as a basis for this planning process.

The survey included evaluation of all existing sewage facilities, identification of all existing sewage problem areas, a determination of facilities needed to obtain acceptable levels of treatment and an estimate of facilities needed to serve populations projected to the year 1990. Existing sewage facilities were evaluated by the Environmental Health Administration, while areas in need of sewage facilities were indentified by the County Health Departments. A determination of the degree of wastewater treatment needed to meet water quality standards was made by the Water Resources Administration, estimates of costs were supplied by the Maryland Environmental Serice, and population projections were provided by the Department of State Planning. Specific local information was obtained from sanitary commissions, departments of public works and local elected officials.

Results of the 1974 Survey of Needs indicated that the State of Maryland would require approximately $4 billion to provide acceptable municipal wastewater treatment facilities through the year 1990. The survey further indicated that an estimated $9.5 billion will be necessary to provide effective control and treatment of stormwater runoff.

Each county in Maryland has been required by the Department of Health and Mental Hygiene to develop a Comprehensive Water and Sewage Plan and a Comprehensive Solid Waste Plan. Each plan anticipates needs, identifies areas in need of public water or sewage service and proposes possible solutions. These plans are updated annually to reflect changing needs at the local level. The Secretary has review and revisory power over these plans and - importantly - no building or other permit may be issued that is not in conformity with an approved plan.

Another cause of pollution is that of failing septic systems. In many areas of the State there are numerous small enclaves of people whose sole means of sewage disposal is through individual septic systems.

An important part of our ongoing program includes our sanitary surveys which are routinely made of areas disposing of sewage through the use of septic systems and are used to locate concentrated pollution problems. House-to-house surveys are conducted in all shellfish water areas and all major tributaries. These surveys are presently being extended further inland to identify upstream pollution contributions. This ongoing program of identifying septic system problems and referring these violations to local health departments has been exceptionally successful in correcting individual problems.

In areas identified by survey as having high concentrations of failing septic systems, we have helped communities design community wastewater treatment plants. Through State and Federal grants administrated by the Environmental Health Administration, we have been able to fund 87½ percent of the cost. Since 1975, nearly 750 projects have been funded or are in the planning process utilizing 650 million dollars in federal aid and 332 million dollars in state funds.

In conjunction with the sanitary survey program, the Environmental

Health Administration routinely monitors approximately 2,000 shellfish water sampling stations monthly for bacteriological contamination. These water samples are used to classify shellfish waters for shellfish harvesting and to identify areas where shellfish waters may be deteriorating. Many stations are used to monitor and determine the location of upstream pollution, so that sanitary surveys may be conducted to pinpoint sources and corrective action initiated.

Shellstock is routinely collected from areas open for the harvesting of shellfish. These samples are analyzed for bacteriological pesticide and heavy metal contamination.

This multiplicity of approaches and improvements has begun to show up quite tangibly in the bacteriological quality of our shellfish waters. Since 1974, we have recovered 87,654 acres of shellfish waters. But they have had their price, not only in terms of tax dollars, but also in terms of controls. The controls in these cases have been in forcing local governments to encourage construction of community wastewater treatment systems; in not issuing permits for septic systems in areas where the soil and water table do not promise success; in forcing local government to pay its share for improved and expanded treatment facilities, and in hiring certified operators and paying them what their training demands.

The problem of marinas and pollution is as emotional as gun control legislation is with the National Rifle Association. Boatmen jealously guard their right to use and enjoy the State's waters and, unfortunately, in too many cases, they jealously guard their right to pull the chain in the dock. Sewage, combined with gasoline and oil discharges which will come from every engine, sometimes make marinas a very difficult pollution problem to solve. As of December 1976, there were 130,000 vessels of all kinds registered in Maryland, with another 7,000 with federal documentation. Of these, approximately 35,000 are marina slip holders or own anchorage in small protected waters. There is no need to describe the pollution suffered by many of the State's rivers as a result of this congestion. Add to these 35,000 the 95,000 skiffs, dinghies, and runabouts, whose users cannot be on the water for a day without benefit of the head, and the problem broadens.

For nearly three years, personnel in the Environmental Health Administration have worked to promulgate regulations effectively dealing with the sanitary and sewage disposal facilities at marinas. This effort was brought about because of the serious concern about the ineffective means of controlling sewage discharges both from vessels docked or moored in the confined area of marinas and the ultimate treatment of sewage from on-land marina facilities. Of particular concern is the fact that most marinas are located in waters used for recreational purposes or shellfish harvesting.

It has thus become critical that the state develop an effective means of controlling the discharge of human waste at both marinas and in water designated as shellfish harvesting waters. For that reason, we have worked closely with the State Department of Natural Resources to try to develop a comprehensive plan to alleviate the impact of human waste from vessels. Such a plan, by necessity, must include the prohibition of discharges, treated or untreated, from vessels into specified waters.

The proposed Environmental Health Administration regulation governing marinas addresses such problems as sewage disposal facilities, pump-out facilities, minimum sanitary facilities, water supply and solid waste disposal. The thrust of the regulation, however, is to establish, within a reasonable time, pump-out facilities in all marinas to remove sewage from vessels using the marina. The effective disposition and treatment of this vessel sewage as well as that generated by the on-land operation is also considered.

The regulation envisions that all marinas which can be serviced by community sewage systems will be connected as soon as possible.

In 1975, the enabling legislation for the county Comprehensive Water and Sewer Plan was amended to require the inclusion of all existing marinas for consideration for sewage service within the plan. The Environmental Health Administration is also requiring 201 facility plans under the Federal Water Pollution Control Act of 1972 to include the location of marinas in the planning area and to identify those marinas needing sewage collection and pump-out facilities. These two requirements anticipate some of the planning necessary for implementation of these proposed regulations.

The establishment of adequate pump-out facilities as soon as possible will give recreational boaters a viable alternative to high maintenance discharge devices that produce effluent of a questionable quality. In this regard, we suggest immediate action be taken by the State to establish pump-out facilities in such areas as State Parks. Pump-out provisions in our proposed regulations should help increase the above facilities within a reasonable time.

Once pump-out facilities are established in all marinas, the State should establish "no discharge" zones by making application to the Administrator of the U.S. Environmental Protection Agency as required by Section 312 (f) (3) (4) of the Federal Water Pollution Control Act Amendments of 1972. Most of these zones will be shellfish harvesting waters. The actual establishment of "no discharge" zones should be established by the Department of Natural Resources by amendment to the established water quality regulations or by adopting a new regulation.

When we get to non-point sources of pollution, we face problems that are much less defined and more difficult to abate. Storm run-off is terribly difficult to handle, without constructing thousands of miles of drainage ditches, dykes, berms and pervious asphalt blankets. These along with sedimentation ponds, down drains, slope drains, weirs and vegetation and mulching are some of the many methods being tried to alleviate pollution from storm run-off.

The question of agricultural pollution is another emotion-laden problem. Many traditional agricultural practices must be reevaluated or redefined to prevent animal wastes or pesticide runoff from reaching our waters.

I have tried to give you some insights into some of the approaches that we are utilizing to address environmental problems which can affect the shellfish industry. But innovative approaches and solutions cannot be developed or implemented without a strong working relationship between various state agencies, and the seafood industry. Controls are necessary but they should be well thought out as to the goal they are trying to achieve and be reasonable in their approach. The Seafood Marketing Authorities, the Water Resources Control Agencies, Fisheries, State and local health departments, and the industry need to maintain open lines of communication to facilitate the exchange of information to prevent duplication of effort and conflict in regulations.

There will always be disagreements concerning the need, type and extent of controls. Wherever possible, these should be resolved through open discussion among the various agencies and industry.

Industry should be invited to participate in the drafting of rules and regulations affecting their livelihood so that basic and mutual understanding can be achieved. Controls are not necessarily synonymous with regulations. As I have shown, a very effective control - and benefit - can be the county water and sewer plan. All too often, though, by the time that plan reaches us for review, we find minimal input from some local agencies, citizens and concerned industry. This much-needed cooperative effort, however, in no way can be permitted to interfere with or compromise the integrity of the regulatory agencies or the trust vested in them by the citizens of the State. That statement not withstanding, it is my view that when those we are obliged to regulate know "up front" what is required or expected of them, our respective tasks are greatly simplified.

An excellent example of inter-agency and industry cooperation exists through the recently-established Maryland Oyster Resource Expansion (MORE) Task Force. The MORE Task Force is comprised of regulatory agencies, scientific researchers, economic and community development leaders, and industry personnel. The goals of this task force are to study means and mechanisms to increase the Maryland Oyster supply, to increase the processing capacity of the plant and to improve the marketing aspect of the industry. In order to meet its goals, the task force must thoroughly study the present conditions which affect the supply of the oysters, the present status of the processing industry, and new and better ways to market additional products from the water. As one can readily see, in order to assure safe increased supply and to assure safe quality products which are marketable on a nationwide basis, various controls must be considered. This would be true whether the controls are placed by the regulatory agencies or by the industry itself. The important aspect is, however, that it is an opportunity for both industry and the various state and research agencies to sit down together and develop comprehensive, manageable programs for the future.

Let us now turn to consideration of what I consider to be a most important development in public health and that is the passage of the Toxic Substances Control Act. Although Dr. DeCarlo will be speaking in detail about this this afternoon, I cannot let such an important development slip by without some reference to it in terms of protecting the shellfish industry.

As you well know, for many, many years the whole thrust in public health, which for all practical purposes embraces a large facet of preventive medicine, was concerned with communicable diseases. This preoccupation manifested itself in mammoth research efforts to develop vaccines for the prevention of numerous human diseases. Now, many diseases, especially childhood diseases, are preventable provided immunizations are received at the proper ages and at the proper intervals.

Today, we recognize that toxic substances in our environment constitute an ever growing threat to human health and our natural resources. The emphasis in public health is shifting to the study and identification of the health effects of known carcinogens and other toxic substances. Massive efforts are also now being directed toward the identification of other hazardous substances in the environment and the study of their effects, if any, on human health.

As Maryland's Toxic Substances Coordinator to the EPA, I have become deeply involved in these efforts. In Maryland, we have one whole unit which has made substantial progress in compiling an inventory of toxic and hazardous substances. Including known carcinogens, the inventory lists all substances manufactured, used in manufacture of other products or stored in various industries in the state. Another group has developed an inventory of hazardous wastes. We feel these inventories will begin to give us an insight on exactly what toxic substance is, where it is and why. After these inventories are complete, we can develop appropriate statewide policy regarding the use, storage, disposal, etc. of such substances. Toxic waste control is really the wave of the future; this is the new frontier in public health.

One only has to recall the incredible impact of what I choose to term "Industrial Irresponsibility" that the whole kepone mess has caused, especially in Virginia, and to a lesser extent in Maryland. Here the activities of one, small "boiler house" operation have virtually made one whole river, the James, useless to water contact sports, and sport and commercial fishing.

To contemplate how many other such questionable operations are causing as yet undiscovered dessimation of other bodies of water and land masses is awesome.

A recent report of the Second Task Force for Research Planning in Environmental Health Science, commisioned by the U.S. Public Health Service, states that "A high proportion of human cancer - commonly stated as between 50 and 90 percent - is mediated by environmental factors." Such a conclusion, even if we take the lower figure of 50 percent, indicates the magnitude of the problem as well as the magnitude of the research effort which will be needed to solve it. And here the report is only speaking of cancer. If we apply the same line of thought to other considerations with which the Task Force dealt, namely mutagenesis, terratamatous abnormalities from drugs or radiation, plus the plethora of other physical manifestations of environmental agents, such as arterio sclerosis, cardio-vascular disease and allergenic reactions, the scope of the research effort becomes, to say the least, macrocosmic.

As each new exotic substance used by man is uncovered, the future course of public health action will dictate that it - in all its environmental ramifications - will have to be subjected to the keen edge of scientific investigation.

To us here today, the questions we must ask are what happens when these substances get in the food chain. Will they - and we have no idea how many they are - create more closures of shellfish harvesting waters? Will the general public become so wary of eating marine life that the seafood industry will die? In the month of July, 1976, the public affairs section of our agency received more than 2,000 phone calls from the general public on kepone in seafood, alone. What the Virginia people received, I dare not think.

The simplistic answer to these questions lies in two general areas: first money, and second controls.

A 1975 public opinion poll commissioned by the EPA and conducted by an outside, private consultant concluded - and we must remember this was during a period of recession, acute energy shortage and long after being "an ecology freak" was fashionable - that "given a choice, most people (60%) indicate that they believe that it is more important to pay the costs involved in protecting the environment than to keep prices and taxes down and run the risk of more pollution." This says a lot about the American people.

Right along with that, we must obviously conclude that the cost of research of the kind I have been describing as outlined by the Task Force and implementation of the conclusions that research will dictate will be staggering and colossal. If Maryland has spent $1 billion on wastewater treatment alone - 1 out of 50 states - the cost of environmental health protection and research could reach, over the next several years, into the trillions.

The EPA poll also revealed that "acceptance of the concept of paying for pollution control may be explained, to a great extent, by the fact that an overwhelming number of people believe we are paying now for the pollution caused in the past."

Besides the cost we face in atoning for past environmental sins and in preventing future falls from grace, we come to the reverse side of the coin, and that is environmental controls. There is no question that these two are inexorably intertwined, for controls either require implementation of different methods which may require new and more costly equipment, or place restraint on production, both of which are reflected in the auditor's report. As we all know, the pocketbook nerve is the most sensitive nerve in the body.

It is my fervent hope that Allied Chemical and all of us who have been involved have learned a very important lesson from the kepone fiasco. No doubt there are a legion number of other industrial offenders whose sins may equal or even surpass the devastation wrought by kepone in the James.

Participation by and involvement in workshops, seminars, and training sessions will, in the end, provide the best kind of control. So, the time is ripe for industry to join together with us and acknowledge corporate responsibility for the preservation and protection of the environment. The days of uncontrolled exploitation for fast profit are as obsolete as the passenger pigeon.

In this day of investigative reporting, alleged or actual corruption in high places and the obvious loss of public trust in public employees as well as corporate bodies, the time has come for a new and valiant assault on all those activities which would demean the quality of life of all citizens.

We do live in a global community, whether we like it or not. The radioactive cloud let loose on the rest of the world by an atmospheric detonation of a nuclear device in China affects the child in Maryland or Virginia who agrees that "Milk is a Natural" as he eats his fruit loops at breakfast.

John Donne's "No Man is an Island" is as relevant today as it was when he lay dying and speculated on the many nuances the ringing church bell held for him.

And so, as we take councel together these next days on the many aspects of the seafood industry, I hope we can do so before a backdrop which is illuminated by a concern for the ineffable wonder of the world order in which we live. I hope that this concern will manifest itself in a desire to improve our stewardship over the waters where marine life live, and the methods by which we harvest and process these gifts from the sea for human consumption. That controls of varying kinds may have to be imposed should in no way deter our efforts, but rather should be viewed as necessary for the ongoing enjoyment of this most excellent and important source of food, and this most necessary source of income to the providers.

INTERNATIONAL IMPACT OF THE 200-MILE FISHING LIMIT

Milan Kravanja

Milan Kravanja of the office of International Fisheries, of the National Marine Fisheries Service, presented a discussion of the effects of the 200-mile fishing limit recently adopted by the United States. According to Kravanja, one of the main considerations in adopting the limit was the biological factor: some species of fish were being overfished. Shorter limits had allowed some foreign nations, sometimes with equipment superior to that of U.S. fishermen, to fish one the U.S. continental shelf without enough concern for the future availability of the fish.

The establishment of the 200-mile limit in March 1977 has had a domino effect on worldwide fishing limits. Fewer than 40 coastal countries now have a limit less than 200 miles, and these countries are likely to extend their limits.

The new law does not prohibit all fishing by foreign countries, but requires a permit before fishing. This permit specifies the species and allowable catches. Violators are subject to fines.

Kravanja believes that the limit will not, in the long run, hurt developing countries, since through effective management of the fishing waters the fish available for catch will actually increase in a few years.

CONSTITUTIONAL ISSUES ASSOCIATED WITH ESTUARINE MANAGEMENT

J. W. Looney

In February and March of 1968, Ronald Just hauled 1,040 square yards of sand onto his property located in Marinette County, Wisconsin, and filled an area approximately 20 feet wide. Part of this fill was within 300 feet of a lake and upon wetlands located contiguous to the water. The land owned by Just was designated as swamps or marshes on the United States Geological Survey map and was within a "conservancy district" under the shoreland zoning ordinance of Marinette County. This ordinance required that in order for owners to place more than 500 square feet of fill on such property a conditional-use permit was necessary. Just had not secured a permit (which cost $20) and was charged with a violation of the ordinance.[1]

This case, although dealing with protection of inland lakes, raised many of the constitutional issues involved in controlling private land use in critical areas. The basic issue involved is the conflict between the public interest in protection of natural resources and individual property rights.

At common law, property owners were generally free to use their land as they saw fit, subject only to the doctrine that no one should use land in such a way as to damage neighboring property -- the concept of private nuisance. Nuisance law has been the legal theory used in settlement of many conflicts between neighbors. In addition, the idea was extended to encompass situations where a particular use affected a large segment of the community -- a public nuisance. Public nuisance cases gave early judicial recognition to the idea that individual rights must sometimes be subservient to the public welfare. The state, through the exercise of its police power, may take action to protect public welfare, safety, order, morals and health.

The extension of the police power to statutory land use regulation was first upheld by the United States Supreme Court in the Euclid v. Ambler Realty Case in 1926.[2] In cases following Euclid v. Ambler Realty, courts have given substantial judicial deference to zoning ordinances although they are subject to review for possible infringement of constitutional safeguard.

One primary constitutional issue in such cases involves the provision of the United States Constitution which states, "...nor shall private property be taken for public use, without just compensation."[3] Because of this provision lines must be drawn between regulation under the police power and taking of private property for public use by exercise of the power of eminent domain.

In the years since the Euclid v. Ambler Realty case a wide range of regulatory schemes have been upheld as legitimate exercises of the police power (and hence not "takings" of private property).

The fuzzy line between regulation and taking has been described by Professor Gerald Bowden of the University of California as "an impressionistic expression obscured by ornate digressions."[4] Courts have attempted to define the line by various tests. The traditional view of "taking" as a physical divesture of property was used in several early cases. One example is the 1887 case of Mugler v. Kansas,[5] involving the Kansas prohibition law. The law was challenged by an owner of a brewery whose property had no other beneficial use. The United States

Supreme Court ruled that no taking was involved -- only a restriction in use -- and that the state possessed the power to protect public health, safety, morals and general welfare by enactment of the prohibition law.

Subsequent cases used a "balancing test" in which the social gain produced by a regulation is balanced against the loss to the individual owner as a result of the regulation. Such a test, applied by Justice Holmes in the 1922 case of Pennsylvania Coal v. Mahon,[6] is difficult to apply unless the private property rights have been rendered useless for all reasonable purposes. Even in such cases the test has not met with broad judicial favor.

A similar "harm-benefit" test has been applied in a few recent cases. Application of this test allows regulations that are designed to control harm to the public to be upheld, but those designed to secure a public benefit at private expense are not permitted. In State v. Johnson,[7] a 1970 case involving Maine's Wetlands Act, the court held that application of the Act was an unconstitutional extension of the police power. The court found that the landowner -- Johnson -- would be unreasonably deprived of a reasonable use of his property if not permitted to fill the land (a small tract of salt water marsh) so that it could be used for housing. The benefits of wetland preservation served the public at private expense.

Obviously, whether a particular regulation is designed to "prevent a public harm or to secure a public benefit depends upon one's perspective."[8]

Another consideration in determining whether a particular regulation is an invalid taking or an acceptable restriction on use is the "loss of value" as a result of the regulation. Significant value reduction is probably not, by itself, a basis for invalidity of land use regulations. In fact, the United States Supreme Court has on one occasion upheld a local decision denying a sand and gravel extraction permit although the result rendered the land essentially economically worthless.[9]

The conclusion from the prior cases can only be that any land use regulation must be subjected to close scrutiny (perhaps judicial) to determine if it is a valid exercise of the police power. Land use regulation for environmental purposes has received recent judicial management and the results are of particular relevance to coastal resource management programs. Of particular interest is the case of Just v. Marinette County, introduced above. The Wisconsin court upheld the constitutionality of the shoreland zoning ordinance and the restriction against filling on lakefront property. In ruling that the restriction was not confiscatory or unreasonable the court stated:

> "An owner of land has no absolute and unlimited right to change the essential natural character of his land so as to use it for a purpose for which it was unsuited in its natural state and which injures the rights of others. The exercise of the police power in zoning must be reasonable and we think it is not an unreasonable exercise of that power to prevent harm to public rights by limiting the use of private property to its natural uses."[10]

It has been argued that this case reflects a new attitude toward land use control for environmental purposes and may be a trend in judicial thought involving "ecologically fragile and important areas."[11] The case is of particular interest in constitutional law in that it deals directly with the "takings issue." However, the decision is broader than other similar cases and it may be necessary for the United States Supreme Court to ultimately decide the future of land use regulations of this nature.

A second important constitutional issue in land use regulation schemes arises from the constitutional requirement of equal protection of the law. This requirement applies to the states in the 14th Amendment to the United States Constitution in that no state may "...deny to any person within its jurisdiction the equal protection of the laws."[12]

In land use regulations there must be some rational basis for distinctions among landowners. Any plans providing for distinctions between landowners must carry out a permissible state objective in a rational way. The United States Supreme Court has ruled that environmental quality is a permissible state objective.[13] In addition, land use regulations have generally been upheld unless there is discrimination against some specific racial, economic or other group or some denial of a fundamental civil right. Courts much prefer to leave matters of judgment up to legislative bodies so long as the law is directed toward achieving some valid legislative goal. Recently, in the first case involving zoning to reach the United States Supreme Court in over 50 years, the court upheld a municipal ordinance which on its face appeared to discriminate against unmarried couples because it prohibited occupancy by two unrelated persons while allowing occupancy by a number of related individuals. The court emphasized the state objective as being related to environmental quality (wide yards, few people, motor vehicles restricted) and ruled that the ordinance did not unreasonably discriminate against a class or group nor did it deny any fundamental legal right.[14] Equal protection questions arise only in those situations where no reasonable basis exists for classifications within land use regulations.

A third Constitutional issue that occasionally arises in land use regulation cases involves challenges to legislation as "vague and impossible of compliance."[15] Generally, standards required by statute must be sufficiently clear so that the public will know what conduct is prohibited or permitted. On occasion, ordinances, statutes or agency regulations are found to be unconstitutionally void for vagueness but most language commonly used in land use regulations has been interpreted and construed by courts in the past and is no longer subject to attack.

All of the issues discussed above are relevant to land use regulations in general and do not apply solely to coastal areas. As federal, state and local governing bodies develop coastal zone management programs (in response to the Coastal Zone Management Act of 1977, as amended) these constitutional issues must be addressed. They may occur in management programs which regulate industrial activities in the coastal zone, in beach preservation programs and in wetlands regulations. The trend is to uphold regulation of large-scale commercial development, but the issue of the "denial of one man's beneficial use of a plot of wetlands or dune lands," however, is controversial and involves the outer limits of Fifth Amendment property rights[16] as illustrated by the inconsistent results in recent cases.

Additional legal questions, including some constitutional issues, are raised by land use regulations designed for beach preservation and the related questions of public access. Once again the problem arises when public and private rights come in conflict. If a coastal zone management program includes a commitment to preserve beaches, two conflicts with private ownership rights evolve. First, questions of use-restrictions are apparent. For example, the Delaware Beach Preservation Act[17] has been interpreted as preventing new construction from the toe of the dune line seaward and restricting construction on the landward side of the dune toe within the 1,000-foot zone.[18]

Secondly, questions of public access are involved. Traditionally, the public has had the right to use and enjoy the non-vegetated wetlands or intertidal flats with the boundary line of public ownership terminating at various points. The common law boundary, recognized by several states, is the mean high tide. Some states (Virginia, Connecticut and Delaware) have adopted the mean low water boundary. The trend in recent state court decisions has generally been in support of the public's right of access to beach areas including the dry-sand area which is often in private hands.[19] Not only have the decisions indicated a trend toward allowing public access but several have prohibited private uses which would interfere with public use. For example, in the 1969 Oregon case of State ex rel. Thornton v. Hay[20] the Oregon Supreme Court allowed an injunction to stand which prevented private construction in an area of dry sand between the line of vegetation and the mean high tide line on the basis that the public had acquired a preeminent right by customary use. Other cases have relied on concepts of prescriptive rights, dedication, public trust rights and implied reservation of public rights to establish public rights to use and enjoy the privately-owned portion of the beach.[21]

The real difficulty lies in the unresolved issues resulting from erosion of the shoreline. If upland development stops shoreline erosion and at the same time hastens the destruction of the beach, the public has lost the beach itself. But, if the private owner is forced to re-locate or re-design protection devices or is prevented from construction of such devices in the first place, the beach may retreat inland and public rights may follow at the expense of the private owner. Resolution of these conflicts will necessarily be a part of the policy-making decisions in coastal zone management. Courts will have to interpret policy decisions in light of the constitutional safeguards relating to property rights.

The same can be said for all the legal issues discussed here. Ultimately, these and other issues of coastal management will be resolved by the political process and not by the courts.

FOOTNOTES

1 Just v. Marinette County 56 Wis. 2d 7, 201 NW2d 761 (Wis. 1972).

2 272 U.S. 365 (1926).

3 U.S. Constitution, Fifth Amendment.

4 Bowden, "Legal Battles on the California Coast"2 Coastal Zone Management Journal 273 (1976) at 285.

5 123 U.S. 623 (1887).

6 260 U.S. 393 (1922).

7 265 A. 2d 711 (Me. 1970).

8 Supra, note 4 at 281.

9 Goldblatt v. Town of Hempstead 369 U.S. 590 (1962).

10 Supra, note 1.

11 Pedrick, John L., Jr., "Land Use Control in the Coastal Zone: The Delaware Example." 2 Coastal Zone Management Journal 345 (1976).

12 U.S. Constitution, 14th Amendment.

13 Berman v. Parker, 348 U.S. 26, 75 S. Ct. 98 (1954).

14 Village of Bell Terre v. Boras, 414 U.S. 907, 94 S. Ct. 234 (1974).

15 see dn re Spring Development 300 A. 2d 736 (Me. 1973).

16 Supra, note 11 at 362.

17 7 Del. Code Ann. 68.

18 Supra, note 11 at 355.

19 Burka, Paul, "Shoreline Erosion: Implications for Public Rights and Private Ownership." 1 Coastal Zone Management Journal 175 (1974).

20 254 Or. 584, 462 P. 2d 671 (1969).

21 Supra, note 19.

COASTAL ZONE MANAGEMENT: POTENTIAL AND SHORTCOMINGS

Sandra S. Batie

Last winter was a particularly severe one for Virginians as existing supply distributions of fuel were strained to meet increased demands caused by the coldest winter in over a hundred years. The problems faced by the citizens of Tangier Island, Virginia were no exception. However, they had an additional complication: oil tankers were unable to reach the island to replenish fuel tanks because the channels leading from Cheseapeake Bay to the storage tanks were silted in. The Army Corps of Engineers had designated $300,000 to deepen the channels, but could not proceed until an acceptable dredge disposal site was located. Much of Tangier Island is marsh, and island officials wanted to use one of these wetlands as a spoil site. They planned that this site would eventually become a public park. However, the Federal environmental agencies would not approve the wetlands as dredge-spoil site. During this dispute, one frustrated local official stated, "We lived on this clump of marsh all our lives and nobody's given two hoots about it. Suddenly the marshes have become more important than the people."[1]

Perhaps this local official overstated the situation, but he was certainly correct in his perception that changes have occured in public attitudes toward wetlands. Attitudes toward the management of other coastal resources: beaches, dunes, fisheries, agriculture and shorelines have also changed. Coastal resource allocation was at one time mainly a market allocation, where the forces of supply and demand, as description of protection and provision of public beach access, (8) the delineation of the process for locating energy facilities and managing their effects on coastal resources, and (9) the assessment of shoreline erosion and identification of erosion control measures. The Act specifies three optional types of controls: (1) direct state regulation, (2) local regulation consistent with state established standards, or (3) local regulation subject to state review.

There is nothing in the CZM Act that suggests direct federal action nor that suggests the Federal Act will itself probe the limits of the constitution.[6]

The Public Interest in Coastal Zone Management

Virginia, as well as 29 other coastal states, has elected to participate in coastal resource management as specified by the Federal legislation. The Coastal Zone Management programs of these various states are meaningless unless they produce an outcome that differs from what present market forces would have achieved without the CZM programs. Presumably the CZM will emphasize environmental quality enhancement by the alteration of existing and foreseeable development trends. Thus, the programs can be viewed as new institutional arrangements created within a political context with the intent of creating new property rights to the coastal resources. There is nothing unusual about this: all government regulations are an attempt to alter the property rights attendant to some property object - whether it is the right to unrestricted use of the citizen band frequencies or the right to place a beach cabin or a sewage outfall at a specific location. This perspective of the CZM programs as allocators of coastal resource property rights is important, however, when identifying the public interest in coastal resource manage-reflected in prices, dictated the use of coastal lands and waters.[2] Unfortunately, some services such as the waste assimilation capacity of the water and air, the fisheries productivity of wetlands, the amenities of open space, were priced at zero and used accordingly. The resulting land use pattern and attendant pollution, erosion and congestion was unsatisfactory to many. These dissatisfied individuals and groups of individuals have very effectively turned to the political arena for redress.

One response to these new political demands is the Coastal Zone Management Act of 1972 which states that "the Congress declares that it is the national policy to preserve, protect, develop, and wherever possible, to restore or enhance the resources of the Nation's coastal zone for this and succeeding generations."[3] The Coastal Zone Managemnt (CZM) Act is a Federal grant-in-aid program. States which agree to develop an approved program for coastal resource management originally received up to two Federal dollars for every state dollar spent while developing and administering the program. This Federal support has now been increased to 80% by the 1976 CZM Act Amendments.[4] The CZM Act does not compel a state to take action, but "encourage(s) the state to exercise their full authority over the lands and waters in the coastal zone."[5] However, any state management program must address nine items: (1) the identification of the boundaries of the coastal zone, (2) the inventory and designation of areas of particular concern, (3) the development of broad guidelines on priority of uses in particular areas, (4) the determination of permissible land and water uses which have a direct and significant impact on coastal water, (5) the determination of the means by which the state proposes to control those uses, (6) the determination of the organizational structure which would implement the managment program, (7) the ment programs. For, there is no public interest that is distinct and separate from selfish interests; government regulations are not altruistic endeavors.[7] Even the history of the Coastal Zone Management Act itself illustrates this point. "The Act did not grow out of a single concept advanced by a single interest or a set of compatible interests. It was brought about by discrete and sometimes discordant constituencies motivated by a variety of concerns and advocating the pursuit of diverse goals by a wide range of means.[8] At least four distinct clusters of political factors dominated the Act's history. Chronologically these were recreation development interest, estuarine protection interests, ocean development interests, and finally, land use control interests. These divergent interests in coastal resources remain, as well as those interests in the status quo arrangements such as those of present landowners, developers, and the construction industry. The mission of the CZM programs will be to arbitrate between these shellfish interests in the coastal resources.[9] Furthermore, each of these interests represents a use of coastal resources that is valuable. Should Tangier Island get fuel, a deeper channel, and a park at the expense of high productivity marsh? Fuel, channels, parks and marshes are all worth wanting; there are no villians, just choices.

There is No Such Thing as a Free Lunch

Thus, when one asks the strengths and weaknesses of CZM programs, one is really asking what is being sacrificed to get a different outcome than without the program. Further, are the results of the program worth the costs?

The costs of the CZM programs are threefold: (1) the costs of negotiating, administrating and enforcing the program, (2) the cost of opportunities foregone, such as cheaper coastal housing, and (3) loss of some individual choice with established interests in the previous allocation system.

The first of these costs, the cost of negotiating and administering and enforcing the program, are significant. Just the first two years of planning the Virginia Coastal Resource Management program, 1975 and 1976, cost the Virginia taxpayer over $327,000 and the Federal taxpayer $654,000, or approximately $1 million total.[10] That expenditure represents only two years of program development. Administering and enforcing the program has not yet commenced.

The second set of costs are those of the opportunities foregone. If society preserves a beach access or a wetland, it foregoes the alternative use of the land such as a marina, a park, or a high rise apartment. Furthermore, reducing the supply of these alternatives raises the price of existing marinas, parks, and apartments. Thus, altering property rights for residential or commercial construction so as to exclude construction in certain coastal areas suggests gains to existing homeowners, losses to existing owners of undeveloped, but now restricted, coastal land, higher housing costs and probably exclusion of lower income individuals.[11] One study estimates that the "cost incurred by a developer as a result of the standard regulatory process (in the coastal zone area) in New Jersey amounts to $4,584.00 per single family unit and $2,185.00 per multi-family unit. As a result of the new Jersey Coastal Area Facility Review Act procedure, these costs have now increased to $4,720.00 for single family units and $2,310.00 for multi-family units - an increase of $136.00 for single housing units and $125.00 for multi-family units."[12] Further, industries locate in the coastal zone frequently in order to capture various economies present there, such as lower transportation costs. Forcing these industries to locate elsewhere means forcing them to accept their second choice and the attendant higher costs. These costs will eventually mean higher product prices for consumers. Delaware's coastal program, for example, forces new heavy industry to locate off the coastal plain and by doing so grants a virtual monopoly to the industries presently located there.[13] Present industries gain the locational advantages and lower costs; newcomers cannot.

The third set of costs is that of loss of some freedom of choice for those with established interests in the pre-program property rights structure. "Wipeouts," financial losses from the changes in the property rights structure, are visited on owners of undeveloped but now restricted lands, developers and industries which must meet new regulations.

In California, AVCO Community Developers, Inc. estimated that delays in coastal commission permits are costing the company $13,000 day.[14] Another California company pays $700,000 a year in property taxes on coastal lands that strict coastal zone regulations have prevented it from developing.[15] Uncertainty as to future rights can further raise this set of individual costs as well as those of the opportunities foregone.

Trading Nickels for Dimes or Vice Versa?

What are the benefits purchased with these costs? There are a potential of at least four:

(1) the reduction of certain negative external effects eminating from land and water uses (e.g., pollution),

(2) the provision of certain demanded collective goods (e.g., beaches, views, parks),

(3) the reduction of costs of other public services,[16]

(4) increased individual choice for those whose interests coincide with the new allocation system.

Negative Externalities

Achieving benefits in the first category, the reduction of negative externalities such as pollution, is one of the main goals of most CZM programs. Reduction of pollution raises amenity and recreation values, increases the productivity of the estuarine system, and reduces human health hazards.

Achieving such a reduction is not guaranteed by simply legislating a reduction, however. Success depends on an understanding of the physical and social-behavioral relationships that cause the externality to exist and the ability of the CZM policy measures to influence these relationships.

For example, one goal of CZM programs is to reduce non-point pollution such as agricultural runoff. The motivation for controlling non-point pollution is that such pollution affects marine life and the recreation and amenity values of the receiving waters. Certain information is desirable for the design of public management strategies for reducing non-point pollution in a manner to achieve these benefits. First, is knowledge of the physical processes involved. That is, it is desirable to know how various land use practices affect runoff and receiving water quality. Second, it is desirable to know the social-political behavior relationships: what incentives or disincentives are influencing the landowners to select the present land use practices? Also, there needs to be a valuation of impacts. That is, an estimate of effects of the various levels of non-point pollution on <u>the value</u> of marine life and on <u>the value</u> of water quality is desirable. These values, when compared with information on the costs of achieving alternative land use practices would enable estimates of the net benefits for various "clean-up" levels by specific land use practices. Finally, the design of the management tool to achieve the desired level of cleanup will be more effective the more specifically it is directed at the external effect. "Measurement and administration problems aside, if we wish to reduce (non-point) water pollution, a tax on fertilizer residues in return flows from irrigation would be more effective than a tax on fertilizer or the crop to which the fertilizer is applied."[17]

Of course, the information bases available are scanty and incomplete, monitoring and measurement devices are costly and inconvenient. But regulating in a different manner with poor knowledge bases, say, with land use zoning, reduces the probability of achieving the desired result of reducing non-point pollution to an optimal level. For example, assume zoning mandates a border strip be left between creeks and agricultural lands. If the farmer responds to the reduced acreage available by increasing his fertilizer usage for increased yields, it is conceivable that fertilizer runoff will increase rather than decline.

The point is not that coastal zone management programs cannot be designed to achieve reductions in negative externalities, but rather that achievement of these benefits is not assured solely by legislating their achievement.

Hopefully, however, there is enough knowledge available regarding linkages between human actions and resulting environmental impacts to expect some mitigation of environmental damages and net benefits as the result of reasoned coastal zone public management. Protecting a particular wetland that serves as a blue crab nursery will provide recruitment into the crab population and presumably will add to the value of the crab harvest above the costs of achieving the environmental quality improvement.

One further benefit in this category is that of the provision of a "safety margin." To the extent that the linkages between coastal resources and various environmental values unknown or uncertain, society may wish to be conservative in the amount of alteration allowed. Preserving some wetlands, for instance, maintains future options that may be valued if either our demands for preservation services or our knowledge of the importance of these services increases. If these options can be maintained at reasonable present costs of present opportunities foregone and direct management costs, these "option maintenance" goals may indeed be associated with net social benefits.

Collective Goods

Another potential benefit that can accrue to CZM programs is that of the provision of collective goods such as parks, biological preserves, beach access, or attractive views. These are goods that have certain attributes that suggest the private market will fail to provide sufficient quantities relative to demand. Thus, there is a role for the public sector. Even here, however, the result will depend on the process used to obtain the collective good. If zoning and police powers are used to obtain these goods, the public body is not "price-constrained" and will have a tendency to overstate their desires for parks, beaches, preserves, etc. That is, if one group can fulfill their demands for public parks and beach access at zero cost to themselves, they will demand more parks and access than if they were required to bear some or all of the cost of obtaining these collective goods. In contrast, actual purchase of the previous owner rights will provide a barometer to measure the taxpayers willingness to sacrifice some goods (i.e., schools or crime control) in order to obtain others (i.e., beach access). In one study[18] of Santa Barbara residents, researchers found that although most respondents expressed a high degree of concern for the environment, over half would not agree to increase their taxes to guarantee an environmental improvement such as halving smog reduction or obtaining a tar free beach. Thus, Santa Barbara residents might demand clean beaches with political currency if the costs would be borne by others, but less than half were willing to back up their political currency with dollar votes. Obviously, a different amount of environmental quality improvement or collective good provision will be obtained depending on who is asked to bear the costs of achieving the change in the status quo.[19]

Public Service Provision

Another potential benefit that can probably be claimed by most CZM programs is that of the reduction of costs of public services. Low density settlements are preferred by consumers but they are also more costly in terms of public services than are high density areas. Thus, parts of the CZM program could conceivably be a pricing scheme that causes developers to take into account these additional costs related to the more dispersed settlement pattern, and thus cause consumers to bear the additional public service costs associated with a less dense locational pattern. Simply dictating the location of residences, however, while achieving the same economies in public service provision will sacrifice some benefits of consumer choice.

The Distributional Benefits

Environmental improvement is a luxury good. That is, as individual's incomes rise, they tend to demand more environmental amenities. Therefore, it is generally the higher income groups that have widened their choice set with a CZM program. The costs of achieving environmental quality which can include higher housing costs, lower production and employment schedules, higher product prices, reduced expenditures of public funds for other government services, are borne relatively more by the poor. Further, existing undeveloped landowners may lose development rights while non-owners may gain rights. Whether or not, one views such changes as benefits depends on whether you are a gainer or loser and whether or not compensation is paid.

The Score?

The possible benefits of CZM, then, are improved environmental quality, collective good provision, reduced public service costs and gains in choice for some individuals. The costs are the opportunities foregone which are then reflected in higher costs for development services, the transaction costs of negotiating, enforcing and administering any program and the losses of choice of some individuals. The problem in the design of a new institutional arrangement is to find the set of property rights which in the long run maximize the difference between the two, between the benefits and the costs of coastal resource management. Virginia's Office of Commerce and Natural Resources[20] is presently in the process of developing a coastal resource management proposal to submit to the legislature. Therefore, it is a fortuitious moment to ask what are the characteristics of a program that might be expected to lead toward a maximization of net benefits from coastal resource management.

Coastal Resource Management and Institutional Design: A Proposal

Historically, social intervention in the market place has been output oriented, determining the social output desired, such as environmental quality, and then regulating to achieve it. An alternative is to concentrate on the process by which resources are allocated and seek to correct the reasons the process has been faulty. The first approach replaces the market system, the second improves it. The first is a command control structure. The second is an incentive oriented structure.[21] The advantages of the second approach are that it reduces both the need for coercion and the need for appeal to morals, ethics or patriotism as a control mechanism. Further, it reduces administrative costs, and tends to allow innovation in meeting objectives and expands the role of personal choice.

For example, one strategy of non-point pollution control is through traditional land-use planning techniques such as zoning. Zoning is a command control strategy operating through the police power vested with the state.

A possible alternative to this regulation by zoning is a pricing alternative where land practices that result in high runoffs are taxed or land practices with low runoffs are subsidized. The private entrepreneur then has a choice of whether or not it is worthwhile to him to alter land use practices to the desired practice to avoid the tax (or gain the subsidy). The tax (subsidy) level can be set at a level that ultimately results in the appropriate aggregate number of acres in the land use.

There is nothing perfect about price incentives as management tools, but there is nothing prefect about regulatory procedures either.

Indeed, histories of previous governmental regulations suggest that it is not unusual for these governmental activities to produce sizeable externalities of their own.[22, 23]

Although the ultimate choice of the method of social intervention is a political one, there is a rationale for basing social controls on an analysis "of where and to what extend the private market fails to meet acceptable standards,"[24] and to design an improvement in the market process that protects the integrity of the private incentive system.

This approach is obviously not a traditional one in U.S. politics, and Virginia's Coastal Resource Program could not be expected to embrace it completely. Any incorporation of economic incentives in governmental policies for resource management will be a gradual process.

Coastal Resource Management and Institutional Design: Criteria

What criteria, then, would I apply in analyzing any Coastal Resource Management program in addition to the incorporation of economic incentives? I propose ten:

1. Are the objectives of the program specified as well as the process for achieving those objectives?

2. Do the objectives reflect recognition of the tradeoffs involved in resource allocation decisions?

3. Is there analysis of and consideration of the resulting employment level, income distribution, recreational facilities mix, housing prices and location, environmental quality and property right structure?

4. Does the program generate the information necessary for informed choices?

5. Is the authority and accountablity for management given to the level(s) of government that can be expected to incorporate considerations of those groups preceiving gains and losses from coastal resource use and management?

6. Is there a process expressed for weighing social gains against losses?

7. Does the program reflect an ability to manipulate the factors and incentives that will influence the realization of the objectives.

8. Is there a mechanism provided to determine if the objectives are being met?

9. Does the program provide flexibility to change objectives or procedures with changing information or changing values?

10. Are the direct costs of the program appropriate for the probable net benefits to be received?

These are obviously demanding criteria that highlight the difficulties in designing new institutions that do indeed result in net benefits from coastal resource allocations. However, the U.S. has been evolving toward more governmental regulation. Much of this growth in regulation has occurred since 1950.[25] surely we can learn from these 35 years of experience and improve our public management capabilities. I do not expect to immediately see an ideal coastal resource management program anymore than I expect an unregulated market system to be allocated ideally, but improving allocation institutions is a worthwhile social objective. It is a difficult political objective however.

> "Identifying heroes and villians, imputing values to technical choices, stressing the urgency of every problem, promising speedy results, and offering easily understandable solutions which specify outputs and rights - all of these are the common techniques of the political process whereby concensus is formed and action taken."[26]

I personally feel that society has evolved to a point of rejecting easy answers to complicated allocation problems. Virginia's Coastal Resource Management designers are aware that management is a complicated allocation problem, but careful institutional design requires political support. Virginia's program will be what it is demanded to be. I, for one, would like to be able to answer the gentleman of Tangier Island's lament that "marshes are more important than people" with "no, you are missing the point of coastal resource management - that of striking a desirable balance between the various competing and valuable uses of the coastal area's resources."

FOOTNOTES

1 The Roanoke Times, November 11, 1976.

2 Of course, market prices also reflected government programs and policies such as capital gain taxes, highway location, zoning ordinances, sewer locations, and credit availability.

3 Public Law 92-583, 92nd Congress, S 3507, October 27, 1972.

4 Public Law 94-370.

5 Ibid., Sec. 302(h).

6 Zile, Zigurds L., "A Legislative-Political History of the Coastal Zone Management Act of 1972, "Coastal Zone Management Journal, Vol. #3, 1974, p. 236.

7 Power, Garrett, "Altruism, Selfishness, and Coastal Resources." Coastal Zone Management Journal, Vol. #2, 1977, p. 116.

8 Zile, op. cit., p. 236

9 For more elaboration, see Sandra S. Batie and Burl F. Long, "The Public Interest and Land Use Policy: The Role of the State," Land Issues and Problems #21, September 1976, Virginia Polytechnic Institute and State University Extension Division, Blacksburg, Virginia.

10 Commonwealth of Virginia, Office of the Secretary of Commerce and Resources, Draft Application for Third Year Coastal Zone Management Grant, October 7, 1976.

11 Johnson, Bruce M., "Land Use Planning and Control by the Federal Government," No Land is an Island, Institute for Contemp. Studies, San Francisco, p. 83, 1975.

12 Richardson, Dan K., The Cost of Environmental Protection: Regulating Housing Development in the Coastal Zone Center for Urban Res., New Brunswick, New Jersey, 1976, p. 3.

13 Pedrick, J. L., Jr., "Land Use Control in the Coastal Zone: The Delaware Example," Coastal Zone Management Journal, Vol. 2, No. 4, p. 350.

14 Business Week, May 3, 1976, p. 71.

15 Ibid.

16 Ervin, D. E., et al., Land Use Control: Evaluating Economic and Political Effects, Ballinger: Cambridge, Mass., 1977, p. 8.

[17] Clark, Richard T., "Predicted Economic Effects of Environmental Quality Control Policies on Linear Models and an Application to an Irrigated Farm Model," Unpublished Ph.D. Dissertation, Oregon State University, Corvallis, Oregon, 1972. As cited in Ervin, op. cit., p. 10.

[18] Hetrick, Carl, Charles Luberman and Donald Ranish, "Public Opinion and the Environment: Ecology, the Coastal Zone and Public Policy," Coastal Zone Management Journal, Vol. 1, No. 3, 1974.

[19] One rationale for suggesting public purchase of rights is that the political longevity of the CZM program will depend on the successful management of "wipeouts" associated with obtainment of the objectives. Too many wipeouts can wipe out public environmental management by generating a political backlash.

[20] Fifth Floor, Ninth Street Office Bldg., Richmond, Virginia 23249.

[21] Schultz, Charles, "The Public Use of Private Interest," Harper's Magazine, May 1977, pp. 43-62.

[22] McKean, R. N. and Jacqueline Browning, "Externalities from Government and Non-Profit Sectors," Canadian Journal of Economics, Vol. 8, No. 4, November 1975, pp. 574-90.

[23] Even the Federal CZM Act, as amended, has given some recognition to regulation induced externalities. The Act requires the Secretary of Commerce to review the shellfish industry regulations and standards in order to assess the economic impact and determine if the benefits of the regulations do indeed outweigh the costs of the regulations.

[24] Schultz, op. cit., p. 44.

[25] "The growth of federal regulatory activities has been...striking. Even as late as the middle 1950s there were only four areas in which the federal government had a major regulatory responsibility: antitrust, financial institutions, transportation, and communications. In 1976 there were seventy-seven federal agencies engaged in regulating some aspect of private activity." Schultz, op. cit., p. 43.

[26] Schultz, op. cit., p. 24.

TOXIC SUBSTANCES CONTROL ACT AND IMPACT ON SHELLFISH CONTROL

Vincent J. DeCarlo

With the passage of the Toxic Substances Control Act on October 11, 1976, the Environmental Protection Agency has the authority to control the introduction and use of toxic chemicals in commerce. As shown on slide 1, through this authority EPA could regulate the manufacture, processing, distribution in commerce, use, or disposal of a chemical presenting an unreasonable risk of injury to human health or to the environment.

Today, I will describe briefly some of the more critical sections of TSCA, the chemical information base being developed at EPA, and the mechanism by which this will be beneficial to the shellfish industry in the future.

The Act can be characterized as having four main thrusts, as shown on slide 2. First, the law will be a vital source of new data upon which to assess the potential risks presented by current chemicals in our environment. Since only a few of the many chemicals used in commerce have been tested in laboratory animals for long-term effects; TSCA now gives EPA the authority to require the chemical industry to report existing data and to develop new data as deemed necessary to clarify possible risks.

This legislation has often been termed a "front-end" approach to chemical problems. Under the Act, manufacturers of new chemicals and of existing chemicals with significant new uses will be required to report to the administrator 90 days before they market these chemicals.

While this mechanism is far short of a certification or registration procedure, it gives EPA a chance to review and take action to prevent hazardous chemicals from coming on the market.

A third facet of the legislation is the regulatory authority to take action necessary to protect against harm from toxic substances. The new law provides, however, that before the Administrator can take regulatory action against a chemical, he must balance the benefits of the chemical, the availability of substitutes, the economic impact and other related costs associated with the proposed action.

Finally, the bill provides the impetus for improving coordination among Federal Agencies concerned with the health and environmental effects of chemicals. For example, the EPA Administrator, in consultation with HEW and other Federal Agencies and Departments, is required to devise a system for collecting and retrieving scientific data which will be useful to the Administrator under this Act. The system, once in place, will be useful to all regulatory Agencies, providing them better data upon which to base their regulatory actions.

Slide 3 lists five of the more important sections in TSCA. I would like to discuss some of these areas briefly.

<u>Testing</u>

As directed by the Act, EPA has organized an Interagency Testing committee on chemical substances. This committee has been reviewing current industrial chemicals to designate 50 priority chemicals for further testing. Listing has required that they consider:

1. amount manufactured and released to the environment;
2. human exposure in the workplace and general population;
3. carcinogenicity, mutagenicity, teratogenicity;

4. behavorial effects; and
5. synergistic and cumulative effects.

Premarket

This authority requires that manufacturers and processors of new chemical substances, or of chemical substances for which a significant new use is intended, to notify the Administrator of their intention -- at least 90 days in advance of manufacturing or processing.

Within the 90 day period, the Administrator must decide whether to allow a chemical to be manufactured or processed; or to limit its manufacture, distribution, use, or disposal.

Regulations

We are also in the process of developing specific rules to control polychlorinated biphenyls (PCBs) and chlorofluorocarbons. Section 6 (e) of the Toxic Substances Control Act requires the Agency to follow a strict regulatory schedule to eliminate PCBs from use. The first regulations were promulgated on May 24, 1977, and cover the labeling of PCB products and the disposal of PCBs. By January, 1978, we must promulgate rules which restrict PCBs to use in closed systems. By January, 1979, we must promulgate rules prohibiting any further processing and distribution of them in commerce.

The chlorofluorocarbon rule will cover non-essential aerosol uses, and is being developed in coordination with the Food and Drug Administration and the Consumer Product Safety Commission.

Reporting

Reporting is required of manufacturers and processors of selected chemicals. The information of interest includes the chemicals's identity, use, production level, byproducts, adverse health and environmental data, and the number of workers exposed to the chemical. Some of this data will be available; much of it will not.

Citizens Petitions

Citizens petitions are allowed under the Act. To date most have been concerned with CFCs and PCBs. A recent petition from EDF has requested that non-pesticidal uses of ethylene dibromide be regulated. EDB finds its major useage as a gasoline additive. Slide four lists some of the ongoing program activities; developing potential regulatory information.

Chemical Information

1. Inventory

The Administrator is required to publish an inventory of all existing chemicals. The purpose of this list is to identify chemicals already in use so that manufacturers of new chemicals will know whether they are subject to the premarket reporting requirements. That is, by checking the inventory, a manufacturer will be able to determine whether his chemical is in fact "new".

The dimensions of the chemical industry suggest the magnitude of the undertaking EPA is now facing. We estimate that there are approximately 30,000 chemicals in commerce which will be subject to the legislation and approximately 1,000 new ones which may be introduced into commerce each year. The major data categories which may be collected and some examples of data elements are shown below:

• SUBSTANCE IDENTIFICATION	• PRODUCTION
Structure	Quantity
Physical Properties	Location

- USAGE
  - Function
  - Application
- EXPOSURE
  - Workplace
  - General Population
  - Environmental
- ENVIRONMENTAL EFFECTS
  - Bioaccumulation
  - Disposal
- ECONOMICS
  - Cost
  - Substitutes
- TOXICITY
  - Metabolism
  - Acute
  - Subacute

Two major design techniques are of note. The chemical substance identification is crucial to the system -- it must be effective both in the sense of chemical description and computer processing. We selected the Registry System of the Chemical Abstracts Service (CAS), Division of the American Chemical Society. A second design tactic was to publish a preliminary candidate list, in order to reduce the reporting and processing burden. A list of 33,800 chemical substances was compiled from a variety of published sources. This candidate list is accessible by three keys: CAS Registry Number; CAS name; molecule formula. It was published in hard copy from computer printed copy as a three volume set of some 2,000 pages. It is also available on several on-line computer networks, in particular CHEMLINE, Lockheed Dialog Network, and Tymeshare. Manufacturers of substances on the candidate list need only report the registry number of each substance -- thus increasing the accuracy of reported information while significantly reducing the processing burden. Narrative reporting has been minimized to as great an extent as possible.

The Information System is now in the design state and will incorporate analytical capabilities to respond to well structured queries i.e., all manufacturers and processors of specific chemical substance on a particular waterway.

Hazard Evaluation

These are in-depth chemical evaluations covering:

(1) product flow from manufacturer, various uses, and disposal;

(2) health assessments covering animal toxicity data, available epidemiological data, and possibly new data on low level such as effects on the central nervous and endocrine system;

(3) ecological assessments, considering environmental movement, environmental sinks, bioaccumulation and environmental chemistry;

(4) environmental assessments, identifying air, water, soil and biota measurements around known manufacturing sites; and

(5) risk assessment considering the critical receptors and evaluating the population at risk.

Environmental Measurements

1. Unrecognized Pollutants

In addition to measuring the environmental levels of specific chemicals, the Office of Toxic Substances, using advanced analytical techniques, such as GC/MS, can determine, in a general way, what organic chemicals actually exist in the environment. To this end, a program has been underway for the last two years with the University of Illinois in which approximately 200 water samples from heavily industrialized river basins have been collected. A total of 310 different compounds have been identified at levels from less than 1 ppb, including 110 different volatile compounds and 200 compounds from the solvent extraction step. The 310 compounds reduce to 240 compounds if one considers only those compounds showing up a 1 ppb level or higher. The volatiles then account for 100, and the solvent extracted for 140, of the total. Slide five gives an overview of the general area in the United States where samples were taken with an indication of the number of samples taken in a given area.

The most frequently occurring compounds are shown on slide six.

The University of Illinois water study is now being followed by a study to identify trace organics in 150 different effluent pipes. Samples are being obtained from a broad range of industrial effluents.

2. Recognized Pollutants

Major air, water, soil, and biota measurements, around industrial sites have been undertaken for benzene, trichloroethylene, methylchloroform, organo tins, acrylamides, chlorinated naphtalenes, chromium VI, β-chloroethers and polybrominated biphenyls.

The polybrominated biphenyls are a recent and interesting study and the commercial products are shown on slide seven. The study has been underway since February, and the initial results released by the Agency in June. The problem, until February, centered in Michigan, where widespread contamination of dairy herds and food occurred in 1974 when PBBs from the Michgan Chemical Company were inadvertently mixed with animal feed. Michigan Chemical was the only known plant in this country that manufactured polybrominated biphenyls for domestic use. The plant was closed in November 1974 as a result of the incident.

In January 1977, we learned that there were several other plants in the United States still manufacturing this chemical and initiated a field sampling program to determine if PBBs were being released to the environment. The plants identified were White Chemical in Bayonne, NJ, and the Hexcel Corp., Fine Organics Division in Sayerville, NJ and are shown on slide eight. As a result of this monitoring effort, PBBs were found in human hair, fish, plants, soil sediment, and water in the New Jersey area. Compounds identified in White Chemical Company's outfall are listed on slide nine. The State of New Jersey, FDA, and OSHA are coordinating in this effort with EPA.

Regulatory Efforts

I have mentioned that the regulatory efforts currently under TSCA include regulations for PCBs and CFCs. In addition, the first regulatory PBB Work Group was held yesterday. They will consider regulating use and manufacturing of PBBs under TSCA using Section 6 (a) and 6 (b). Under Section 6 (a), the use of PBBs would be prohibited; new uses would then be subject to review under Section 5, Pre-market review. Under 6 (b), quality control limitations would effectively control the manufacture of PBBs for export and eliminate any air and water emission. It is expected that rulemaking for PBBs will be initiated this coming July. Other chemicals are under consideration for control under TSCA, but firm regulatory decisions for these have not been made as yet.

SLIDE 1:

REGULATORY AUTHORITIES UNDER TSCA

MANUFACTURE
PROCESSING
DISTRIBUTION
USE
DISPOSAL

SLIDE 2:

THE FOUR THRUSTS OF TSCA

TO OBTAIN BETTER INFORMATION FOR USE UNDER SEVERAL AUTHORITIES.
TO PREVENT PROBLEMS THROUGH PREMARKET SCREENING.
TO BALANCE COSTS, RISKS AND BENEFITS IN ENVIRONMENTAL DECISION-MAKING.
TO ACHIEVE COORDINATION IN FEDERAL GOVERNMENT ACTIVITIES CONCERNED WITH TOXIC SUBSTANCES.

SLIDE 3:

TSCA SECTIONS

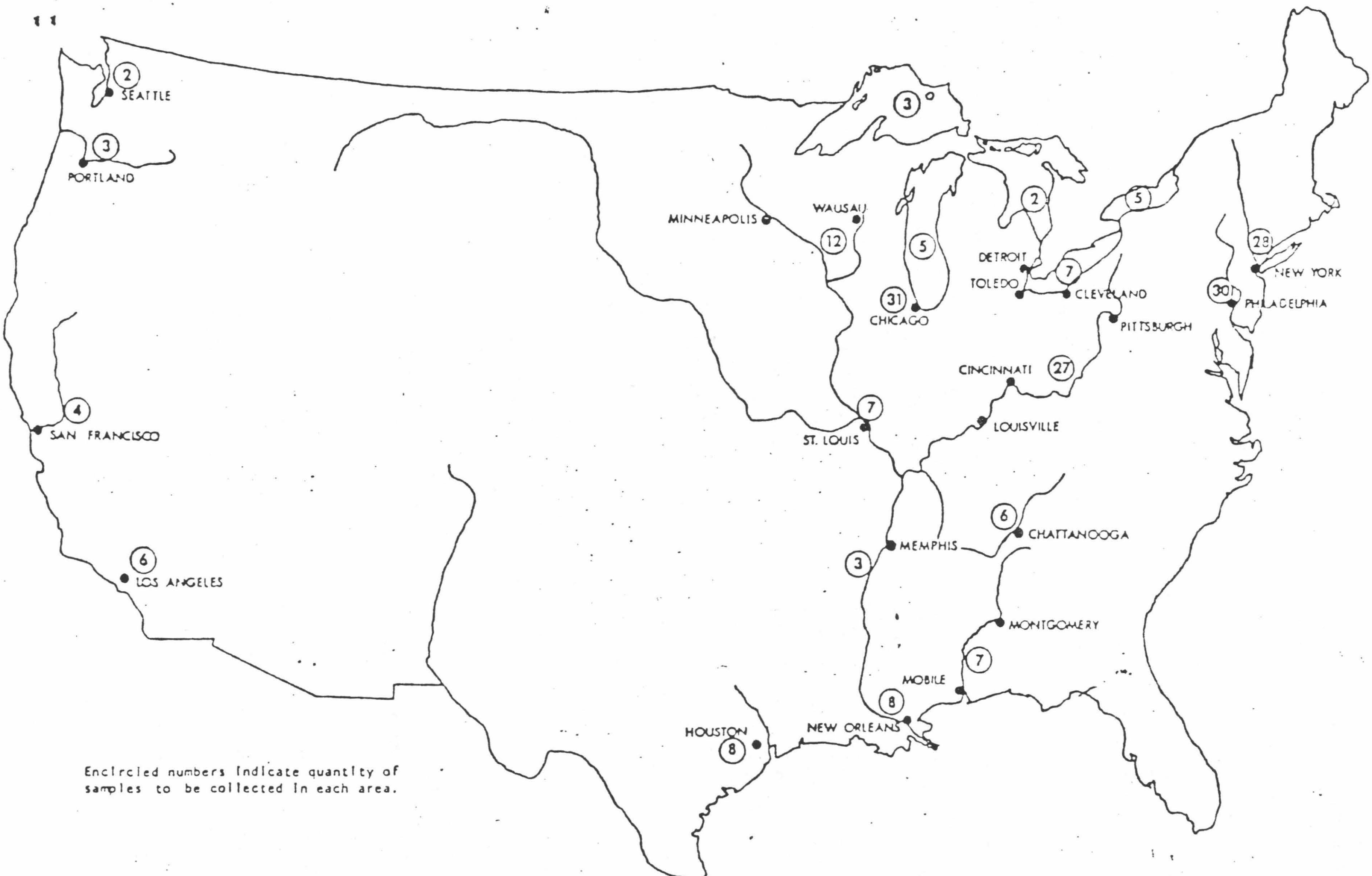
TESTING
PREMARKET
REGULATIONS
REPORTING
CITIZENS PETITIONS

SLIDE 4:

TSCA ACTIVITIES

CHEMICAL INFORMATION	HAZARD EVALUATION	ENVIRONMENTAL MEASUREMENTS	REGULATORY
INVENTORY	MARKET	UNRECOGNIZED	PCBS
DATA BASE	HEALTH	RECOGNIZED	CFCS
PHASE I			
II	ECOLOGY		PBBS
III	ENVIRONMENTAL DATA		OTHER
	RISK		

UNIVERSITY OF ILLINOIS SAMPLING SITES



Encircled numbers indicate quantity of samples to be collected in each area.

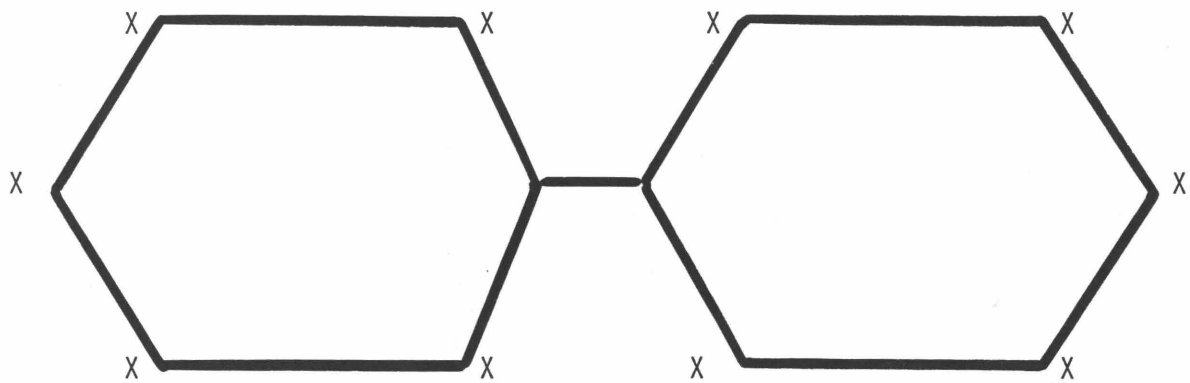
SLIDE 6:

CHEMICAL COMPOUNDS IDENTIFIED IN SURFACE WATERS

FRACTION ANALYZED	GENERAL CLASSES OF COMPOUNDS	MOST FREQUENTLY OCCURRING COMPOUNDS
Acid Fraction	Alcohols Fatty Acid Methyl Esters Phthalate Esters Polycyclic and Polyunsaturated Hydrocarbons Hydrocarbons Substituted Phenolics Halogenated Hydrocarbons	Methyl Palmitate Methyl Stearate Diethylhexyl Phthalate C_{15} Terpineol
Base Fraction	Phthalate Esters Hydrocarbons Halogenated Hydrocarbons Polycyclic and Polyunsaturated Hydrocarbons	Diethylhexyl Phthalate Dibutyl Phthalate C_{15} Terpineol C_{10} Terpineol
Volatile Organic Analysis	Halogenated Hydrocarbons	Chloroform Trichloroethylene Tetrachloroethylene 1,2 Dichloroethane Benzene Acetone Dichloromethane Toluene Bromo-Dichloromethane

SLIDE 7:

POLYBROMINATED BIPHENYLS



(209 Theoretical Isome)

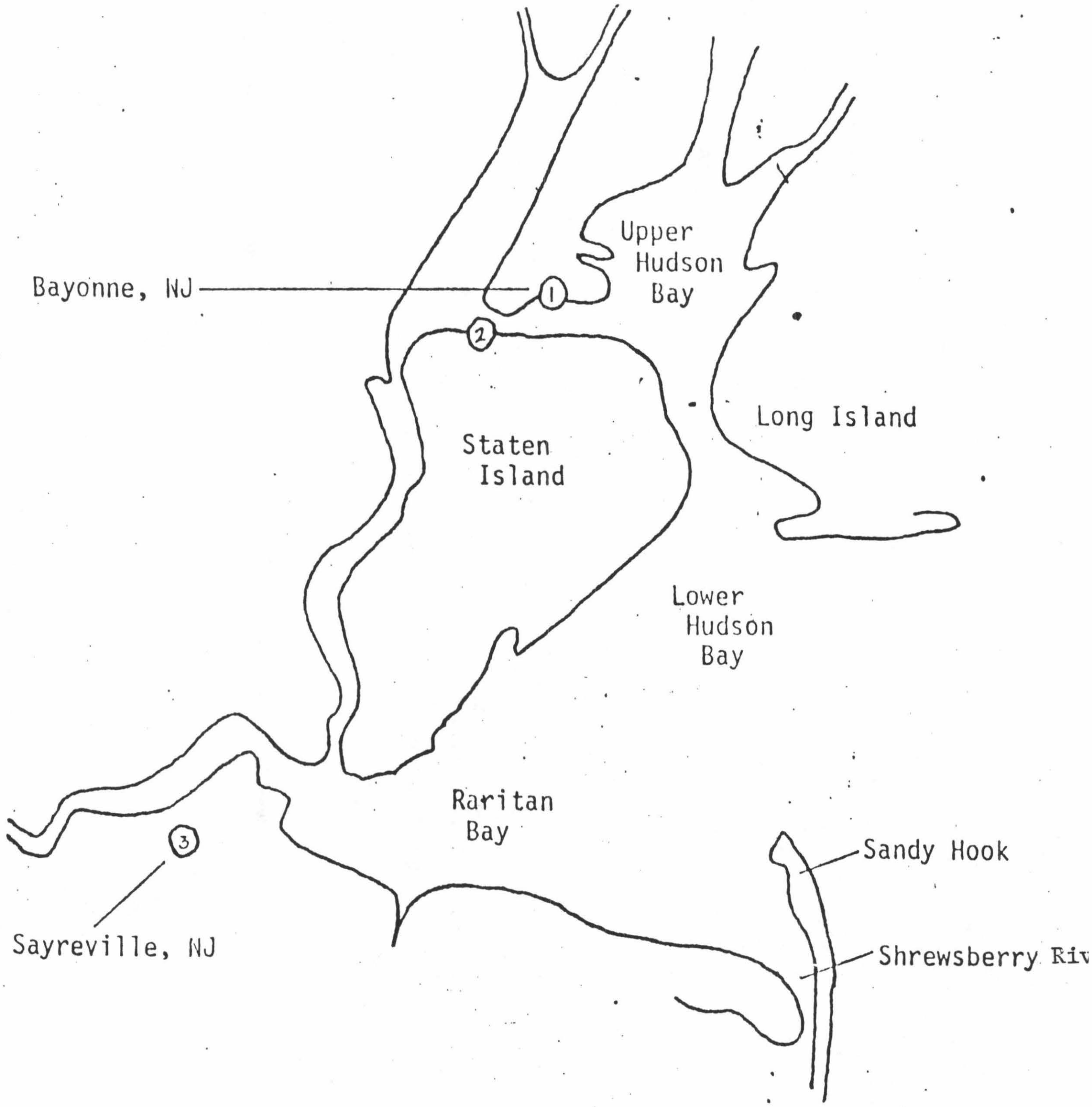
COMMERCIAL MIXTURES

Firemaster BP6	Firemaster FF1	Octabromobiphenyl	Decabromobiphenyl
2% Tetra	BP-6+	2% Hepta*	*
10% Penta	Anticaking Compound	45% Octa	2% None
63% Hexa		47% Nona	98% Deca
4% Hepta		6% Deca	
11% Other			
Brominated Naphthalenes			

EUROPEAN PRODUCTS

Brokal 80 (Germany)	Flammex B-10 (England)
1% Hexa	?
27% Hepta	
72% Octa	
TR Nona	

NEW YORK - NEW JERSEY AREA



1. WHITE CHEMICAL COMPANY (PRODUCER)
2. STANDARD T CHEMICALS (USER)
3. HEXCEL CORPORATION - FINE ORGANICS DIVISION

SLIDE 9:

COMPOUNDS IDENTIFIED IN WHITE CHEMICAL COMPANY OUTFALL

Dibromobenzene
Tetrabromoethylene
Tribromotoluene
Tetrabromobenzene
Tribromobiphenyl
Pentabromotoluene
Hexabromobenzene
Tetrabromobiphenyl
Tetrabromodiphenyl Oxide
Pentabromobiphenyl
Pentabromodiphenyl Oxide
Hexabromobiphenyl
Hexabromodiphenyl Oxide
Heptabromobiphenyl
Heptabromodiphenyl Oxide
Octabromobiphenyl
Octabromodiphenyl Oxide
Nonabromobiphenyl
Nonabromodiphenyl Oxide
Decabromobiphenyl
Decabromodiphenyl Oxide

VOLATILE ORGANIC COMPOUNDS IDENTIFIED IN WATER SAMPLE TAKEN FROM KILL VAN KULL

COMPOUND	APPROXIMATE LEVEL (PPB)
Dichloromethane	2
Tetrahydrofuran	1
1,2-Dichloroethylene	2
Chloroform	4
1,2-Dichloroethane	1
1,1,1-Trichloroethane	1
Trichloroethylene	4
1,1,2,2-Tetrachloroethane	1
Tetrachloroethylene	4
Dichlorobenzene	8

PROBLEMS WITH CONTAMINANTS IN SEAFOOD

John Emerson

This title probably covers about twenty-five to fifty percent of everything of concern to this seminar. I think you could make a list of problems that contaminants in seafood present to the public, to the agencies that are trying to protect public health and to the seafood industry. The small aspect of it that I'm going to talk about will deal with the problem of contaminants as they affect seafood products. It has nothing to do with the large problem they can present to the living resources. But even in that little sector, we have many objectives. The main objective is to protect public health. There are other concerns.

The economic impact of such things on the fishing industry, the concern of the consumer himself as to the safety of seafood whether it be real or imagined, the cost of the problem of regulating and action levels or actions that may be taken to resolve this problem, and the cost to the public and the taxpayers are other problems facing regulatory agencies. Is there a drain on the regulatory agencies in terms of money and manpower on any particular contaminant? There's the cost of developing information that is necessary to come up with a valid action level. A high cost is involved in terms of setting an action level because of all these other costs and problems it presents. It is absolutely essential that there be a valid regulation. So, this level should be a valid level. In very simplistic terms there are perhaps four general types of information needed to establish an action level, which is a very complex process in itself. There are generally four types of information. One is the toxicity of this material. In this case, we're talking about toxicity to humans. Another is consumption patterns of seafood consumers and the level of the particular material in seafood. There is a fourth area that involves the chemical interaction between this particular hazardous material and others which may be in the fish that may increase or decrease in toxicity.

In that regard, the National Fishery Services engaged in a program or project to put some of the information that is available into a context which will allow a better assessment of the action level for mercury in seafood, the present action level being .5 parts per million. The .5 action level was established on the basis of the best information that was available in 1969. There was an absolute need to establish an action level because people had been poisoned by mercury, and we knew it was in the fish.

In the last eight years, a lot of information of the type I mentioned has been developed; much of it has been only fairly recent. We're at a point now where you can make a new assessment of that guideline for mercury and put it into a better context so that we can assess the actual risk of mercury in seafood to consumers. By consumers, I don't mean 200,000,000 people in this country on a per capita consumption basis, but I mean the people who in fact eat seafood, what species, how much and how often they eat it. We're talking about young children and women; whether they are pregnant, healthy or aged. All these things must be considered. We are just not finishing up a development of the computer model which will permit an assessment of the statistical risk by individuals of mercury in fish. This computer program might be developed under contract from us by the same indivudual that developed a very similar program for Kepone in the Virginia situation. In fact, he did such a good job in that case that EPA was able to raise the interim action level for Kepone, which was at .1 parts per million in finfish, up to .3 parts per million.

The computer model takes all the information we have on mercury levels in fish by species and combines this information with seafood consumption information. So that, for example, on the consumption side you have an individual that eats sole fish. We know how much sole fish he consumes. Then from the other side, we have how much mercury is in sole fish. Put that together and the computer will tell you his average daily intake. The allowable daily intake (ADI) for mercury right now is 30 micrograms a day per individual. When we take our data through the model for this individual who ate sole fish, we can determine how much mercury intake on the micrograms per day basis, and if it does or does not exceed 30 micrograms?

Now, it's fairly simple and straightforward in that respect. It assumes that the consumption information we have is accurate. This was done through a consumption survey where people filled out their own forms. We can do this over a sample for indivduals, where 25,000 people participated in this consumption survey. So you can get a very good statistical projection from a nationwide standpoint as to what is the risk throughout the nation of people eating all fish containing mercury. What kind of problem does it present if it does present a problem? We can say to whom it presents a problem and what is the extent of it all measured against the yardstick of this 30 microgram ADI. We could plug in data of any chemical contaminate of this type, if we have the information that we're talking about. So the mercury data came from a resource survey which was over 200 species of all fish and of shellfish. Primarily they were marine species, but there were some freshwater species included. And on top of that, we added such additional data that we're gathered through in-depth surveys, which would be more extensive information on species where there might be a problem. So we have a lot of data, for example, on lobster, swordfish, tuna and some of the Gulf species.

In the case of mercury, generally speaking, shellfish come out pretty good. It seems to be primarily a finfish problem. The survey was conducted by National Purchase Dairy, Inc. (NPD) and they provided information in April, 1977. I must say though, that the original survey NPD conducted was the result of a contract from the Tuna Research Foundation. I mention this only because I think it significant that the fishing industry itself has taken the initiative to provide information, which in my opinion, the Federal Government should have had years ago.

Now this is very important because it's the individual's health that the regulatory agencies were charged with protecting. I can't talk in broad terms like families, or geographic areas , etc. Also the individual himself has to be defined as to whether it's a young child or a woman of childbearing age. The survey did ask the women who were polled if they were pregnant. I think ten women admitted it or knew it. But in case we did ask their age. Whether we got an accurate age from all these women is something else, too. But it's probably more significant to know whether they're childbearing age, or whether in fact they are pregnant. The concern here is with the fetus, the effect of mercury on it and not the woman herself. The survey covered 7,000 plus families and 25,000 individuals. Nearly 5,000 of the 25,000 were young children. Young is defined as 10 years old or less. And for the pregnant women, there were 3,000, which gave us a little better data.

Now, what it does is to estimate the risk and the percentage of risk to .01 of one percent probability. Now that's pretty fine. In fact, the gentleman who is our contractor, is a statistician and a mathematician. He said that's about the limit of the math and the statistics involved. You just can't meaningfully make it any finer than that. So we're getting down to that level of risk. It will also identify the individuals in the consumption survey. Now if you know if it's a man and his age, you also know what he ate. The species will come right through. For example, if his total seafood diet came out to be 40 micrograms per day then it will print out the species that he consumed throughout his diet and their individual contribution to this 40 micrograms. It is very easy then to see which fish, in his particular case, may be causing his problem relative to the ADI.

You have to be careful how you interpret some of these things. It could just be fish from a certain area, which is very good. But I was amazed at how many other species did not come through this first run; species that we would otherwise thought were presenting some serious problems.

Well I don't want to make too many conclusions, obviously about a rough program like this. It does sort of indicate to me, and I think to the FDA, that the .5 guideline which covers all fish and shellfish as a magic number really isn't the best way to go about it. If there could very well be a column of mercury in fish, I think it is up to us to determine exactly what that problem is and what kind of a hazard it really presents. I think up to this time we have been forced to make a lot of educated guesses and the more information we get and by putting the puzzle together in a proper fashion, I feel we will be able to say if there is a problem and how large a problem it will be.

Significance of Estuarine Sediments on Water Quality

Bruce J. Neilson

I was asked to speak on the subject of sediments and their role in water quality in estuaries. I would like to address the topic from three aspects. The first of these is a naturally occuring phenomenon, namely suspended sediments in the water column. Turbid waters appear to be the normal situation in estuaries, with the suspended sediments originating in run-off from the land, shoreline erosion and resuspension of bottom sediments. Of course, man has increased the rate at which sediments enter the estuaries, through farming, construction and other activities which disturb the land. Because erosion and resuspension are natural processes, Mother Nature has developed mechanisms for dealing with the problems. Marshes are "living filters", shellfish filter out fine material and produce much larger sized biodeposits, and settling occurs in the more quiet and still portions of the waterways. Probably the greatest negative impact of turbid waters is the money spent in dredging the navigational channels and harbors. But from the point of view of water quality, there doesn't seem to be any major impact. In fact, in some areas the turbidity can have beneficial effects. For example, in Hampton Roads it appears that the levels of nutrients are high enough to support much higher levels of phytoplankton than we now observe. As far as we can tell, light inhibition is the major factor controlling algal growth. Thus, the turbid waters probably are protecting the Hampton Roads area from nuisance blooms of algae.

Bottom sediments act as a reservoir for natural organic compounds, a second facet of their role in water quality. In particular, the sediments can be rich in the nutrients nitrogen and phosphorus and also contain biodegradable materials. Decomposition of the organic matter consumes and removes dissolved oxygen from the overlying waters. This oxygen demand by the bottom sediments can significantly alter the quality of the water in an estuary; for example, in the York River between the Coleman Bridge at Yorktown and Chesapeake Bay. The York River is about 60 feet deep in its main channel. However, there's a sill at the mouth of the river that is only 30 to 40 feet deep. In the summertime water in the deeper portion of the river is somewhat stagnant. Even though there is very little density stratification, nonetheless we see a very distinct gradation in dissolved oxygen from the surface to the bottom. The source of oxygen is the atmosphere and oxygen is consumed by BOD in the water and also by the benthal deposits on the bottom of the river. Apparently the physical processes of mixing and transport are not sufficient to meet all of these demands. As a result, the bottom waters in the York River often have very low dissolved oxygen content. Levels on the order of two to three milligrams per liter are common.

A second case is the Pagan River, a small tributary of the James. Land uses are mostly rural in nature with more than half of the watershed in forest and about a third agricultural. The agricultural uses produce rather large "non-point source loads". The quantities of both BOD and nutrients in the run-off are substantial. The Water Control Board has stated that the municipal treatment plants located in the basin have "poorly treated effluents". And finally, several meat packing plants (The famous Smithfield Hams are produced here) discharge into the river. As a result of all of these pollution sources, the bottom sediments are rich in organic matter and have a high oxygen demand. This was measured in the summer of 1976 and the level was four grams of oxygen per square meter per day as compared to a typical value of about only one gram per square meter per day. DO values near the river bottom were much lower than concentrations at the surface. Concentrations of 1 and 2 mg/l were not uncommon. Nutrient inputs to the estuary are high, too, with the result that we have a very high phytoplankton population. Most people would consider it an algal bloom since concentrations for a significant portion of the river are above 100 micrograms per liter. It is very likely that the dead phytoplankton settle to the bottom and are incorporated in the sediments. At a later date the sediments release nutrients back to the water column, thereby increasing the likelihood of more algal blooms. The two impacts then are that there is an oxygen demand of the organic material decaying in the bottom sediments (which decreased DO's in the overlying waters) and that nutrients are released to the water resulting in algal blooms which cause large variations in dissolved oxygen over a daily cycle . The DO levels in the Pagan River have been observed to vary from a high of 11 mg/l during daylights hours to about 4 mg/l in the early morning. The saturation value at that time was about seven mg/l. Obviously the impact of the phytoplankton can be great.

With regard to these problems, my own feeling is that the prognosis is rather good. In particular, point surfaces are being controlled as the result of Public Law 92-500. Many people are gaining a new awareness of non-point sources of pollution and how these should be controlled. As an example, for the lower James River the flow of sewage is likely to increase from about 40 million gallons per day (MGD) now to something like 80 MGD in 1995. However, as a result of higher treatment the BOD load will be reduced from 30,000 pounds per day to something on the order of 20,000 per day. In my opinion, we are beginning to get a handle on the problem of organic loadings to our rivers, and I think that there will be continued improvements in the future. The other reason that I am optimistic is that this is a natural problem. I am fairly certain there were zones with algal blooms and high nutrient concentrations before man appeared on the scene. I think Mother Nature has developed her ways of coping with the problem.

A third manner by which bottom sediments affect water quality is acting as a reservoir for what I call exotic compounds. This includes heavy metals, pesticides, herbicides, insecticides and so on. The Elizabeth River, for example, has been documentated by EPA to have concentrations of many metals two to ten times higher than what exists in the Chesapeake Bay or the Potomac River. Chromium, iron, aluminum, lead, copper, cadmium, mercury, zinc and many other minerals are there in very high concentrations in the sediments. They may be unavailable to the biota now and for some time into the future, but it is very unlikely that these compounds will always be unavailable. It appears that we really don't know the magnitude of the problem or the types of things that are out there. Nobody knew about Kepone before the workers began getting ill, yet they had been making Kepone for years, first at

Allied Chemical and then at Life Sciences. Unfortunately, I have a feeling that in Virginia and elsewhere there are other problems that are building up right now, and we don't even know they exist. As with most environmental problems there are no easy solutions. In particular, since it is a non-natural situation, Mother Nature hasn't had time to develop the means to cope with these things. Probably in a hundred years or so there will be bacteria which will degrade pesticides and some of these other compounds. But for the moment, many of these compounds persist for years. The residence time of these materials in the estuary can be very long indeed, since they are bound-up with the sediment and are not flushed from the estuary.

In summary, we can look at turbidity, organic sediments and exotic compounds attached to sediments. For the first two, the problems are manageable; it appears that we are beginning to get a handle on the problems and the future looks fairly good. Sediments with exotic compounds pose problems for the future, and I am not sure that we have even begun to scratch the surface of this problem area. This should be a major focus for water quality efforts in the years to come.

THE STATUS OF EPA'S CHESAPEAKE BAY PROGRAM

John Roland

The EPA Chesapeake Bay program was initiated about two years ago, when the Congressional Subcommittee on appropriations decided that the Chesapeake Bay needed study. EPA was directed to undertake the study, and for the past two years they have been groping with the problem of trying to put a program together, in spite of the complicated political and jurisdictional structure of the Bay region. Two states, Maryland and Virginia, are basically the caretakers of the Chesapeake Bay; then there are other states and the District of Columbia who are contributors to the pollution of the Bay. Additional problems stem from the myriad of conflicting and overlapping federal responsibilities in the Bay. The EPA originally was supposed to get 50 positions to run this program and they ended up with ten. I don't think this is going to change. These are some of the reasons for the delay in getting the program off the ground.

In the spring 1977, the State Water Control Board was approached by Maryland representatives who'd put together a package of what they thought the Chesapeake Bay needed in terms of protecting it as a resource. We were asked to join them in putting together a bi-state proposal which would be basically a management proposal from the states of Virginia and Maryland. Virginia's input was put together on very short notice. We held a workshop in April, 1977 and also solicited proposals from some of the research institutions in Virginia. One combined Maryland and Virginia package was submitted to EPA. EPA didn't accept the proposal in total, because we wanted to manage the program for them. That was unacceptable to EPA but they did incorporate a lot of our proposals while developing a program plan. They put together the plan in early August, 1977 and it's the first thing that they're come out with that is a broad, general program plan that addresses the needs of the Chesapeake Bay. What I'm going to do is go through this plan very briefly and give you an idea of what the thinking is as far as the needs of the Chesapeake Bay is concerned.

Before discussing the plan I'd like to briefly explain some of the historical background on how the program came to be. The Committee on Appropriations in 1976 noted that "the Chesapeake Bay is a critically important natural economic resource, but is subject to many pressures, which if uncontrolled will lead to the degradation of the whole Bay area." This is the premise on which they based the study. Now to give you an idea of the scope of the study, it was envisioned as a five year program, $25,000,000, basically $5,000,000 a year. The EPA was directed to address the following during the study: to conduct this in-depth study, to perform an assessment of the principle factors adversely affecting the environmental quality of the Bay, by considering the needs of the Bay users and scientists; to direct coordinated, research abatement programs that would most effectively address these factors; and to analyze all environmental sampling data presently being collected in the Bay. Also, to undertake methods for improving such data collection and establish a continuing capability for collecting, storing, analyzing and disseminating such data. And this is the tough one: to determine what units of government have management responsibility for environmental quality in the Bay, and find how such management responsibility can best be structured. Also to improve communications and coordination between Bay users, scientists and government units.

The goal of the Chesapeake Bay program is very simple, to protect and preserve the quality of the Chesapeake Bay by effectively managing its uses and resources. The EPA staff in Philadelphia used the information that the states of Maryland and Virginia provided them and also the results of the bi-state conference held last spring in Patuxent, Maryland. Basically, it has three objectives. Number 1, is to assess the needs of the Bay users to determine what stresses the Bay ecosystem may be anticipating in the immediate and distant future. The way they're going to do that is to have a public participation study group address this problem. The public participation study has been funded. George Hagerman from Hampton, VA is going to be heading that. Basically they're going to be looking at what the needs of the Bay users are and they are going to be working with the EPA and the states of Maryland and Virginia in the overall management and development of the program. I think the grant is $250,000 for the first year. An ecological study, which will basically be a sociological and anthropological study, is supposed to go out for competitive bidding for proposals within the next week or two. It was supposedly funded by October 1, 1977. Objective 2 is to identify existing programs that may address the problem of intergovernmental management of the Bay once the study is completed. Objective 3 is to determine, develop and implement where possible the programs necessary to address the unmet high priority needs identified by the Bay users. This one is the meat of the study in terms of where the research will be directed.

The research needs of the Bay program were the toughest problem facing EPA and the states on the Bay study. There's so many things that need to be learned in the Bay, so much information that needs to be gathered, how do you decide which areas of study you want to address? What EPA did was take the information the states and the bi-state conference provided them combined this with input from their own technical staff to come up with seven work tasks. I'll go over each work task and give you an idea of how they are to be developed. Task I is a research inventory or baseline data search that will probably be conducted by the Chesapeake Research Consortium. This is a one year study looking at what research data is available for the Chesapeake Bay, how and where you can get this data. This literature search will include data from other estuarian areas that might be applicable to the Bay.

Task II is a point, non-point source inventory that will be trying to get an idea of what the pollutant in-puts to the Bay are in the terms of non-points sources and also identifying and quantifying point sources to get total loadings for the Bay. An attempt will be made to set priorities within the Bay's tributaries to pinpoint where the largest problem areas are and then maybe going into more detail in terms of channeling research money into tackling those problems.

Task III is to setup a Chesapeake Bay data bank. The purpose of this task is to promote a place where data can be stored on the Chesapeake Bay. Monitoring data, biological data and any other data that would be applicable to the programs suggested would be stored in the data bank. And this will be done, hopefully within the first year or two so we'll have this data storage system in operation while research tasks are underway. The present plan is to use the EPA's storage system in Washington. Maryland and Virginia will be putting all their data into this system, as well as data from other states and Washington, DC. Biological data will be going into the system and you'll have one central data system for Chesapeake Bay. The purpose of the monitoring development task (Task IV) is to set up a monitoring structure in the Bay so that we can keep track of how the Bay's water quality is being maintained. It will also be used to identify problem areas. The monitoring program will be an on-going thing to keep track of the quality of the Bay. The rooted aquatic plant disappearance (Task V) has had a rough program plan already developed. This is to try and solve the problem that we're having in the Bay with the submerged aquatic vegatation disappearance. It's identified as a problem by most everybody and will be addressed early in the program in terms of funding as well.

Task VI (Non-Point Source Research) calls for the development of a program of study to try and understand the pollutant inputs from NPS that result from various land use practices. Some work in this area is already under various 208 programs, but the impact on estuaries systems needs further study. Task VII calls for a water quality assessment. This task has not yet been fully developed and will be further outlined as the other tasks get underway.

What they're doing on each of these work tasks is appointing committees to set up work outlines for the technical studies. The state of Virginia and the state of Maryland and EPA staff make up the committees that will develop a work plan for each of these areas and then requests for proposals will go out for the research that's needed to address the problem.

There have been several flow charts that EPA has developed to show how the management structures in the states and the federal government will coordinate the whole program. To date they haven't been able to come up with one that satisfies everybody. Either Maryland, Virginia or EPA felt like they didn't have enough responsibility or authority. But basically these are the actors who are going to make the final decisons on how this program develops. In all probability decision-making will be the responsibility of five individuals. One will be the director of the Chesapeake Bay program in EPA Region III, Leonard Mangiaracina. Two, will be the Chairman of the Technical Advisory Committee (representing EPA's Research and Development), Tudor Davies. There will be a bi-state representative, one from Virginia and one from Maryland. Virginia's representative is Ray Bowles, who is the director of the Bureau of Surveillance and Field Studies for Water Control Board. In Maryland the representative is Frank Hammons.

There will also be a representative from the citizen's program for the Chesapeake Bay. George Hagerman will be representing the citizen's interest. We don't know if a representative from the Susquehanna River Basin Commission will be a member of this decision-making body or not. They have been asked to participate. Final authority rests with the EPA Regional Administrator, but the individuals listed above will for all practical purposes be running the Bay program. The states of Virginia and Maryland will have significant input to program direction, technical proposal review, program management and program review.

The final products of this study at the end of five years and \$25,000,000 will hopefully be, number 1: an effective management strategy for the Bay. This will be a difficult undertaking because of the complexity of the Chesapeake Bay management structure with all the interjurisdictional responsiblities that exist at the present time. There has been some discussion of a Title II Commission as well a number of other options but the basic philosophy now is that the people who have the responsibility for management, which is the states under EPA, are going to have to get their act together and come up with a workable management strategy. Number 2: is a central data bank. This should be no problem. Existing data simply needs to be compiled at one location (Storet has been suggested.) A fourth product will be demonstration projects for pollution abatement. These will result from some of the research work that will be done on nonpoint sources and other studies. Number 5: a transferable estuarine management methodology that can be taken and used in some other estuarine system similar to the Chesapeake Bay.

In a nutshell that's where the Chesapeake Bay program is now. What has been accomplished thus far is not locked in concrete. The seven areas of research can be added to if the members of that management coordinating committee feels that amendments are necessary. In other words, changes in the overall program are not only possible but invited. The EPA has stated that if the states come up with something better or along the line we find something that may alter present thinking, the program is flexible enough to change.

UNDERUTILIZED SPECIES OF SHELLFISH IN VIRGINIA WATERS

Dexter S. Haven

Introduction

There are many edible molluscs in Virginia waters and off its shores which occur in considerable numbers, but which are underutilized as a food. Many could be used to a greater degree. While some of these species are consumed to a limited degree in areas like New York City or New England, many are almost completely unknown among those who eat other species such as the oyster, *Crassostrea virginica*, and the hard clam, *Mercenaria mercenaria*.

There are several reasons for this underutilization. Consumer preference plays a major role. For example, people in Virginia have always eaten oysters, scallops or hard clams; they are familiar with these species. There is always a market for them and they are available at most retail outlets. In contrast, most of the underutilized species, while edible, are unfamiliar to the public, and are not generally available at retail stores. Moreover, when some are harvested along with the better known species, the harvester is not always sure if they are edible.

Overfishing

There is one point which needs emphasis at the start of this discussion on underutilized species. An underutilized species may quickly be overutilized if they are subject to overharvesting.

For example, prior to World War II, the surf clam *Spisula solidissima* was underutilized. This mollusc occurs at a depth range from about 5 to 55 meters in vast quantities off the East coast of the United States. Today, about 30 years later, it is regarded as an overexploited species; a quota on commercial landings has recently been applied by the Federal government.

The rapid development of the fishery for artic quahog *Artica islandica* is an example of the rapidity at which an underutilized resource may become overexploited. The artic quahog resembles the common hard clam in shape, but it is larger; the surface of the shell is dark brown and the meat is more highly pigmented than that of the common hard clam. It is harvested with large hydraulic dredges at depths ranging from 36 to 146 meters. The meats are extensively used in chowders by several large canning companies.

While the existance of concentrations of the artic quahog off the East coast of the United States has been known for sometime, populations off the Virginia coast have been harvested only during the past 2 or 3 years. With the onset of quotas on the landings of surf clams, however, industry began harvesting this species; today a quota has been applied to landings.

Underutilized Species

The short razor clam, *Tagelus plebeius*, is a good example of an underutilized mollusc which is widely distributed throughout the lower Chesapeake Bay. It commonly occurs from the intertidal zone down to about three meters in areas where salinities range from about 12 to 32 parts per thousand. In shape, it resembles a "stumpy" razor and may reach a length of about 15 centimeters. It lives in a burrow 20 to 30 centimeters below the sediment surface. Its shell is fragile and easily broken. Densities of from 50 to 60 per square meter commonly occur in the intertidal zone.

A limited quantity of short razor clams are sold commercially and in 1973, 5,000 pounds were listed by the National Marine Fisheries Service as being sold in New York City.

The short razor clam may be harvested commercially with a Maryland-type soft clam escalator harvester. If limited quantities are desired, then a bucket full may easily be dug from the sediment with a long-handled shovel. The meats of razor clams can be made into a chowder or simply steamed open and eaten after dipping into melted butter. They have a distinctive flavor which does not resemble that of the oyster, soft clam or hard clam.

A second species of razor clam in Virginia is known as the long razor clam, *Ensis directus*. The shell resembles that of the short razor clam except that it is proportionally narrow than the short razor clam. It occurs in the deeper waters of lower Chesapeake Bay and in many of the shallow areas of the Eastern Shore of Virginia. It is edible and often abundant.

Blue Mussels

The blue mussel *Mytilus edulis* is a much esteemed item of food in European countries such as France and Italy. In these areas, they are often cultured by suspending young mussels attached to a rope from a float. This mollusc has a smooth blue-black or dark blue shell and occurs in clumps attached to solid objects by short threads (byssal threads). Mature animals may be 5 to 7 centimeters long. They are not often seen in the Chesapeake Bay, but in 1959 when salinities were unusually high, they were abundant in the lower part of the Bay off the mouth of the James River. Today, they occur on the footing of the Chesapeake Bay bridge and on the Seaside of the Eastern Shore around the inlets.

Mussels may be cooked with rice and tomatoes in a casserole or simply steamed and the meats eaten with butter. It is a species that could be cultured on the Eastern Shore and utilized more widely in Virginia.

Another edible mussel common to Chesapeake Bay which is not presently utilized is the horse or ribbed mussel *Geukensia demissa*. It occurs over wide areas in salt marshes in the upper tidal zone where it forms dense mats half embedded in the substrate. It commonly occurs on the Eastern Shore of Virginia and in lower reaches of the York, James and Rappahannock rivers. It often reaches 8 to 10 centimeters in length. It is recognized and separated from the blue mussel by its dark blue-brown color and the longitudal ridges on the shell.

Although this species is seldom eaten, the meats may be steamed from the shell and eaten with butter or some other sauce or made into a chowder. On occasions, the meats may have a slight muddy taste, but, if kept in flowing seawater or held on a hard bottom for a day or two, this taste may be eliminated.

Two species of edible conchs (gastropods) occur in Chesapeake Bay and off the Virginia coast in the area inhabited by the surf clams. These are the knobbed conch *Busycon carica* and the channel conch *Busycon canaliculatum*. In length, the former species may range up to 20 to 25 centimeters; the latter from 15 to 20 centimeters.

Conchs are caught in crab traps along with the blue crab. Others are caught in crab scrapes operated during the winter months in lower Chesapeake Bay. Additional quantities are caught in the hydraulic dredges used to harvest surf clams off the Virginia coast.

Generally, conchs are steamed and the firm foot is extracted, iced, and then shipped to market. Few persons in Virginia eat conch although the meats are good in chowders and in specially dishes. Most are consumed in the New York and New England areas. Over one million pounds from Virginia were shipped in 1976.

The common periwinkle, *Littorina irrorata*, is a snail which is found along the margin of salt marshes, and is frequently observed clinging to the stems of marsh grasses. They may reach about 1.8 centimeters in length. When cooked, periwinkles may be eaten, but few are consumed in Virginia. To the north, in New England, a closely related species of periwinkle, *Littorina littorina*, is harvested and used as the basis of chowders or the meats are picked from the spiral shell with a bent pin and eaten as a type of side dish. Since there is little difference between the two species, there is no apparent reason why the southern species *L. irrorata* could not be more widely utilized.

The species just discussed are primarily those living in the higher salinity regions. The upper reaches of our tidal estuaries, however, probably support the greatest quantity of underutilized species.

Perhaps the most abundant low salinity molluscs is the brackish water clam or Rangia cuneata. Rangia was introduced into Chesapeake Bay probably from South Carolina about 1960 and since that time has spread with explosive rapidity. It now is abundant in the James and Rappahannock rivers and to the north in the Potomac* and the upper Bay. Rangia inhabits a wide salinity range from areas when the water is fresh to salinities of about 15 parts per thousand. The larvae, however, can not live in freshwater. This clam when small may occur at enormous densities reaching 10,000 per square meter. Generally, densities of 250 per square meter are typical.

Rangia superficially resembles a small hard clam, but they seldom exceed 5 or 6 centimeters in length. The shell exterior is fairly smooth and is light to dark brown in color. They occur in shallow burrows on or just below the sediment surface from the intertidal zone out to 5 or 6 meters.

In the James River, they occur from Deep Creek to just below Hopewell, but they are especially abundant off Jamestown Island. Trials with a Maryland type hydraulic escalator by the Virginia Institute of Marine Science in that

* Most of these died during the cold winter of 1977-78, but repopulation is expected to occur.

region showed that harvest rates of several thousand bushels a day were possible.

The meats of *Rangia* occasionally have a musky or muddy taste when cooked or steamed. The taste may often be eliminated by relaying the clams after harvest onto a firm bottom, or holding them in troughs in flowing water for a few days.

The manila clam *Corbicula manilensis* is also a recent introduction to Chesapeake Bay and only a few were observed as late as 1971. Since that date, however, it has become the dominant mollusc in the freshwater section of the James River above and below Hopewell. It is similar in shape to the common hard clam. The exterior of the shell, however, has a shiny light brown coloration with closely spaced concentric ridges. A recent survey by VIMS showed enormous concentrations in the freshwater zone below Hopewell with density ranging from 50 to 1000 per square meter; densities of 100 per square meter were common.

A major problem in utilizing *Rangia* and *Corbicula* as a food is that most occur in sections of the Rappahannock or James rivers which are presently classed as restricted for shellfish culture. In relation to this aspect, however, Virginia allows relaying clams to pollution-free areas with the approval of the Bureau of Shellfish Sanitation and under the supervision of personnel from the Virginia Marine

Resources Commission. There is also the possibility that clams may be depurated in special tanks, but State regulations relating to this practice have yet to be formulated.

In conclusion, there are species of molluscs which might be used as food species to a much greater extent. Problems exist in respect to the utilization of some, but for others, there is no valid reason why they should not be more widely utilized. Definitely, consumer education is indicated.

THE MOLLUSCAN SHELLFISH INDUSTRY *

Dan Goldmintz

Last July the Coastal Zone Management Act was admended to require the Secretary of Commerce to make a comprehensive review of all aspects of the molluscan shellfish industry and the impact of federal law on water qualities. Very briefly, I will summarize the major findings and recommendations contained in the report to Congress which are based in part on four technical studies. These studies on the oyster, clam and mussel industries and on water quality are commonly known as the Bauman studies. I will highlight the specific problems and recommendations.

The molluscan shellfish industry is an important source of food supply for the nation and contributes substantially to our economic wealth. Because of the fragmented nature of the industry, however, it is subjected to many problems. All the regulations and a lack of coordinated government research and services program are major problems. Small seafood processing businesses, many family owned, are without the mechanization common to other seafood processors and are faced with a tangle of several state and local regulations which threaten the industry. The report concludes that major positive actions must be taken to revitalize the U.S. molluscan shellfish industry. Funds must be provided to carry out programs authorized to protect shellfish growing waters and allow the federal and state fish and wildlife agencies to effectively review permits and determine the effects of waste discharges on growing waters and the resource. Research programs are needed to increase shellfish resources through habitat, rehabilitation and aquaculture. A joint federal, state and industry program is needed to help the industry develop needed technology, meat products and markets. And finally, a mechanism must be developed to address the problem of over-regulation and to achieve better coordination of government research and services. Of particular interest are the following findings and recommendations on water quality, industry revitalization needs and over-regulation.

The quality of shellfish growing waters continues to decline. Inadequate domestic waste treatment and urban run-off are the major offenders. The shellfish harvesting closure rate is .6 of 1% a year. This rate, although half of the previous rate of 1.3% for the 1971-1974 period, still represents a significant loss of resources. These are estimated rates based on changes in acreage classified as prohibited. Actual quota rates are not available because of a lack of uniform criteria and terminology should be developed and that the state report to EPA on the pollution control programs could incorporate these evaluations. The annual assessments would provide valuable insights into the effectiveness of pollution abatement programs and rapidly identify deficiencies. Generally, the report concludes that existing legislation will protect shellfish growing waters if there is adequate funding and enforcement. The criteria for classification of shellfish growing waters was another item of major concern. The report recommends that cooperative federal and state research be used to validate the criteria presently used to define "safe harvesting areas". Presently, associative testing using coliform bacteria has indicated contamination that may be present in waters that are vouched safe. In addition, rapid analytical tests must be developed to detect hepatitis viruses and paralytic shellfish poisoning or PSP. A rapid test, for example, for PSP could be extremely valuable in allowing selective harvesting of the vast clam resources in Alaska and provide seasonal on the spot testing if PSP is present in other localities. Another recommendation is to provide full utilization of existing resources so that additional research should be conducted on depuration and re-laying practices.

The industry is predominately composed of small processors scattered along the entire U.S. coastline. The industry, as a whole, lacks mechanization common to other seafood processors and is marketing a traditional line of products. They need new technology to overcome labor shortages and meat products to compete in a dynamic world of fast-food marketing. The oyster report, of the full report, suggests that additional standards are needed at the retail level to protect the processor, to improve consumer confidence and to prevent economic fraud. Too often the sanitation standards governing the growing, harvesting, transporting and processing the molluscan shellfish are negated by poor handling at the retail level. The processors bear the true cost not only in direct financial losses and suits, but also from a decrease in consumer confidence. The watering of oysters, most prevalent during resource shortages also weakens the product images. And the unscrupulous practices of a few, can adversely affect oyster sales in general.

Over-regulation may be one of the greatest problems facing the industry. Regulations and guidelines will always be needed to protect the resource and assure safe products. However, the shellfish industry appears to be confronted with more regulations and regulators than other food processors. A close examination of the term, over-regulation, often brings forth examples of multi-jurisdictional authorities, i.e. several agencies having similar functions and the outright duplication of regulations. An example of each may be enlightening. As a reference, let's generalize by saying that over-regulation is counterproductive and leads to processing inefficiencies. An oyster grower, unlike a traditional farmer, leases his bottom rights from the state. The restrictions often limit production and harvesting techniques. Leasing, for example, prohibiting off-bottom culturing of oysters and harvesting inefficiencies, has resulted in gear restrictions. Gear restrictions for harvesting oyster beds can go well beyond the protection of adjacent bottoms as evidenced by different regulations from county to county within the same state.

The problem of multi-jurisdictional authority is different from over-regulation. But it can be even more frustrating. Unlike the farmer, mariculture managers and shoreline processors are confronted with numerous wetland and environmental regulations. Dredging to maintain established channels to the processing plant, erection of pilings special harvesting gear, and the bulkheading of properties to prevent erosion may all require special permits. The confusion of applying for these permits and reviews at the central state and local township or municipal level can appear endless. Yet, regulations are needed to protect the fragile wetlands. But, the question often asked is why are there so many agencies involved? Production inefficiencies also result from duplication of efforts. Plants and product sanitation inspection are the best examples. Depending on whether a fresh or breaded product is being produced, the processor could be inspected by several federal agencies, including the FDA, the Department of Defense and the NMFS. The state departments of public health and agriculture and lastly, the countly health officer may also involved. In some cases, the states or municipalities in which the final sales are made may also testify. Often the standards used by the various inspectors are not consistent by definition or in application. The development of uniform evaluation criteria and cross-certification of inspectors could reduce the duplicate efforts and lead to better processing plant effiencies. Cross-certification has already been initiated among federal agencies and between some state counterparts.

The concluding major recommendations of the secretaries' report are that a mechanism be established to explore the streamlining of regulations and record keeping and that an investigative interdepartmental federal task force or a National Molluscan Shellfish Commission be established to accomplish this regulatory review. So, where do we go from here? The numerous problems are identified and the recommendations presented in a report are favorably endorsed by federal, state and industry reviews. The report recommended numerous actions but did not specify who should implement the actions. In case of re-evaluating growing water criteria, a cooperative federal and state action was suggested. To revitalize the industry, a broad federal, state and industry program is needed. A similar broad, cooperative effort, possibly involving a molluscan shellfish commission, needs to examine the problems of over-regulatuon and to better coordinate the research and services programs designed to assist the industry. The report was delivered to the Congress on September 21, 1977. We anticipate that the Congress will request the federal agencies to report on what, if any, additional manpower and funding we will need to carry out these recommendations. Information should also be requested from the states and industries and should be presented through public hearings. The NMFS is optimistic that the cooperation given in making this report will continue and be expanded to cooperative actions to re-vitalize our molluscan shellfish industries.

* (Paper presented for Dave Dressel)

RESUME OF THE TENTH NATIONAL SHELLFISH SANITATION WORKSHOP

J. David Clem

Purpose of the workshop:

Recommended Changes in NSSP Administrative Procedures

Recommended Changes in NSSP Technical Standards

Review Research Needs and On-going Projects

Discuss State Program Activities and Emerging Problems

Describe New Federal Legislation, Regulations and Programs

Some people have had the misconception that the Workshop constituted a decision-making body. It is an advisory body. There was an attempt several Workshops back to obtain a vote from recognized delegates. For a number of reasons this procedure was abandoned.

Maryland was the host state for the joint SINA-NSA Convention and Meeting of the 10th National Shellfish Sanitation Workshop held June 27-30 at the Hunt Valley Inn. This was the second time the Workshop had been held in conjunction with SINA-NSA's annual convention and meeting. Apparently this is a desirable arrangement, saving participants the extra time and travel expense involved in attending two separate meetings.

Approximately 600 persons, including wives and children, participated in the meetings and events of the week.

James B. Coulter, Secretary of the Maryland Department of Natural Resources, welcomed participants to the 10th Workshop, stressing the importance of the NSSP to the shellfish industry, and the great value of the shellfish industry to Maryland. He described some of the State projects underway to sustain and promote the shellfish industry. Ambitious plans for his Department called for depositing shell on natural oyster bars and planting seed, mapping the bottom of the Chesapeake Bay to locate potential sites for additional bars, monitoring and policing activities, establishing a shellfish hatchery, and promoting shellfish products in the marketplace.

The subject of FDA's proposed NSSP regulations was mentioned. It was hoped that there would have been positive news to report on the progress of the proposed NSSP regulations, but, at the time of the Workshop and up to the present, the revised proposal is still being reviewed by our General Counsel. I want to reaffirm, as I did at the Workshop, the Commissioner's intent to publish a revised proposal of the NSSP regulations. Once published as a proposal in the Federal Register, copies will be made available to all interested persons. We plan to hold public hearings during the comment period. There will be sufficient time provided for additional comments based on discussions at the hearings. During the rule-making process, I want to again encourage your participation and comments.

Mr. Richard Loring, President of SINA, presented the Shellfish Industry Report to the 10th Workshop. Dick listed no major industry problems, developments or confrontations since the last workshop, citing the hold on the regulations as creating a limbo state for industry members who are waiting to see what will happen next.

Mr. Loring stressed the importance of industry still being recognized as an active partner in the cooperative NSSP. A vote of confidence by industry for continuation of the cooperative program and joint SINA-NSA and NSSP Workshop meetings was expressed. This affirmation by industry is encouraging. It is the active State-Federal-Industry involvement which is the key to the success of the NSSP.

Foreign interest in the NSSP is increasing, as was demonstrated by the attendance of representatives from Canada, Japan, Korea, Mexico and Iceland at the Workshop. Mr. Jon Arnalds, Secretary General of the Icelandic Ministry of Fisheries, presented a brief overview of their fishing industry. Iceland now ships 2/3's of its total production of frozen fish to the U.S. Molluscan shellfish (Ocean Quahogs and Blue Mussels), on the other hand, is an undeveloped fishery resource in Iceland. Mr. Arnalds expressed Iceland's desire to develop a shellfish industry for U.S. markets.

The Workshop participants were treated to the showing of an informative film on Japanese aquaculture practices. Mr. Rentaro Ito, in charge of the Shellfish Sanitation Program in Japan, made several impromptu remarks, mentioning that Japan has been a member of the NSSP for 15 years.

Mr. Dave Dressel of the National Marine Fisheries Service (NMFS) discussed their technical appendices for their Report to Congress, "The Molluscan Shellfish Industries and Water Quality -- Problems and Opportunities". Mr. Danny Goldmintz has just brought you up to date on this subject. Dr. Vincent J. Decarlo of the Office of Toxic Substances, Environmental Protection Agency (EPA), highlighted provisions of the Toxic Substances Control Act and its impact on the shellfish industry. Dr. Decarlo discussed the provisions of this Act for you yesterday.

FDA officials made several presentations to the Workshop's General Session on in-house research. Dr. Read, Acting Director, Division of Microbiology, summarized a statistically designed survey of microbiological quality of fresh shucked oysters at retail, in-shell soft clams at wholesale and hard shell clams at wholesale in the U.S. market. Results of the survey showed that when the NSSP recommended standard is applied at wholesale level there is at least 95% adherence. The microbiological profile appeared different for three species of shellfish sampled. Dr. Read felt that it would be beneficial to have standards tailored to the product and not just one set of standards for shellfish in general. A good beginning point would be the development of a standard for oysters at retail.

Mr. MacMillan from New York asked a pertinent question as to why the proposed NSSP regulations had not included standards of quality for shellfish.

An NSSP project coordinated by FDA and presented jointly by Mr. Daniel Hunt, Shellfish Sanitation Branch, and Miss Janet Springer, Division of Mathematics was reviewed. Their report concerned the A-1 Bacteriological Rapid Method for the Detection of Fecal Coliforms in Shellfish Growing Waters. The Canadian Department of the Environment was so impressed with the preliminary results of this study that they had already accepted the Modified A-1 test as an alternative to the standard EC test. Based on this work FDA is accepting Modified A-1 test data for the classification of shellfish growing waters. We are further studying the applicability of this test for shellfish meats -- the first year's data looks encouraging. The test procedure is being submitted to the AOAC at its annual meeting in Washington later this month for first action leading toward a recognized standardized method.

With the increased ocean harvesting of shellfish as well as increased oceanic pollution, classification of offshore waters has become necessary. Mr. Bill Eisele, Supervisor, Shellfish Control Unit, New Jersey Department of Environmental Protection described New Jersey's "gearing up" efforts required to complete ocean classification work for their off-shore waters. Bill and his staff made the same presentation at the last seminar.

Captain Verber of our Northeast Technical Services Unit followed Bill's remarks with a description of FDA's responsibilities for classification of ocean waters beyond the States' 3-mile coastal zone jurisdiction. Ocean waters known to be contaminated, that is, designated dump sites or areas subject to major estuarine complexes' discharges of sewage effluents or other contaminants, and located in or near a commercial shellfish resource, are classified as closed to harvesting by FDA. Presently, three oceanic areas along the Atlantic seaboard are classified as closed, with the Coast Guard making routine patrols under an agreement with FDA. The present procedure of limited closures, with periodic studies and random surveillance patrols, appears to provide the most reasonable, prudent and cost effective system to assure safe and sanitary ocean shellfish on the market.

The late afternoon session welcomed three Virginian presentations dealing with different facets of pollution. Mr. Oscar Adams from the Virginia Department of Health discussed marine and vessel sanitation in Virginia. He described the uncontrolled discharge of raw and partially treated sewage from boats and marinas in close proximity to shellfish growing areas as a potential public health problem. He said flow-through devices for boats do not provide adequate treatment of sewage for discharge over shellfish beds. At the present time, holding tanks and the prohibition of sewage discharges from boats appear to be the best means of protecting the sanitary quality of shellfish and of enhancing water quality. Marinas also need adequate onshore sanitary facilities to handle their custumers without degradating the surrounding water quality.

Mr. Robert Huggett presented a fascinating story about Virginia Institute of Marine Science's involvement in assisting Virginia regulatory agencies in monitoring, developing analytical techniques and interpreting data as a result of the Kepone incident. Part of their work on depuration experiments with Kepone contaminated shellfish demonstrated that the shellfish purified themselves faster in summer than in winter. They also found a correlation between concentration of kepone and quality of meat -- fatter animals had more kepone. Kepone is one of the most stable compounds chemically known to man. It has contaminated 200 miles of the James River. It has been found throughout the food chain and along the entire East Coast. He admonished the Workshop that hopefully everyone has learned from the Kepone story: once chemical contamination takes place, it is too late.

Mr. Dexter Haven and Dr. Frank Perkins, also from VIMS, presented the results of a three year depuration study accomplished under FDA contract. They found that oysters contaminated in nature depurated fecal coliforms to levels below 50/100 g in 48 hours over a wide range of environmental conditions typical of the lower Chesapeake Bay region. Depuration of total coliforms was more erratic and the use of total coliforms is not recommended as an indicator of depuration success or failure. The pumping rate or biodeposition activity of oysters did not appear to be correlated with coliform clearance. As long as gaping oysters were removed from the system, oyster size, meat quality or infection with pathogens *Dermocystidium marinum* and MSX did not affect depuration rate.

Thursday, the final ½ day of the Workshop heard the results of deliberations by the Chemistry and Microbiology Task Force Groups. Both Task Force Groups had met on Tuesday to discuss a large number of topics.

Mrs. Elizabeth Zook, Chemist retired from the National Marine Fisheries Service, presented an overview of the activities and accomplishments of the Chemistry Task Force since the 9th Workshop. A brochure entitled "Chemical Procedures -- Collection, Preparation and Analysis of Trace Metals in Shellfish" was issued and a seminar on the analysis of trace metals in shellfish was held at VIMS for state chemists. The Chemistry Task Force had held four meetings since the 9th Workshop.

Several papers presented at the Chemistry Task Force Meeting were summarized by Mrs. Zook. One study concerned the uptake depuration of oil in soft shell clams by using carbon L4 labelled benzo (A) pyrene. Results indicate depuration is moderately rapid and resembles a first order decay curve. The biological half-life ranged between 5.5 and 9 days. Another presentation emphasized the need for reliable analytical standards, a clean working environment and trained analysts in order to obtain accurate data for use in regulatory decisions. Much concern has been voiced about the adverse effects of effluents from nuclear reactors. In studying the use of heated effluent from a nuclear reactor in culturing shellfish, one investigator found that the most consistent growth rate in oysters was obtained in the warmer water closest to the reactor outfall, but, as might be expected, these oysters had the highest level of radionuclides. Another paper described a chemical indicator of fecal pollution, coprostanol. Analytical methods can presently detect coprostanol at a level of 0.2 ppb. The analytical method used appears to be promising, but more work needs to be done. Mr. Ceasar Roy presented the final subject on the rationale for development of FDA guidelines. Before guidelines are established, consumption patterns, toxicity of compounds, and levels of compounds remaining in finished products are considered by the Bureau of Foods.

Final actions adopted by the Chemistry Task Force:

1) Obtaining toxiciological data on metals from FDA;
2) Initiating an evaluation of all available data on metals in order to develop Environmental Index Levels;
3) Transmitting all Task Force accepted data to NMFS computer in Beaufort, N.C. for statistical analysis and storage;
4) Developing a second seminar on analytical techniques for PCB's;
5) Emphasizing speciation analysis in future trace metal's work; and
6) Encouraging analytical methods development of practical II and straightforward procedures.

The microbiological task force met morning, afternoon and night on Tuesday. There were 3 papers on virus research projects, 3 papers on paralytic shellfish poison activities, 9 papers on sanitary microbiology and one paper on epidemiology presented and discussed. Technical advisors to this task force made about 20 recommendations and comments concerning future research and technical revisions to the NSSP recommended practices.

The most significant items recommended were: adoption of the proposed fecal coliform standard for shellfish growing waters; adoption of the A-1M rapid microbiological test for fecal coliforms in seawater; initiation of a laboratory quality assurance program for PSP and seawater and continue shellfish meats (potato substrate).

At the close of the Workshop, participants were invited to present proposals and recommendations. Several were presented and one was received several weeks after the Workshop. This was a joint resolution by 12 State program officials requesting FDA to undertake a re-evaluation and present a justification of the microbiological standard used in the classification of shellfish growing waters.

We hope to have the proceedings of the 10th Workshop printed and ready for mailing by Spring 1978.

STATUS OF MARICULTURE ON THE EAST COAST -PRESENT AND PROJECTED

Robert F. Pratt

Maine has made great progress in aquaculture since 1971, mostly because of the benevolence of the government in Washington we call big government, and through a Sea Grant program, which is funded by the University to do research in oysters and mussels. We have been fortunate that salmon and trout have also been successful in our state.

This presentation is brought to you by the Marine Advisory Service whose base of operation is the Ira C. Darling Center on the Damariscotta River. We have about 6000 feet of shore frontage, about 200 acres of land, and think of ourselves as one of the better aquaculture research facilities in the country.

Early in the 1970's, the federal and state governments combined funds and built an aquaculture building, in which we have our equipment, hot and cold water and seawater systems, and of course, oysters.

We have tried as many different techniques for oyster cultures as possible, including John Dupuy's method of setting them on plastic. We are now setting our oysters on small shell chips with a great deal of success. We are producing both the American and the European oyster. When these oysters are 2-3 mm, they are sold to small companies or, as we call them seafarms, for grow out. We are having a fair amount of success with both species.

Early in the 1970's, we gave the oysters away and therefore introduced people to the prospect of seafarming. We still have many people that grow oysters and mussels in their back yards, much like you grow carrots and corn. Many of these people, twelve in fact, have gone from this stage of non-commercial aquaculture to commercial seafarming. Those that have not have still been provided seed, or opportunity to buy seed, they grow for their own consumption. The commercial people have developed many types of gear. We, on purpose, have not discussed gear construction and design with them. We have done this so that those individuals that are doing it will come up with their own unique designs and provide us with new innovations in seafarming techniques. You will see in some of these slides a different type of raft, and a different kind of tray. The evolution of the tray has now gone to the lantern nets which are being imported from Japan. The second type used is the pearl net, which is much smaller and triangular in shape. The lantern net is relatively inexpensive, costing about $20.00 each. They hold a hundred market sized oysters, and yet collapse down to about 5 or 6 inches in depth when they are not being used. Their life span is about 4 to 6 years on our waters. Being doubledipped galvanized, and then doubledipped vinyl, with nylon mesh, they are almost indestructable.

The older system that the Maine Coast Oyster Company uses in Blue Hill is ten square trays that float just under the surface of the water, and a block of styrofoam. These are becoming more obsolete because our water temperatures are getting warmer and we are going to be beset with the torido worm as you have been, therefore the plastic and metal trays are working much better for us. We have developed a new system which we call flip-flops. The trays float right on the surface, and although an area is contaminated very heavily with torido worms that would spoil wood at a depth of two or three feet, we have no torido worm problem on the surface. The tray is meshed both top and bottom and it is flipped every day. This eliminates all types of fouling organisms from attaching to the screen and also, apparently, the torido worms that might sit on the wood. These trays have proved very successful and have increased growth in our oysters.

Overwintering has been the most severe problem in the past and this is a diagram of five different overwintering systems that we use. They are a square mesh tray, with small styrofoam blocks on cement blocks suspended onto the bottom. The first one is a big skid that we layed on the bottom with 96 trays attached. One of our downeast fishermen suggested using lobster crates, which he puts legs on and on hard bottom that worked finestkind. The next one is very similar to the first, but on a smaller scale, with cinderblock elevations. The next one was made by an inidividual who took galvanized pipe and two-by-fours to keep the oysters off the bottom.

All of these are non-commerical methods. The method that is primarily used now is the long line system, where we simply sink the long line and float the trays or the nest off the bottom and then they can be grapneled in the spring. From this slide you can see that in the winter we have problems because most of our bays and estuaries are frozen over. If we want to sample the oysters for research or marketing, we must cut through the ice. This is the most devastating picture I can present to you. It is a few hundred thousand European oysters about the size of a quarter that died at one site this year. Our mortality this winter exceeded 50% state wide. The reason we think this is true is because our water temperature got down to 1° below zero centigrade for about 30 days. Saltwater freezes at about 2°, so you can see that the oysters were probably filtering ice crystals and they had a great deal of difficulty surviving. This has put a damper on aquaculture, at least oyster culture, in Maine, but it has not eliminated it. We are now actively looking for deeper water sites with warmer water temperatures. We are taking them to offshore islands. We will be doing many experiments to study overwintering.

Mussels are the second crop that is being grown in Maine's estuaries. Abandoned Farms is the first and only mussel farm along our entire 4000 miles of coastline.

The mussels spawn in spring and fall, the farmer sets our rope collectors to catch the spatfall. Abandoned Farms uses old rubber tires injected with foam for floatation, and tires filled with rocks to hold the ropes tied between them taut. President Edward Myers also used old telephone poles as floatation, but this system did not work out quite as well as the tire units.

The mussels are market sized in about 12-15 months. This is when the real work begins. This is a very labor-intensive operation, very difficult to get the mussels clean and still be able to sell them at a competitive price. The wild mussels in Maine are getting a price of about three to five dollars a bushel, and cultured mussels would have to be in the vicinity of $20 or $21.

The biggest problem we have had with the wild mussel is the pearl. As you know, the trematode Gymnophallus worm gets in and the pearl is formed around this. The intermediate host is the Eider duck, which we have an awful lot of in Maine. Dr. Richard Lutz, from the University of Maine, did some research to see how to eliminate the pearl, or how to get around it. This shows the best example of his research. The mussel at the left is a cultured mussel, at about 12 months old. The mussel on the right is a wild mussel, which was grown 500 or 600 feet away from the first and is about five years old. The mussel on the left had no pearls, the mussel on the right was full of pearls. What we found was that the pearl is forming in all of the mussels, but if the mussel grows very fast you can get it to market size and into somebody's stomach before the pearl is big enough for the consumer to detect. So, if you harvest mussels in Maine, below the low water mark, you are not apt to be able to detect the pearl. However, if you harvest mussels high in the intertidal zone, where it takes a much longer time for them to grow, then the pearl is much more prevalent. Because of their rapid growth the farms guarantees the mussels to be free of pearls.

The next species that I am going to deal with are coho salmon and steel-head trout, sometimes called rainbow trout. These are oceangoing west coast species. They are brought to our state and are grown in pens by three farms. One is in Goose Pond, or the old Callahan mine in Cape Rosier. Callahan Co. owned a copper-zinc pit that they had depleted. They wanted to get rid of it and figured the best thing to do was drown it. Therefore, they blew up a little dam and filled it with seawater and for a while we had the largest water fall in the east coast, at 385 feet deep. When it was filled it turned into an ideal aquaculture site. A graduate student of the University of Maine was hired to manage the farm, experimenting with oysters, mussels, salmon, trout and developing a farm plan. Callahan quickly got disinterested and sold out everything, very inexpensively, to Bob Mant who is now marketing exclusively coho salmon. He, like all of our other operations, has had pretty hard sledding. Up until the bicentennial year, that is. Then, the Queen of England came to the United States and ate coho salmon in Boston, Massachusetts. There was a lot of publicity in Maine and all around New England, as to how the Queen enjoyed our cultured fish and this helped marketing a great deal. When the United States culinary olympics team went to Germany to compete, they took Maine Sea Farms salmon with them and it won a gold metal. Bob Mant does not have any difficulties marketing his fish now. He may be one of the only aquaculture companies in the country to go into the black shortly.

Another operation is at an oil-fired generating station in Wiscasset, Maine called Maine Salmon Farms. They use a much smaller pen which is only 15 cubic feet. They also grow their fish to market size, about 12 inches, or 8 ounces. This size salmon sells for about $2.25 per pound. They are being shipped as far away as Florida, but are primarily going to the Boston market. Bio-Groton Industries, in Groton, Mass., is doing an experiment with this farm. They have produced a copper pen. This has surprised most of us, because we know that copper is quite toxic to small oysters. It is not, however, considered harmful to fish. They have developed a pen that leaches copper at a very slow rate and yet the leaching rate is high enough to keep the fouling organisms off the side of the pen. I cannot tell you how it's doing, because this photo was taken in the middle of July and the pen wasn't even sunk at that point.

Within a year or so, if you keep an eye on Bio-Groton Industries, you probably will hear a report on how this is doing.

The last fish farm is on Vinalhaven Island, 15 miles offshore. This farm, on February 2nd of last year, lost 60,000 pounds of fish at 10:00 am. They froze to death. As a result of this, Spencer Fuller decided to buy steel-head trout and have them shipped to the state of Maine very early in the year. They went through their smolt period in May and right now he is in the process of marketing them. He will be marketing about 100,000 fish by the end of November or early December and he will be all done. He will not have to overwinter his fish and will not have to worry about mortality in February.

I guess no discussion of Maine aquaculture would be complete without saying something about the lobster culture.

There is one company down in Kittery, which is the last community before the New Hampshire border, who has been doing some independent research for years and years. They grow lobsters in a cylindrical tank with a series of dividers in it. As you know, the lobster is carnivorous, so they can't be allowed together in the pens. They grow at a fairly rapid rate and should be of market size in about four years. The lobster in wild takes about seven to ten years to get market size.

I have a few other slides that I wanted to show you. I am hoping that John Dupuy can fill in for me at least from New York south and if not, most of you know what is going on in aquaculture down this way.

Many operations of aquaculture or seafarming start out in some kind of fresh water. The fish are the best example of this. We have fresh water hatcheries in Mass. that produce fish. This particular one is in Sandwich, Massachusetts, where they're producing salmon for fresh water farming. Woods Hole Oceanographic Institute has the Environment Systems Laboratory under Dr. John Ryther, where they have been taking sewage, placing it in holding tanks, running the effluent in this water thru raceways and growing algae. This is one of the red algae that they are growing which appears to have terrific economic potential. Their biggest problem, believe it or not, is that they can't get enough raw sewage to maintain the ESL. I was hoping that Dick Loring would be here today, but he is not, so I guess I can put in an advertisement for his company. It is in Dennis, Massachusetts, and is called Culture Clam. They are growing the hard clam to market size. They have worked on methods of tagging the clam by coloring the shell and they have done a lot of work with growth and survival as well as hatchery techniques.

The University of Rhode Island has been doing some silo-culture of trout and salmon. I can't go into anymore details because I have only been there to visit once.

The last operation that might be of interest to you is the Long Island Oyster Farms where they are growing oysters to about 25mm in the hatchery, putting them out on their beds, and growing them out to market size. They had mass mortalities in their larval stages and at post setting stages of their oysters and they are having poor survival. They have spent an enormous amount of money to come to Maine to do research on our water and they have just recently purchased, what we call Moxie Cove, an old shrimp plant. They are going to set up a hatchery to grow and set oysters and then, apparently, transfer the very small oysters back down to their facility in New York.

I might leave you with one thought. The aquaculturist have had a tough time finding out where they belong. Fishermen say they are not fishermen because they don't go out and hunt wild products. The farmers say they are not farmers because they don't work the land. The government now has decided that they are, in fact farmers. If you read John Guild's book, <u>Maine Lingo</u>, a farmer is defined as 'one of them fellers outstanding in his field.' Under that definition, aquaculturists would be underwater. Thank you very much.

STATUS OF MARICULTURE IN EUROPE

John Dupuy

My purpose is to update the status of the mariculture industry in Europe. I'm going to primarily hold my comments to the countries which border the Atlantic Ocean and describe what these people are doing compared to the general trends in mariculture here in the United States.

I had the opportunity last year to make three trips to Europe, one of which was an invitation to explore the disease problems that they are having with the European oyster primarily in Brittany, France. It is related to <u>Minchinia</u> (MSX) as far as we can tell. The industry, in Belgium, Holland and France were threatened six years ago with disease. It started in a small fiord in Brittany and has spread slowly over the coast of France. As of last year, the disease had stopped spreading and some hope was held out.

The prime mariculture product is the European oyster. The French, Belgians, Germans and Spaniards pay high prices for these. In general, the wholesale price for European oysters is $4.00 a dozen. In Paris, Brussels and other areas, European oysters bring $8.00 to $12.00 a dozen wholesale. This is for an oyster that is well-shaped and in top condition.

The major species that are being actually utilized in mariculture are the European oyster, the Japanese oyster, Blue mussels in Spain, and the Manila clam, which has taken hold in many areas of Europe. Other small mariculture systems are starting to work on the abalone.

This is primarily being done by the French government and is given to the French fishermen to plant on private grounds. It is a very small industry. The largest industry in Europe is the European oyster.

One area in France impressed me very much in the sense that here was a system that was put together by a man who had no education other than high school, whose family had a history of primarily selling oysters and not growing them. In 1963, Mr. Maheo started a new idea in culturing the European oyster. He supplies 20% of the oysters market in France. His system is one of mechanization, mass production and a sales unit which is centered out of Paris and which now is spreading to Canada and Boston.

The Maheo collector which was developed by Guy in Brittany, France, is a plastic frame which looks like a radiator and is covered by a layer of lime cement. His company in France started with about 500 of these in 1964 to collect natural set. He has now increased his system in size to over one hundred thousand of these collectors. Several of his collectors were placed at the Virginia Institute of Marine Science, where we are testing the system for possible use in the Chesapeake Bay area.

The advantage to this particular collector besides being almost crab proof, is its ability to be mechanized for harvesting seed. They have a hydraulic machine in France that can take these seed oysters off the collectors at the rate of 6 metric tons a day. This allows them to handle vast quantities of seed oysters automatically. They also have utilized these collectors for Japanese oyster seed which are grown in the southern part of France in Arcachon.

The mechanization that was utilized by this particular company and which will probably be adapted by other mariculture ventures in France is also being tested in Holland. The collector is put into a special factory barge where they have a hydraulic system to remove the seed. Before this occurs, however, the collectors are brought up by cherry pickers on another barge. They're brought on board in groups of eight and then stacked. The barges have tracks where the cherry pickers can go up and down to place the collectors. Each barge has two cherry pickers which are operated from the bridge. The barges are motorized and they go to the factory ship that is also a barge which then removes the seed. The company now has fifteen of these barges and a system is set up in the area where they normally harvest the natural set in France. They're eventually going to go to hatcheries to implement their seed production. When the oyster seed is taken off it is automatically put into containers, and put on other motorized barges which then take it to shore.

On shore they have specialized trucks modified to haul containers which hold 15 tons of seed. The seed are put on the truck automatically and moved across the peninsula to another barge which has an automatic hydraulic system where the containers are tilted and shaken at a given rate to plant the seed overboard. The European oyster in Brittany normally takes approximately one year to reach a size where it can be removed from this collector. If utilized in the Chesapeake Bay, we anticipate the seed can be grown and removed at 3/4 to 1 inch in size in approximately a month and a half with very little problem.

The French are now utilizing row planting in their oyster growing system so that they can exactly pinpoint their plots just as the farmer does and they rotate their system. They do not plant the oysters the same place every year. Again I want to emphasize, at this point, that they're using a highly mechanized system, where in the old days to operate the barges you needed fifteen people. Normally they'll only need three people to a barge today as they operate this sytsem.

They have a specialized docking facility for the area where these barges can come up. They have trucks that come in and the containers are rolled right up on the trucks by hydraulic system and within three hours they are transported back on the barge to be planted in a different area of the Brittany coast.

The next area I want to discuss is the famous place where they have the claires and grow the green oyster. The unfortunate aspect of this story is that the sea water in the area is polluted from herbicides. This extensive area of claires has been reduced to only produce 20% of the total output of oysters of what it was ten years ago. The original claires were very small and irregular. With time, as the oysterman needed more oysters for the market, he expanded his new claires to be larger, more rectangular and more regular. This, unfortunately, has brought problems in the sense that the larger claires in the back cannot be properly flushed out due to the small canal which brings new sea water containing food. On top of this, a lot of pollution due to herbicide is occurring in this area and is essentially wiping out the natural food on which have killed the primary diatom that causes this greening, the industry is slowly decreasing.

In Arcachon, which is a very large oyster center, the mariculture industry primarily use to produce the Portugese oyster. Now it is stuck with the Japanese oyster which is one very good example of mis-management. About 1959, they brought in approximately 500 tons of the Japanese oysters, plus I don't know how many tons of seed oysters from Japan. The situation now is that the Japanese oyster literally has ruined the estuary which was a prime growing area. It is so prolific in terms of producing seed that the oysters are sitting on top of one another resulting in poor growth and disease problems.

The Japanese oyster pumps a lot of water, much more than the American oyster. And in terms of stripping the water of food, it is much more efficient than the Portugese oyster and especially the European oyster. This whole bay we estimate will no longer support production of the Japanese oyster in about three more years. They had another phenominal set this year and the problem is getting worse and worse. As in many mariculture ventures in the U.S., they use trays or bags to hold their oysters and set them up on stakes. The utilization of trays is turning against them in this particular bay in France. The Japanese oyster is very efficient in filtering. It produces huge masses of feces and pseudo-feces and they are having terrible problems from the massive amount of mud they're accumulating in and under these baskets. In addition to the increased mortalities of oysters the huge mounds of mud that are being produced by oysters in this area are causing changes in the current patterns in the area resulting in the curtailment of fresh sea water and food coming into the area.

The Dutch decided about five years ago, after having all their oysters frozen during one winter and faced with the possibility of this happening again, have started again to import the European oyster primarily from Mr. Maheo and two other seed producers in Brittany. However, they're going about it in a different way. They're taking relatively large seed oysters for planting. In addition they are starting nursery areas before they're putting the smaller seed oysters on the beds. The Dutch government is working very closely with these people to try to revive the mariculture industries in Holland. Now, in Holland, due to pollution, they are also going to have to transfer oysters to areas of non-polluted water which is going to add to the cost of the production of the European oyster. And so what they're looking at in terms of mariculture is a three step operation: importation of seed, for raising in a nursing area, constant surveilance by the Dutch government for disease increase or production of disease in the imports, transferal to growing beds which are polluted and finally growing these oysters in other beds of non-polluted areas. Up to this time, the Dutch have imported only European oysters, which required about five months of growing time before they were marketed because of the fear of the ice. You have to remember that the major area the Zuyder Zee which used to grow oysters in Holland, is now being filled for use for agricultural crops. So their growing areas are slowly diminishing with time and they're being hurt by this problem. The Belgian oyster growers now primarily consist of about five companies in a very small area. Again, the production is very minimal.

The French government, in cooperation with the Spanish government, the Dutch and the Belgian governments, are now starting to think about shrimp culture. At least one French laboratory has recently been able to produce penaeid gravid female shrimp which has been a breakthrough in terms of shrimp production being completely done in one facility rather than going out to hunt for the gravid females in nature as they have done in the past. So this total cycle is being completed at a major facility in Brest, France. They're now going to go ahead with trying to start a shrimp mariculture industry, at least in France for the present time.

In comparing the mariculture industry in France with the U.S., the Maheo system, within the French industry is relatively small, in comparison to those that are the traditional oystermen. However, there is an ingredient that is becoming very obvious in France, particularly because of the disease problem. The traditional oystermen are now beginning to listen to the biologist and are trying to modernize their mariculture systems. Unlike many places in the U.S. where there is back-lash to any modernization, over there they are starting to work to modernize and mechanize their systems in cooperation with the French government. There are still the problems of rivalries between agencies, but this is slowly being changed through the realization that modern aquaculture or modern mariculture must be utilized.

France, at one time, did have a hatchery in Normandy which was trying to produce a lot of different species of shellfish. My latest reading on this is that they have closed, primarily because of a lack of success in producing any of these species consistently and in large quantities. One of the interesting production items this hatchery was producing is what they call the "horse's foot". This is a particular strain of the European oyster which lives at depths of 60 feet or greater. It is an oyster that requires very cold water and when brought above the 20 ft. level, the water becomes too warm and the oysters die. But it is a prime oyster which brings up to $20 a dozen in Europe. It grows to sizes about five times that of the European oyster presently being marketed.

In Spain there are several hatcheries being formed for the production, not only of blue mussels but of oysters and, at my last reading, these had not yet started to produce anything of consequence. Again, as was mentioned here, Spain's main production is the European blue mussell. This is exported in large quantities to France, Holland and Belgium. There is a great concern by the French government in transportation of these mussels because of the potential harboring of diseases that affect people. The mussel is a prime example of an animal that can take up human pathogens in a very rapid fashion.

The U.S. in terms of numbers of mariculture ventures, both those that have started and failed and those that are continuing, is massive compared to Europe. Massive in comparison to most countries in the world, even Japan. The amount of money that is being put into research by the U.S. Federal government here is massive compared to France, Holland, Belgium and even Spain. I feel that except for modernization of mariculture, the U.S., in terms of the numbers of people involved and the money spent both in research and marketing, is far ahead of the Europeans in terms of mariculture and aquaculture.

EVALUATION OF THE A-1 METHOD IN ESTIMATING FECAL COLIFORM DENSITIES IN SHELLFISH

M. Saba, W. L. Smith, T. S. Hosty, and C. B. Kelly

Microbiological criteria for assessing the sanitary quality of shellfish at the market have been applied for many years. The cities of Chicago and New York were probably the first to apply such criteria soon after the momentous outbreak of shellfish-borne typhoid in 1925. Those criteria were based on densities of coliform organisms, the indicator group that was declared to be unreliable as an index of fecal contamination in shellfish (workshop, 1961) and which was replaced by the fecal coliform group in 1964 (workshop, 1964).

The advantages of fecal coliforms over total coliforms have been the subject of study and controversy for many years. The use of fecal coliforms as indicators of sanitary quality of shellfish growing areas was first introduced by Perry (1928) using at first a modification of Eijkman's medium, later refined to the EC medium incubated at elevated temperatures. The applicability of the EC test was studied by scientists in the field of water pollution and as a result of these studies the fecal coliform group is the recognized bacterial index of sanitary quality in pollution surveys and it is the bacterial parameter of sanitary quality for many uses of water.

Attempts to promote the use of the fecal coliform group as the indicator of sanitary quality of shellfish growing areas have finally come to successful accomplishment (workshop, 1975) after more than 45 years of study and re-study. Concurrently, there were studies to develop a simpler, shorter term test for fecal coliform organisms, one that would not require sub-culture or other confirmative tests and which would produce definite results in 24 hours. There were several candidate tests but the one chosen for comparative study with the EC test was the method developed by Andrews and Pressnell (1971).

Alabama participated in the study and, encouraged by the similarity between the EC and the A-1 test results, (Kelly, 1976) decided to test the applicability of the A-1 method to the determination of fecal coliform organisms in shellfish.

Material and Methods

Preparation of the sample, and tests for coliform and fecal coliform organisms were conducted in strict conformity with the methods prescribed in the APHA Recommended Procedures for the Examination of Sea Water and Shellfish (APHA, 1970). At least four serial dilutions were planted into LST presumptive broth. All gas positive tubes were transferred to BGB broth for confirmation of the presence of total coliform group organisms and to EC broth for confirmation of the presence of fecal coliform organisms. The A-1 method was conducted in accordance with the procedure prescribed in the protocol for the comparative study of shellfish growing waters.

Classification of coliform types was conducted by the completed IMViC procedure prescribed in the APHA Recommended Procedures. Three colonies of differing morphology but judged to be coliforms were selected from each EMB plate for classification.

Samples Collected

A total of 202 samples of oysters in the shell were collected during the period June 29, 1976 to August 8, 1977. Statistical information on the samples collected is given in the following table.

TABLE 1. SAMPLE STATISTICS

Number of samples	202
Number of plants sampled	9
Number of shippers or other sources	33

Of the 9 plants sampled, 18 to 51 samples were collected at each of five plants and 13 or less were collected at each of the remaining four plants. Of the 33 sources of shellfish (shippers) twenty were from Louisiana; five were from Mississippi; two were from Virginia; two were from Texas and one was from Alabama. In addition, ten samples came directly from Cedar Point Reef, Alabama, 11 were from Pass Christian, Mississippi and three were collected from Station 118, Mobile Bay, each considered as one source.

Results

Two statistical procedures were followed to compare the MPN values obtained by the two methods. The first method was to array the MPN's in ascending order of magnitude and compare the values obtained at selected percentile levels. The preferred method to determine the percentile MPN values is to extract them from plots prepared on logarithmic probability graph sheets. This was not possible with the data at hand. The plots showed extremely steep slopes, making accurate derivation of the MPN values impossible. Instead, the values were taken directly from the array. They are shown on Table 2.

TABLE 2. MPN's AT SELECTED PERCENTILES

	MPN per 100 ml	
Percentile	EC	A-1
10	<18	<18
50	78	78
90	4900	3300
95	7900	7000

The numerical values for the EC test at the higher percentiles are slightly higher than for the A-1 test, but the differences are probably not significant.

The second method, probably the more meaningful for each paired sample, was to determine the ratio of the A-1 MPN to the EC MPN, computed as in the following equation.

$$R = \frac{\text{MPNA-1}}{\text{MPN EC}}$$

The ratios were arrayed in ascending order of magnitude and plotted on logarithmic graph sheets in accordance with the method described by Velz (1951). The plot is shown in Figure 1.

The plotted values from the one percent to the 95 percent intersects show close conformity with a straight line, and therefore the occurrence of normal distribution in that range. The points at percentiles higher than 95 percent appear to define another straight line parallel to the first, but higher in location on the graph. These points could not be associated with any environmental situation, including time of the year. The broken line represents the 95 percent confidence limits that are inherent to the MPN system of enumeration. Since the experimental data show a steeper slope there are real variations among the ratios obtained.

Ratios at five selected percentile values are shown in Figure 2. The ratios at the 50 percentile (the geometric mean) is shown to be 0.95 which for all practical purposes is unity, considering the vagaries of the MPN system of enumeration. The 90 percent range of values is 0.18 to 5.0. The 95 percent range could not be estimated in view of the off-location of the 6 highest ratio values.

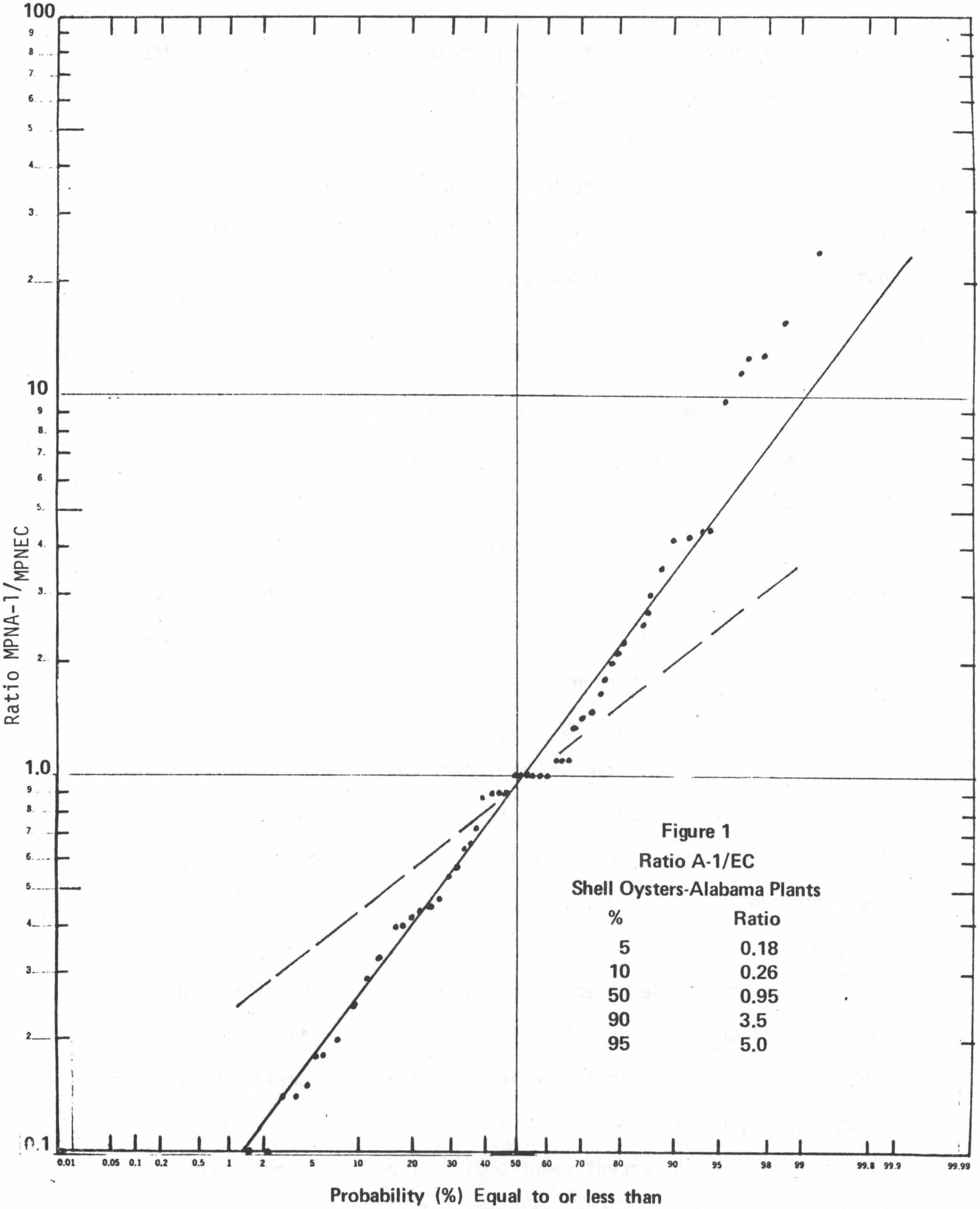


Figure 1
Ratio A-1/EC
Shell Oysters-Alabama Plants

%	Ratio
5	0.18
10	0.26
50	0.95
90	3.5
95	5.0

Classification of Coliform Types

In addition to producing similar MPN densities, the experimental method should also meet another requirement, namely that the spectra of coliform types recovered by the two methods should be similar. Therefore, the study included IMViC classification of the coliform types recovered.

Three colonies of differing morphology, but judged to be coliforms, were selected from each EMB agar plate that was streaked from a fecal coliform positive tube. These were submitted to the IMViC procedure for classification of coliform types. Approximately three-fourths of all fecal coliform positive tubes were so tested. A total of 1556 cultures derived from gas positive EC tubes and 1524 from A-1 tubes were tested. The results are shown in the following table.

TABLE 3. COLIFORM TYPES RECOVERED

Method	Percent of cultures positive for			
	+ + - -	- + - -	- - + +	other
EC	47.24	0.51	41.00	11.25
A-1	50.85	2.23	38.25	8.66

The A-1 method recovered higher percentages of *E. coli* types and conversely lower percentages of other types but not seriously so. The significance of the differences is doubtful. The results are shown graphically in Figure 2.

Discussion

Encouraged by the close similarity between the EC and the A-1 test results obtained on water samples from shellfish growing areas, the Alabama Health Department laboratory engaged in a similar comparative study on shellfish. The study was conducted on shell oysters

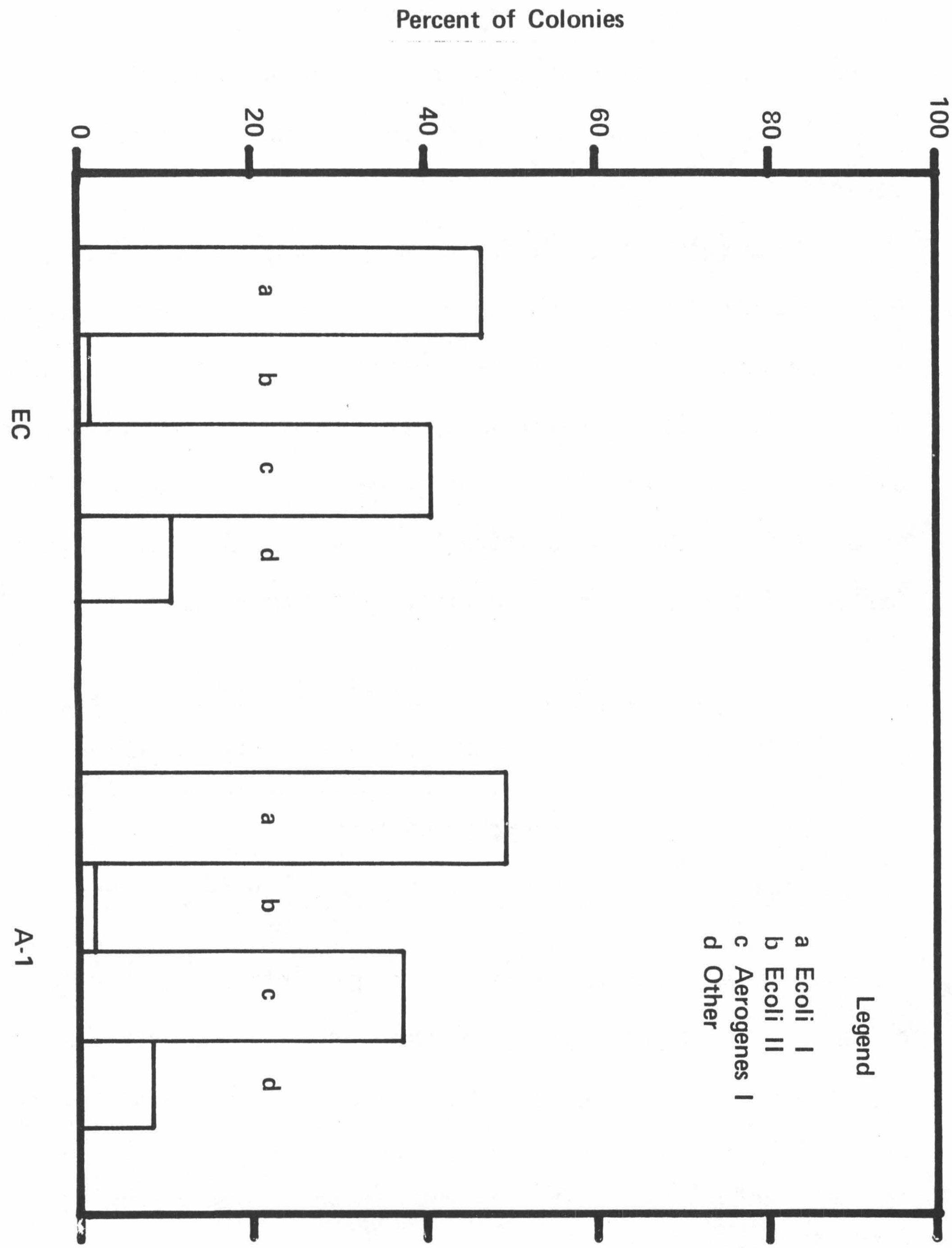


Figure 2. Coliform Types Isolated

collected at 9 oyster shucking plants during the period June 29, 1976 to August 8, 1977. A total of 202 samples were examined.

Statistical analysis of the comparative MPN's obtained by the two methods show an average ratio of $\frac{\text{MPNA-1}}{\text{MPN EC}}$ to be 0.95 which is considered practical unity.

Classification of coliform types recovered by the two methods reveals that the A-1 method recovered slightly higher percentages of *E. coli* types than the EC method but the significance of the differences is doubtful.

Since both the relative MPN's obtained are practically identical and the spectra of coliform types are similar, it can be concluded that in this study at least, the A-1 method was an acceptable alternative to the EC method for the estimation of fecal coliform densities.

The A-1 method has the advantage of simplicity in requiring no transfer of cultures or other confirmatory testing and the 24 hour interim between inoculation of sample and the attainment of final results.

It is hoped that the results of this study will stimulate other shellfish laboratories to conduct similar comparative studies in other geographical locations and on other species of shellfish.

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EVALUATION OF COLI-COUNT SAMPLERS FOR MONITORING THE SANITARY QUALITY OF SEAFOODS

Gary Richards

High costs for laboratory equipment, culture media, and trained quality control personnel are a deterrent to the initiation of routine microbiological testing in many small plants. Thus, only a small portion of the fish and shellfish placed on the market has been analyzed bacteriologically to determine its relative safety.

Coliform bacteria have been the most widely used indicator microorganisms for determining the sanitary quality of water and seafoods. More effective and practical techniques must also be developed to monitor coliforms in fish and shellfish meats. Methods must be developed that are adaptable to the needs of the fishing industry including seafood field inspectors and small processors who can not afford expensive or time-consuming analytical procedures.

Fishery products are analyzed for total and fecal coliforms by a variety of methods most of which employ the most-probable-number (or MPN) technique. This paper will detail a promising alternative method to determine total and fecal coliform counts in homogenates of fishery products using Millipore Coli-Count Samplers (Millipore Corp., Bedford, Mass.).

Methods:

Three samples of frozen cod fish, *Gadus morhua*; and three samples each of fresh American oyster, _Crassostrea virginica_; hardshell clam, _Mercenaria mercenaria_; and Gulf shrimp, _Peneaus sp_. were analyzed for total and fecal coliforms using the Coli-Count Samplers and the MPN procedures outlined in the Food and Drug Administration's Bacteriological Analytical Manual (BAM for short). Samples were intentionally drawn from suspected coliform contaminated sources. Seafood homogenates were prepared according to BAM procedures. Dilutions were prepared with 0.1% peptone buffer (Difco). Three tube MPN's were performed as far as necessary to obtain a determinant MPN's of coliforms. All tubed media were prepared by England Laboratories, Beltsville, MD.

For each seafood sample, duplicate Coli-Count Samplers were immersed for five minutes in the same seafood dilutions used in the MPN determinations. Package instructions were followed for inoculation of the samplers.

One set of samplers was incubated at 35 ± 0.5°C for 18 to 24 hours while the duplicate set was placed in a 44.5 ± 0.2°C incubator for the same time period. After incubation, colonies that were blue or blue-green, all or in parts, were counted as coliforms.

Results:

Preliminary results are summarized in Table 1. MPN's and counts on Coli-Count Samplers per gram of seafood are compared. A wide range of counts were obtained from the test samples. Please note that intentionally contaminated seafoods were collected for the purpose of these tests. The high counts in no way reflect the counts commonly found in seafoods available to the consumer.

Table 1. Comparison of MPN determinations and Coli-Count Samplers for the detection of total and fecal coliforms in seafoods

SAMPLE	TOTAL COLIFORMS/GRAM SEAFOOD		FECAL COLIFORMS/GRAM SEAFOOD	
	MPN	COLI SAMPLER	MPN	COLI SAMPLER
Cod	430	350	430	200
Cod	150	100	150	100
Cod	230	200	230	150
Shrimp	230	100	4	0
Shrimp	230	200	9	10
Shrimp	93	100	4	0
Oyster	1500	1200	1500	1100
Oyster	2300	1600	930	800
Oyster	150	200	150	100
Clam	93	870*	< 3	0
Clam	43	2280*	7	10
Clam	< 3	140*	< 3	0

*Coliform contamination of Samplers suspected.

Statistical regression analysis were performed on the results. They revealed a highly significant correlation coefficient of 0.994 (or 99.4% correlation) between the MPN's and Samplers for total coliforms. Total coliform counts for clams were not included in the calculation due to suspected contamination of the Samplers. A highly significant correlation of 0.991 (or 99.1%) also exists between fecal coliform determinations using both testing procedures.

Discussion

The cost of each Sampler is less than $2. They can be purchased in minimum quantities of 25 samplers and come presterilized and ready for use. On the other hand, prepared MPN tubes cost around 25¢ each. A 3 tube MPN with 5 dilutions requires a minimum of 15 tubes and a maximum of 45 tubes for a median cost of between $3.57 and $7.50 per analysis. The labor involved in recording positive tubes and transferring samples from tube to tube over a 96 hour period compounds the cost of MPN determinations.

The cost of private laboratory testing varies greatly depending on location. Shipping and handling costs involved in transporting the samples to the lab are often expensive. One processor I know pays $13 per fecal coliform analysis, not including shipping and handling charges.

Inspite of the obvious time savings and cost advantages, the Coli-Count Sampler has several limiting factors. These factors include premature drying of the absorbent pad, non-uniformity in colony color staining, possible leadhing of the indicator dye, and possible pH fluctuations.

Further studies are necessary to ascertain the effects of premature drying on the growth and visualization of coliform colonies, and to determine the causes of staining variations and methods to stabilize the dye reactions.

Choosing the appropriate seafood dilution to obtain countable numbers of colonies is very important. Extremely high concentrations of coliforms in a seafood dilution will result in overlapping of the colonies on the Sampler and inability to accurately count the colonies. Such a problem can be eliminated by employing several Samplers to cover more than a single dilution. For example, two Samplers could be employed using 1:10 and 1:1000 dilutions if a wide range of coliforms were expected.

From a monitoring standpoint, if tolerances for total and fecal coliforms are set by processors or regulatory agencies, then it would only be necessary to test for coliform counts above the established acceptable level. This would only require that a single dilution be tested. Perhaps this application of the Sampler will be most beneficial to industry.

Conclusions:

The preliminary results reported above indicate that the rapid 24-hour Coli-Count Sampler may be an effective, inexpensive, and convenient monitoring device for determining approximate counts of total and fecal coliforms in various fresh and frozen fish and shellfish. The Sampler may provide seafood processors, handlers, and inspectors with a practical monitoring tool to give coliform count ranges comparable to the results of MPN's and which can be obtained on a daily basis. Daily analytical results can alert processors of poor product quality and shortcomings in plant sanitation so that immediate corrective measures can be taken. MPN testing procedures, which take several days to complete, place several day's production in jeopardy since carry-over of coliform contamination can not be revealed until test results are available several days after production.

Analyses with the Samplers are so simple, they can be performed by production workers having no previous microbiological background. Instructions accompanying the Samplers give step-by-step procedures for inoculating and incubating the Samplers and for recording the results. Preparation of the homogenates and dilutions is not discussed in the instructions but can be easily followed in the Bacteriological Analytical Manual without any formal training required. The overall savings in labor costs are significant.

Due to the limited number of tests conducted to date, the Coli-Count Sampler can not be recommended, at this time, as a replacement or substitute for the MPN Procedure. Rather, it is a potentially useful analytical tool which needs more thorough testing.

Further evaluation of the Sampler is underway to determine the reproducibility of results, effects of seafood particle size on the filter membrane, and the minimum immersion times required to give maximum coliform counts.

DEVELOPMENT OF A PATEURIZED OYSTER PRODUCT

Daniel Goldmintz*

Introduction

The College Park Lab of the Southeast Fisheries Center, NMFS, has been investigating the use of steam for the production of a pasteurized oyster that is intermediate between the raw and commercially sterilized product. The objective of our study is to produce a pasteurized product that has a high degree of assurance of microbiological safety and quality with acceptable yields and organoleptic characteristics.

The primary criterion for oyster pasteurization was that the process provide conditions sufficient for destruction of organisms of public health concern. To accomplish this, we established times and temperatures of exposure of shellstock that would destroy heat-resistant, nonspore-forming bacteria. Information on the use of heat-resistant inoculated Salmonella as indicators of destruction of other microorganisms in shell stock has been presented at other meetings and is now in press. We will not discuss those experiments today except to say that the target temperatures for our pilot production of steam pasteurized in shell oysters were based on the conditions previously determined in our lab necessary to destroy public health and spoilage microorganisms.

* (Contributors - Robert C. Ernst, Jr. and Jamshid C. Rasekh)

In the development of a pasteurized oyster we began with shell stock rather than shucked oysters. We felt that heating the shell stock would make shucking easier and also sanitize shell surfaces which can be a source of contamination.

We considered the use of several methods for pasteurization. However, since we could only work on one method at a time, we established a selection priority list based on several criteria that include consideration of:

1) Initial cost
2) Operating cost
3) Availability of equipment
4) Familiarity with process
5) Process effect on product quality
6) Recovery of by-products.

Among the methods we considered were: Hot water immersion, use of dry heat, microwave heating, elevated and atmospheric pressure steaming.

Hot water immersion generates large volumes of waste water. Direct water exposure during heating can cause leaching of soluble protein and flavor components. In addition recovery of liquor in large quantities of water is impractical.

Dry air heating has the obvious draw-back of potential for dehydration of the product during heating.

Microwave heating could be used for pasteurization. However, there is a rather high initial equipment cost and it has been reported that microwave treatment can produce undesirable flavor changes in food.

In initial investigations of using elevated pressure steam for pasteurization shell stock we encountered significant problems in loading existing (available) pressure vessels which resulted in non-uniform heating.

The use of non-pressurized steam for oyster pasteurization which we will discuss today has a relative low initial and operating cost. The equipment is readily available and is easy to operate. The process is a familiar one with much information available on the effects of steam processing on various foods. Finally, the liquor expressed during pasteurization could be recovered.

Methods

Our procedure involved steaming of single layers of oysters on trays in a cabinet. The temperature was monitored using thermocouples inserted into the oyster belly masses through holes drilled into the shells. Single layers of oysters were used because stacking causing unacceptable disparity in heating. In addition, the oysters were separated into batches by weight so that time/temperature variations due to size could be minimized. The actual apparatus we used consisted of a converted 18 cubic feet upright freezer. Sanitary steam is provided by a small generator. As soon as the average internal temperature of the oysters reaches the desired level, the steam was removed and the oysters cooled with sprayed water to 30°C. They were then shucked and the yields determined. Further tests included total counts and coliforms, shear press determination and organoleptic evaluations (including triangulation tast panel testing).

Results

Table 1 shows the reduction in total plate count and coliforms as a function of temperature at the come-up time. The temperatures we chose to test were those for which we had established thermal death times of heat-resistant bacteria in previous investigations. At 60°C (140°F) not only was the total count sharply reduced, but coliforms (as representative organisms of public health concern) were virtually eliminated. The remaining total count was due to Bacillus. No spoilage or public health significant organisms could be detected. It appears, therefore, that steaming oysters to 60°C or slightly above would be adequate for pasteurization.

Table 2 shows the yield of shucked meats compared to shell stock after heating. At 60°C (pasteurization) there is approximately a 20% yield loss compared to the raw product whereas there is a 70% yield loss of the fully cooked product. The raw and pasteurization products are visibly similar with the exception that the pasteurized oysters are more uniform in color.

Once the microbiological criteria for pasteurization was satisfied, we turned our attention to evaluation of the food technological aspects of pasteurization of oysters. We are presently offering raw and pasteurized products to taste panelists to ascertain differences and preferences. Acceptability appears satisfactory. At a recent test comparing raw and pasteurized oysters which were deep fried, one-third of the

TABLE 1. EFFECT OF STEAMING ON SURVIVAL OF BACTERIA IN SHELL STOCK

Internal Temperature	Come-up Time (min)	TPC Before Steam	TPC After Steam	Coliforms Before Steam	Coliforms After Steam
56C(133F)	4.8	62,000	900	910	30
60C(140F)	5.5	47,000	230	1700	2
65C(149F)	6.0	55,000	29	340	< 1
71C(160F)	7.0	31,000	17	420	< 1
84C(180F)	12.0	51,000	15	1300	< 1

TABLE 2. EFFECT OF STEAMING ON THE YIELD OF SHUCKED OYSTERS FROM SHELL STOCK

Treatment	Yield
Raw	12 - 15%
Heated to:	
60 C	9.5 - 11%
71 C	7.5 - 9.5%
84 C	5.0 - 6.0%
Autoclave (Comparable to commercially sterilized product)	4.5%

panelists preferred the pasteurized product; one-third preferred the raw oyster; and one-third could not tell the difference between the raw and pasteurized oysters. Since there were no strong objections or preferences, there appears to be no significant preference when the pasteurized oysters are used as a fried product.

In an attempt to determine more objectively factors that influence taste panel judgments we investigated the texture of the pasteurized product using a shear press. To our knowledge this type of work has not been done using oysters. Table 3 compares the results of shear tests of raw, pasteurized and cooked oysters with and without the adductor muscle. Without the muscle the changes due to heating are relatively small. However, when the muscle is present the shear press values increase sharply. This data supports the observations of taste panelists who noted changes on the texture of the adductor muscle. It appears therefore that the shear press can be a useful tool for objective measurement of the texture of oyster products.

In conclusion, we have developed a pasteurized oyster product as an alternative to the raw product. Its closer similarity to raw oysters than to commercially sterile products indicates that it may find use as an adjunct to the raw product. It is also likely, with the sharp decrease in microbial load and the destruction of oyster enzymes at pasteurization temperatures, that shelf life could be extended beyond that for the raw product. We also noticed in our studies that steaming reduced undesirable coloration occasionally present in raw oysters.

TABLE 3. EFFECT OF STEAMING ON OYSTERS TEXTURE

Treatment	Internal Temperature (C)	Shear Values (lbs/sq. in.)
Raw w muscle	18	172
w/o		144
Past. w muscle	62	388
w/o		196
Cooked w muscle	84	493
w/o		206

Last, but not least, application of steam for pasteurization of shell oysters facilitates their shucking.

Further activities with pasteurized oysters will include further comparisons of shear press measurements using a shear compression cell to measure elasticity and taste panel evaluations. Long-term storage studies at 5°C and at freezer temperature (-40°C) have begun in order to evaluate product stability with reference to bacterial, organoleptic, and chemical characteristics. We also hope that in the near future we will be able to work with industry in-plant to evaluate steam pasteurization.

INTERSTATE SHIPMENT OF NON-ICED SEAFOOD PRODUCTS
An Interim Report

Dr. George A. Schuler

Background

Continental Can Company manufactures a machine called Con-O-Fresh 4000. Essentially, it creates a vacuum within the dome (28 inches - 30 being a perfect vacuum) and around the product. Air is evacuated from the product container as well, but since there is already a vacuum within the dome, the product is not crushed appreciably. The package is then heat sealed. The machine is so designed that it can back flush the package with an inert gas if desired. In this case, CO_2 was used.

The project began last December when only four of these machines were installed in industry throughout the United States -- two of which were in Georgia. Both of these were in poultry processing plants. To make a long story short, after running a pilot project to determine the feasibility of the packaging concept, Continental Can Company asked me to run a rather large study using over 1200 birds or almost two tons of chicken. We now know that chickens can be shipped by this method. In fact, processors utilizing this packaging method receive a premium, as well as savings in ice and freight.

About this time, I began thinking how this would apply to the interstate transport of seafood, shrimp in particular. I had already talked about the subject to one of our larger breading plants and we set our plan in action. We wanted to know what the shelf-life of vacuum-packed, frozen shrimp would be after thawing. We reasoned that if shrimp could be packaged in bulk and transported without ice that not only the cost of 400 pounds of ice per 1000 pounds of shrimp could be "saved", but also additional product could be shipped on the same truck.

Ice costs vary depending on your geographical area, the form purchased as well as the quantity purchased. Crushed ice in ton lots sell as high as \$50/ton (\$80 retail). Larger and consistent orders will bring this price down to the \$25-\$30/ton range. Using the lower rates, \$30/ton or \$0.015/pound, a savings of \$12/ton of shrimp could be achieved. The savings, if achieved, would of course be partially offset by the cost of bags and the amorization of equipment.

It is of interest to note that when we talked to the breeders they felt a big problem would be:

(1) Melanosis

(2) An increase in potentially harmful anaerobic microorganisms.

(3) One gentleman told me it is impossible to keep shrimp in the absence of ice.

(4) Others felt that the shrimp would penetrate the poly-bag when a vacuum was drawn.

These were some of the problems which had to be worked out.

Shrimp were caught, deheaded and saved separately aboard a vessel. They were graded and iced until packaged six days later. We used East Coast Browns 41-50's in this study. I would like to see packaging take place as soon after catching as possible, although I feel four to six days from the catch to pack is probably typical of the industry. Eight ounces of shrimp were placed in poly-vinyl bags of 7 and 87cc/m^2 oxygen permability. Control packages were heat sealed without being evacuated.

Test packages were evacuated at 28 inches then flushed with CO_2 gas. All bags were heat sealed. They were frozen then opened at 1, 2, 3, 6 and 9 month intervals. We have presently passed the two month interval in our study.

After two months of frozen storage, bags were removed from storage and thawed in a household refrigerator set at 38°F. Temperatures were checked by minimum-maximum thermometer and showed a variation of ±2° simulating case storage in a grocery store. Shrimp was observed for color and odor, drip was measured, flesh weighed prior to and after cooking, observed for black spots and evaluated organoleptically.

A pilot study was conducted to determine if indeed shrimp could be "dry packed". You will realize this term is a misnomer since obviously the shrimp is not dry. It is, however, dry in comparison to shrimp packaged and transported in the conventional way. These results indicated that there were no detectable detrimental changes in shrimp packaged without ice.

Now before you start packing 50 to 100 pounds of shrimp in this way, remember this was only 8 ounces of shrimp and they were packaged in a 35°F cooler and the shrimp were kept refrigerated.

More work is needed to determine the highest temperature at which shrimp can be packed and the effect of large quantities of shrimp in one container. Observations on both control and test packages showed that there was a slight lightening of color of the shrimp. Whether this is due to the shrimp remaining in their own juices for long periods of time is not known.

The shelf-life of the controls is approximately six days after thawing or a total of 12 days if one considers the six days previous to bagging. The shrimp packaged with CO_2 lasted only one day longer -- which I doubt would be significant.

It was also noted that shrimp packaged with CO_2 were considerably tougher than the control shrimp. This may be due to an interaction between the CO_2 and the proteinaceous material in the shrimp juice.

Conclusion

(1) Shrimp may be successfully "dry packed" without ice in small quantities provided temperatures are controlled with no detectable changes in physical or organoleptic properties. It may be that large quantities of shrimp could be packed similar, but more work is needed.

(2) Frozen dry packed shrimp tend to become lighter in color.

(3) Frozen vacuumed CO_2 flushed shrimp cook much faster and are slightly tougher than frozen dry packed shrimp not flushed with CO_2.

(4) This system would open the way for shipment of shrimp or other conventional "wet" products in trucks normally hauling "dry" products such as red meats, etc.

I believe that as the overall energy bill becomes higher and as our markets become more sophisticated, a packaging system of this type will appear more useful, yes even necessary.

GEOGRAPHIC AND MONTHLY VARIATION IN COMPOSITION OF OYSTERS, CRASSOSTREA VIRGINICA

Virginia D. Sidwell*

ABSTRACT--Cholesterol and glycogen contents of oysters, Crassostrea virginica, harvested each month for one year during 1975-1976 from Upper Chesapeake Bay (Md.), Mobile Bay (Ala.), and Barataria Bay (La.), were determined. The values varied from 38 to 218 mgs with an average of 109.4 mgs for cholestrol and from 467 to 6797 mgs with an average of 2355 mgs for glycogen per 100 gms of raw oyster meat on a wet weight basis.

Chesapeake Bay and Mobile Bay oysters were further analyzed for protein, fat, ash, moisture and amino acid content. The protein varied from 5.8 to 10.4 gms; fat 1.4 to 3.0 gms; ash 0.6 to 2.3 gms and moisture 77.7 to 87.0 gms per 100 gms of oyster meats on a wet weight basis. The variation in values reported in the literature for the composition of oysters may be associated with time of year and area from which the oyster was harvested. The variation is also due to the physiological status of the organism, which is somewhat influenced by temperature and salinity of growing waters and available food.

INTRODUCTION

A review of the cholesterol content of raw oyster meats reported by certain investigators revealed little apparent consistency.

*(Contributors--Audrey L. Loomis and Robert M. Grodner)

Cholesterol levels reported in the literature ranged from 37 mgs (Thompson, 1964) to 470 mgs (Okey, 1945) per 100 gms of oyster meat. Okey indicated, however, that some of the total digitonin precipitable steroids contained sterols other than cholesterol. Composition of Foods, Agriculture Handbook No. 8 (Watt and Merrill, 1963), lists oysters as containing less than 200 mgs of cholesterol per 100 gms. For a low-cholesterol diet, the National Heart and Lung Institute, National Institute of Health, recommends the consumption of not more than 9 ozs. of oyster meats a day. This judgment was made on the assumption that oyster meats do not contain over 40 mgs per 100 gms, in which case the intake would be about 250 gms (Frederickson et al 1973).

The objectives of this study were: (1) to obtain some understanding of the causes for the variation of the cholesterol values reported in the literature for oysters; (2) to observe possible variations in other components--protein, fat, ash, glycogen and amino acids; and (3) to note the relationships between the aforementioned components in oysters collected regularly over a period of one year (1975-1976) from Alabama and Maryland.

MATERIALS AND METHODS

To compare geographical and monthly differences in the composition of the same species, *Crassostrea virginica*, oysters were harvested at beginning of each month for one year (August 1975 to September 1976) from three areas along the coast of the United States--Chesapeake Bay (Md.), Mobile Bay (Ala.), and Barataria Bay (La.).

Maryland samples were 2-year old, tray-grown clutchless oysters propogated in the estuaries of the Chesapeake Bay near Shadyside, Md. As soon as they were delivered to the National Marine Fisheries Service, Southeast Fisheries Center's (SEFC) laboratory at College Park, MD., the oysters were shucked, packed in plastic containers, frozen, and stored at -40 °F (-40 °C). Samples that were to be analyzed for cholesterol and glycogen were packed in dry ice and shipped by air to Louisiana State University. Samples that were to be analyzed for proximate composition and amino acids were homogenized and submitted to the analytical group at the College Park Laboratory.

The Alabama oysters were brought to the SEFC's laboratory at Pascagoula, Miss., shucked, packed and frozen. They were kept in the freezer at -40° F (-40°C) until a shipment was made to the College Park Laboratory or to the Food Science Department, Louisiana State University, Baton Rouge, La. The College Park samples were homogenized and prepared for analyses in a manner similar to those from the Chesapeake Bay.

The Louisiana oysters were brought by the watermen to processors, where they were shucked, packed in pint jars, and transported in refrigerated trucks to Louisiana State University within six hours after harvesting. All oysters samples were held at the University at -25°F (-13°C) for subsequent analysis for cholesterol and glycogen only.

The cholesterol and glycogen determinations were made according to the method described by Grodner and Lanc (in press). The analysis for crude protein and fat were conducted according to the methods described in the Official Methods of Analysis of the Association of

Official Analytical Chemists (Horwitz, 1970: protein 2.051; ether soluble fat 7.048). Moisture analyses were performed by placing weighed samples in moisture tins and drying them for 16 hours in a forced air oven maintained at 100°C. The ash was determined by placing the weighed samples in a muffle furnace at 550°C for 16 hours. Amino acids were determined with an automatic amino acid analyzer by the method described by Moore et al. (1958).

RESULTS AND DISCUSSION

Table 1 lists the amounts of cholesterol determined in the samples of raw oysters harvested each month throughout the year from three areas. The January and February Maryland samples were lost in transit to Louisiana. Maryland oysters were highest in cholesterol during December 1975 and May 1976 and lowest in July 1976. The average for the nine samples were 92 mgs with a range of 37 to 124 mgs per 100 gms of raw whole oysters. The Alabama oysters contained the most cholesterol during January, March and April 1976. The February value does not fall in line with the aforementioned months. The apparent anomaly cannot be explained. The lowest cholesterol levels occured from July through September 1976. For the year, the average was 107 mgs with a range of 57 to 159 mgs per 100 gms of oyster meat. In general, the Louisiana oysters contained the most cholesterol--125 mgs, with a range of 97 to 218 mgs per 100 gms for the year. The overall average for the samples analyzed in this study was 109.4 mgs, with a range of 37 to 218 mgs per 100 gms. Statistically, there is no significant difference among the cholesterol values from the three areas.

Table 1.--Cholesterol values of oysters, *Crassostrea virginica*, harvested monthly for 1 year (1975-1976) from three areas.

Month	Year	Mg/100 g of Oyster Tissue		
		Alabama	Louisiana	Maryland
October	1975	108[1/]	103[1/]	106[1/]
November	1975	109	142	77
December	1975	116	109	124
January	1976	157	129	*
February	1976	76	164	*
March	1976	140	117	105
April	1976	148	107	94
May	1976	124	106	123
June	1976	109	98	91
July	1976	77	218	37
August	1976	57	97	69
September	1976	65	108	*
Average		107	125	92

[1/] Average of two determinations

* Sample missing

A limited number of values have been reported in the literature for the cholesterol content of C. virginica. Thompson (1964) reported 58 mgs of cholesterol in oysters harvested in November from the Upper Chesapeake Bay, as compared to 77 mgs per 100 gms reported in this study. For the sample species harvested in January near Biloxi, Miss., a value of 37 mgs was obtained, compared to 157 mgs for oysters harvested in nearby Alabama Bay. Although the times of the year that the oysters were harvested were not recorded by Achard et al. (1934), Koga (1970 a,b,) Simma and Taguchi (1964), Kritchevsky and Tepper (1961), and Kritchevsky et al. (1967), the values they reported fall within the limits of the values obtained in this study. The physiological status of animals harvested at different times from the same area clearly can be one of the causes for the variation in cholesterol content. In addition, some of the variation between areas may be associated with salinity and temperature of the water.

Table 2 records the amount of glycogen found in raw oysters from three areas throughout the year. The yearly average was lowest for the Louisiana oysters, 1326 mgs (range 467-2960 mgs); Alabama was second, 2495 mgs (range 603-4155 mgs); and Maryland third, 3539 mgs (1919-6920 mgs) per 100 gms of raw oyster meat. The data from each area are correlated with each other, indicating they form the same shape curve. When data were fitted to a sine curve to test for annual cyclic trends, they conformed significantly with the peak in the same area of the curve.

The Maryland and Alabama oysters appear to be fattest during March, April, May and June. This concurs with the results reported by Lee

Table 2.--Glycogen values of oysters, Crassostrea virginica, harvested monthly for 1 year (1975-1976) from three areas.

Month	Year	Mg/100 g of Oyster Tissue		
		Alabama	Louisiana	Maryland
October	1975	603 1/	876 1/	2510 1/
November	1975	1322	467	1929
December	1975	1925	1374	1919
January	1976	2211	1827	*
February	1976	2117	2349	*
March	1976	4069	1597	3346
April	1976	4155	1333	4973
May	1976	6797	2960	6920
June	1976	3731	968	4098
July	1976	953	836	3135
August	1976	916	606	3017
September	1976	1143	715	*
Average		2495	1326	3539

1/ Average of two determinations

* Sample missing

et al. (1960). In Lee's investigations of gulf oysters, glycogen content was obtained by the difference between the sum of protein, fat, ash and moisture content and 100%.

When the data for the three areas were pooled to determine if a correlation exists between the cholesterol and glycogen content of oysters, it was determined that there was no significant relationship ($r = 0.15$). Therefore, a high cholesterol value does not necessarily imply a large amount of glycogen.

Table 3 shows the average and range of the values for the proximate composition of the same lots of monthly samples from the coastal waters of Alabama and Maryland used in the cholesterol and glycogen determinations. Maryland samples were collected from August 1975 to August 1976; therefore, there are 13 lots in this phase of the study. Alabama samples were collected from September 1975 to September 1976, but there are 12 lots since the July 1976 lot was not analyzed. To facilitate the direct comparison of the oysters from the two areas, the values on both a dry weight and wet weight basis are recorded. Also, the data on dry weight basis are graphically reported in Figures 1, 2 and 3.

Figure 1 shows the fluctuation in protein content of the oysters harvested monthly over a one-year period from Alabama and Maryland waters. Between December and April, the protein content of the oysters is low in both harvest areas compared to the other months of the year. The protein ranged from 32.5 to 34.8 gms during these months for the Maryland oysters and from 35.6 to 41.1 gms for the Alabama oysters per 100 gms of dried meat. Protein content was higher during the summer and early fall, before harvest season. Protein content of the Alabama

Table 3.--Proximate composition of oysters, Crassostrea virginica, harvested monthly for 1 year (1975-1976) from two areas.

	Moisture	Protein	Fat	Ash	Glycogen
	%	%	%	%	%
Alabama					
Dry weight	-	47.0[1/]	12.9[1/]	8.1[1/]	14.4[1/]
		33.9-70.1[2/]	10.8-14.6[2/]	3.1-16.2[2/]	4.4-30.4[2/]
		12[3/]	12[3/]	12[3/]	11[3/]
Wet weight	83.4	7.6	2.2	1.3	2.5
	77.7-87.0	6.1-10.4	1.4-3.0	0.6-2.3	0.6-6.8
	12	12	12	12	12
Maryland					
Dry weight		39.2	14.0	9.5	20.0
		32.5-48.4	10.7-15.4	6.9-12.3	10.6-39.2
		13	13	13	9
Wet weight	82.7	6.7	2.4	1.6	3.5
	80.6-85.0	5.8-7.9	1.7-2.9	1.2-2.0	1.9-6.9
	13	13	13	13	9

1/ Average
2/ Range of values
3/ Number of values used to calculate the two statistics

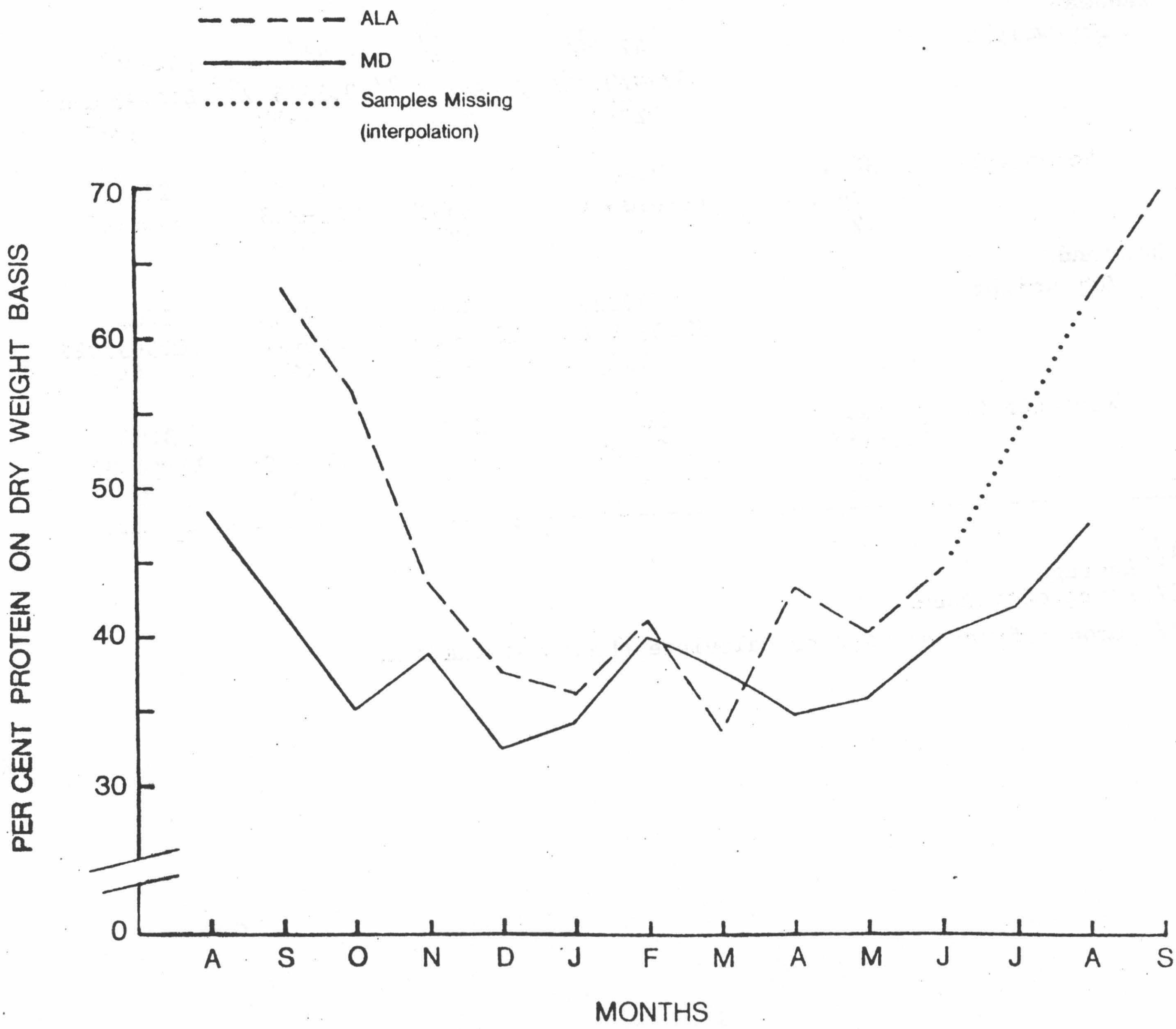

Figure 1.--Comparison of protein content in the monthly samples of freshly harvested oysters from Alabama and Maryland during 1975-1976.

oysters is significantly ($p = 0.01$) higher than that of the Maryland oysters. The sine curves formed by the data from both sites are the same, except the values for Alabama oysters were higher than for Maryland oysters. These curves had a significant fit to sine curves with peaks in August to indicate an annual cycle.

The 11 values for protein reported in the literature for this species ranged from 5.2 to 10.0 gms (Sidwell, in press). The range of the protein content in the oysters used in this study was very similar (5.6 - 10.3 gms per 100 gms) on a wet weight basis. Venkataraman and Chari (1951) reported a similar seasonal variation in this species of oysters harvested from Indian waters.

Table 4 presents the amino acid profile of the protein found in oysters. As expected, the profiles for oysters harvested monthly from Alabama and Maryland waters are similar, because the amino acid pattern of the protein is species oriented. In contrast, the amount of protein in the oyster is influenced by external factors, such as the availability of the food from the surrounding environment.

Figure 2 illustrates the monthly variation in the fat content of the Alabama and Maryland oysters. On a dry weight basis, the fat content of Maryland oysters averaged 14.0 gms, with a range of 10.7 to 15.4 gms per 100 gm; Alabama oysters averaged 12.9 gms, with a range of 10.8 to 14.6 gms per 100 gm. The seasonal trend of the fat content in the Alabama oysters was quite clearly defined. It was low in September for both 1975 and 1976, peaking in June with a decline in August. Lee et al. (1960) observed the low point to occur in July for southern oysters collected at various points along the Gulf of Mexico coast. This trend was not noted for the Maryland oysters.

Table 4.--Amino acid profile of the protein in oysters, *Crassostrea virginica*, harvested monthly for 1 year (1975-1976) from two areas.

Amino Acids	Alabama			Maryland		
	% of total protein					
Lysine	8.4 1/	6.6 2/ 11.0	12 3/	7.6 1/	5.6 2/ 9.6	13 3/
Histidine	2.1	1.7 2.4	12	2.4	2.0 3.0	13
Arginine	6.4	5.4 7.1	12	6.3	5.0 8.8	13
Aspartic acid	9.8	8.8 11.2	12	10.4	9.0 12.2	13
Threonine	4.1	3.6 5.0	12	4.2	3.6 4.7	13
Serine	4.8	4.2 5.2	12	4.9	4.2 5.6	13
Glutamic acid	14.0	11.4 15.0	12	12.8	11.2 14.4	13
Proline	4.4	3.8 5.2	11	4.1	3.6 4.6	10
Glycine	5.1	4.5 5.8	12	5.2	4.5 5.7	13
Alanine	5.5	4.9 6.0	12	5.1	4.6 5.7	13
Valine	4.6	3.6 4.8	12	4.2	3.7 4.6	13
Methionine	2.0	1.6 2.4	12	2.0	1.1 2.3	8
Isoleucine	3.7	3.2 4.4	12	3.8	3.4 4.2	13
Leucine	6.6	5.6 7.4	12	6.3	5.4 7.2	13
Tyrosine	3.3	2.6 3.8	12	3.2	2.4 3.8	12
Phenylalanine	3.4	2.5 4.0	12	3.4	2.4 3.8	13

1/ Average
2/ Range of values
3/ Number of analyses

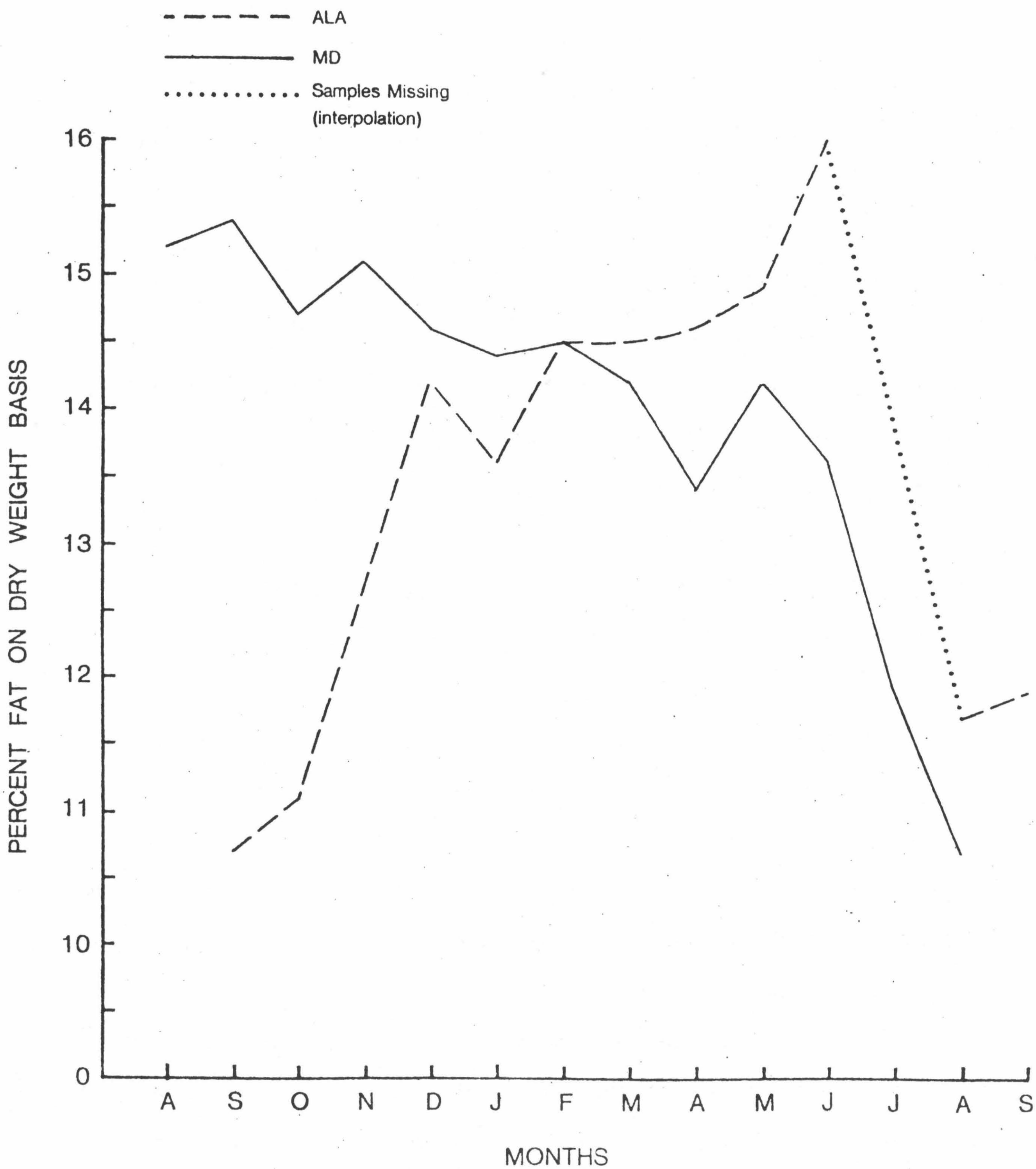

Figure 2.--Comparison of fat content in the monthly samples of freshly harvested oysters from Alabama and Maryland during 1975-1976.

Fat content on a dry weight basis was 15.2 gms in August 1975 and 10.7 gms in August 1976. There was a steady decline throughout the year in the fat content of Maryland oysters.

There was no significant difference between the data on the fat content of oysters from the two areas. The Alabama data fit significantly to a sine curve with a peak in March, April and May. This was not so for the Maryland data.

There is no significant correlation (r = 0.32) between the fat and cholesterol content in oysters harvested from the Chesapeake and Mobile bays when the data are pooled. Separately, there is a significant correlation between fat and cholesterol content (r = 0.80) of the Maryland oysters, but not so of the Alabama oysters (r = 0.47).

In this study, no effect was made to study the character of the fat in oyster muscle. Bonnet et al.(1974) reported that 28.1% of the fat was saturated; 10.6% contained 1 bond; 61.3% contained more than 1 bond.

Figure 3 shows that the ash content of oysters varies with season. It appears to be high during the late summer and lower in the winter and spring months. Again, this phenomenon is more clearly defined in the Alabama oysters. The ash data for the Alabama oysters significantly fits the sine curve with a peak in September. This is not true for the Maryland data.

Table 5 shows that the ash content appears to be inversely related to the fat content of the oyster muscle. This accumulation of mineral salts (ash) may be a physiological effort by the animal to maintain cellular osmotic pressure. On the other hand, there may be a greater

Table 5.--Fat and ash content on a dry weight basis in oysters, *Crassostrea virginica*, harvested in 1975-1976 from the coastal waters of Alabama and Maryland.

Month	Alabama		Maryland	
	Fat	Ash	Fat	Ash
	%	%	%	%
September (1975)	10.7	16.1	15.4	8.6
October	11.1	9.8	14.7	8.7
November	12.7	7.3	13.1	8.8
December	14.2	6.6	14.6	10.4
January (1976)	13.6	5.4	14.4	9.1
February	14.5	5.5	14.5	8.0
March	14.5	3.4	14.2	9.9
April	14.6	4.6	13.4	9.5
May	14.9	6.3	14.2	6.9
June	16.0	4.5	13.6	7.9
July	-	-	11.9	11.1
August	11.7	13.1	10.7	11.9

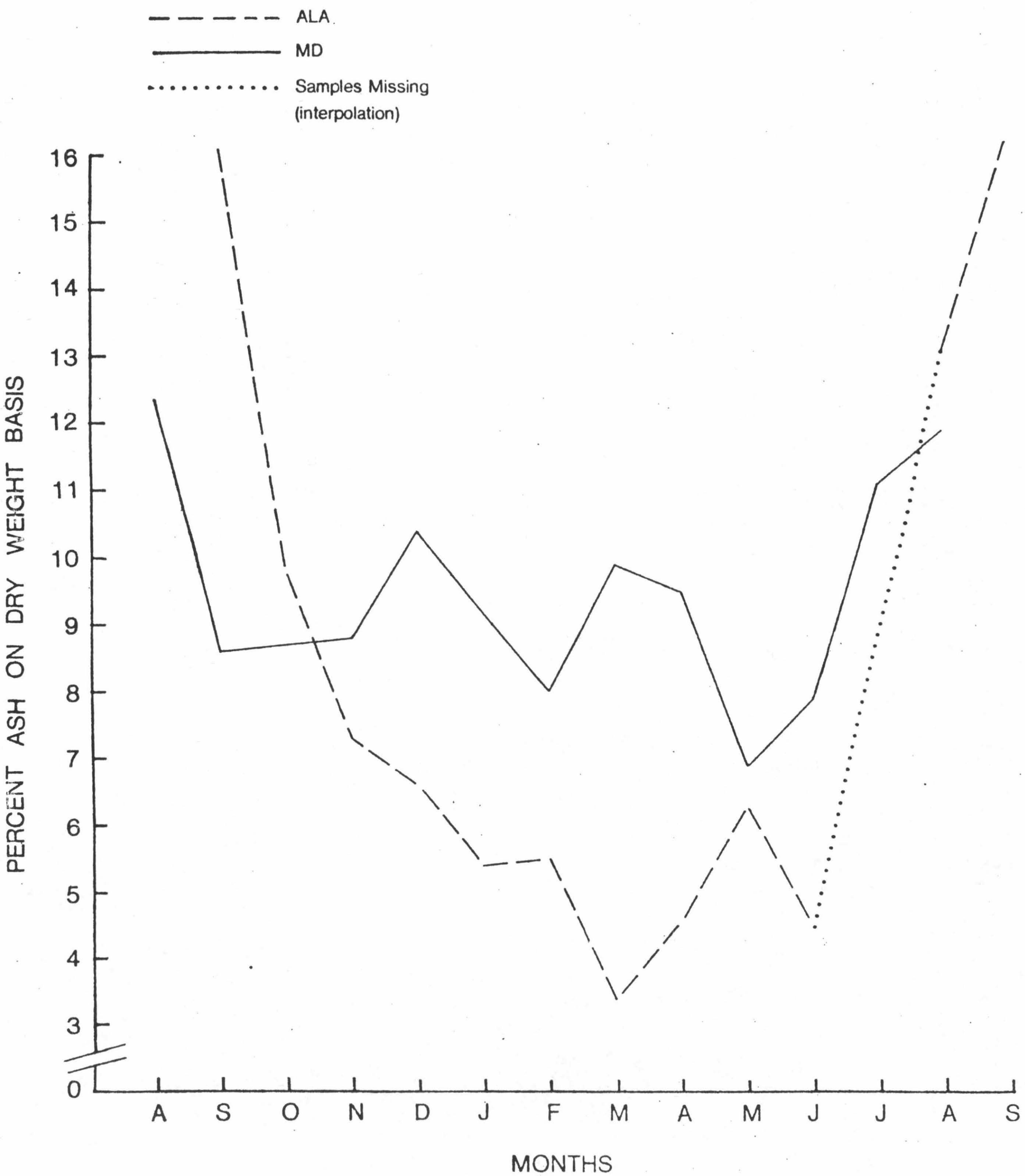

Figure 3.--Comparison of ash content in the monthly samples of freshly harvested oysters from Alabama and Maryland during 1975-1976.

accumulation of sandy materials in the gut during certain times of the year. There is a significant correlation between fat and ash content of Alabama oysters but not Maryland oysters.

Figure 4 shows graphically the relationship between the three components: protein, cholesterol, and glycogen in the whole Alabama oyster during the various months of the year. There is a tendency for cholesterol and glycogen to be high at about the same time the protein is low. The Maryland oysters (Figure 5) show a similar trend but it is not as clearly defined as in the Alabama oysters.

The apparent variation in values for the cholesterol and glycogen content of oysters, C. virginica, reported in the literature is associated with the time of the year, and possibly with the area from which the oysters are harvested. It is logical to conclude that variation is due to the physiological status of the organism, which is associated with environmental conditions, like temperature and salinity of the water, as well as to the available food. The amount of other food components, e.g. protein, fat and ash, in the whole oyster is probably influenced by the same factors.

In this study the results were often not statistically significant because of the small sample. To obtain data that will characterize the cyclic nature of the composition of the oyster, it will be necessary to collect data over a period of at least two years. Each monthly lot of oysters should be subsampled to obtain some information in the variability within each sample. Also, a description of the physiological status of the animals used in the analysis should be observed to help explain some of the variation.

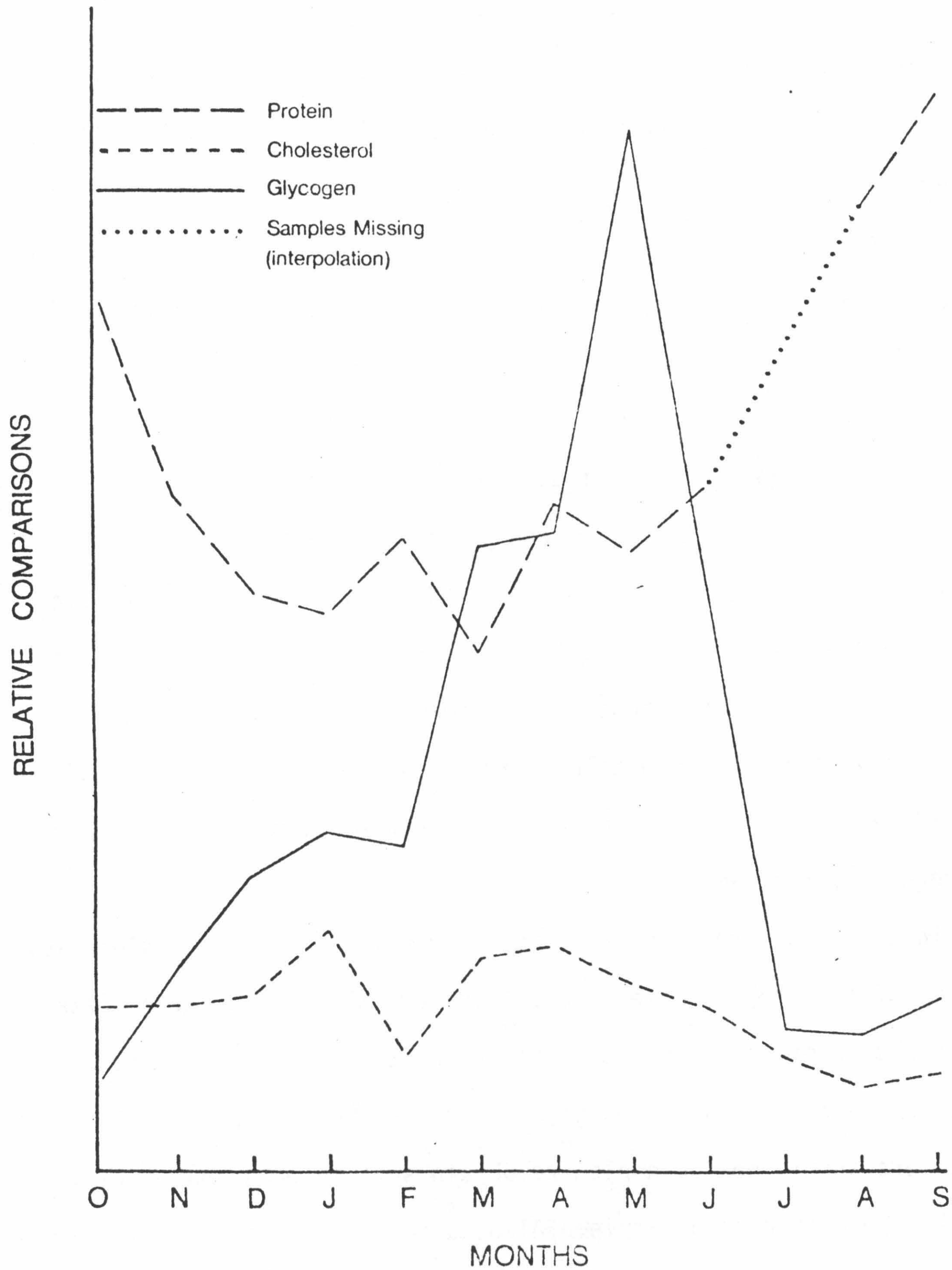

Figure 4.--Comparison of amounts of protein, cholesterol and glycogen present in the monthly samples of freshly harvested oysters from Alabama during 1975-1976.

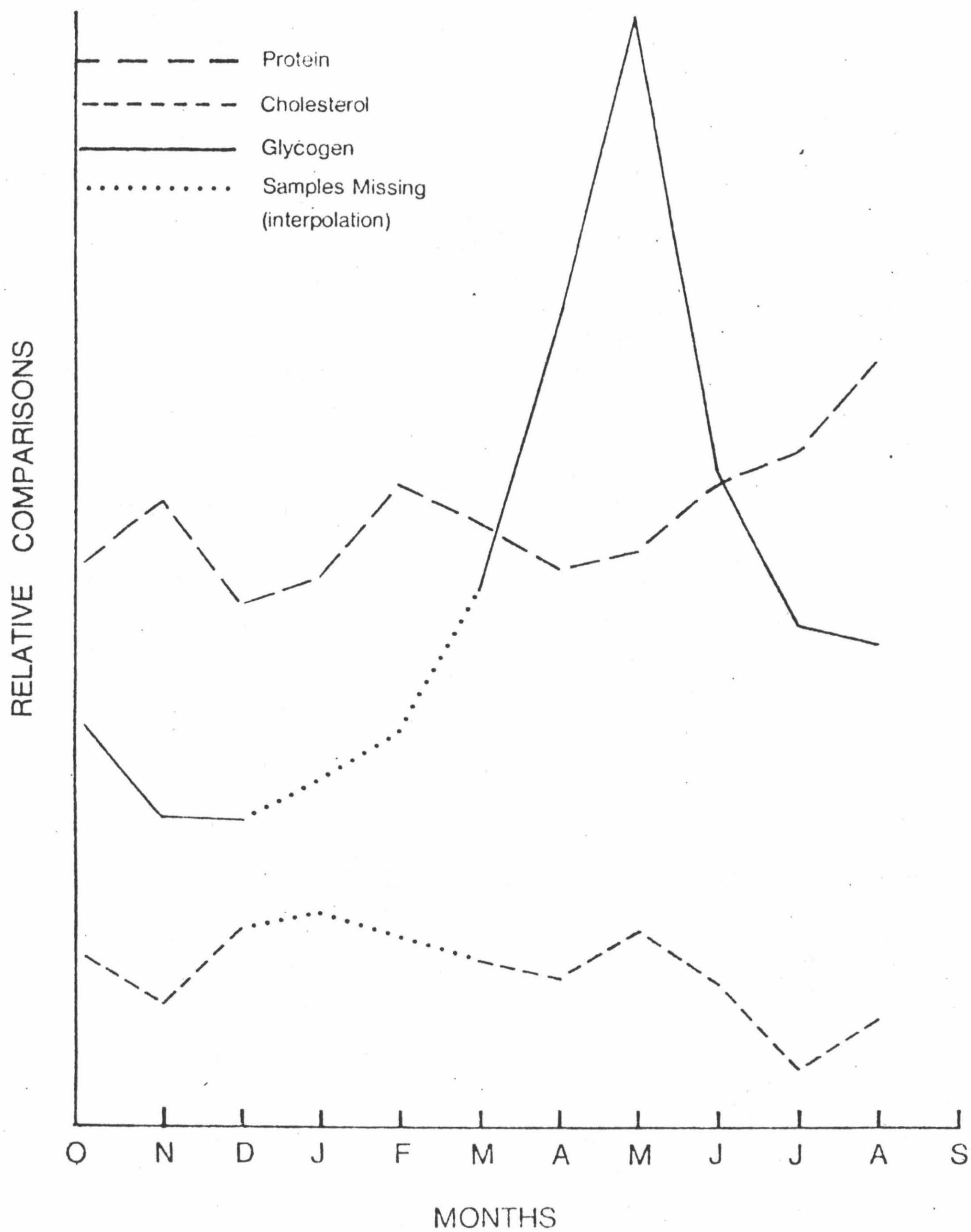

Figure 5.--Comparison of amounts of protein, cholesterol and glycogen present in the monthly samples of freshly harvested oysters from Maryland during 1975-1976.

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ISOLATION OF POTENTIALLY PATHOGENIC MYCOBACTERIA FROM COASTAL MARINE AND FRESH WATERS OF THE SOUTHEASTERN U.S. WITH OBSERVATIONS ON THEIR ECOLOGY

Joseph O. Falkinham, III*

INTRODUCTION

In 1958, the Public Health Service began skin testing all U.S. naval recruits on entry to the Navy, using purified protein preparations from *M. tuberculosis* (PPD-S), *M. intracellulare* (PPD-B) and *M. scrofulaceum* (PPD-G) to detect sensitivity as an indication of prior infection. Data analysis revealed that sensitivity to PPD-S occurred at low frequency and was widely scattered geographically (Figure 1), while sensitivity to PPD-B and PPD-G occurred at high frequency, the highest (70%) being among recruits from the southeastern coastal region of the U.S. (Figures 2 & 3) (Edwards, *et al.*, 1969; Edwards, 1970). Because it is a reasonable assumption that sensitivity to the purified PPD-B and PPD-G antigens has resulted from prior exposure to *M. intracellulare* (the Battey organism) and *M. scrofulaceum* respectively, we initiated this study (1) to find the source(s) responsible for the higher sensitivities and (2) to explain their unusual geographic distribution.

The epidemiology of infection by non-*M. tuberculosis* Mycobacteria (i.e., atypical Mycobacteria) is poorly understood. Despite several recent publications on this subject, the statement made on decade ago by Saito and Kubica (1968) remains essentially correct:

The epidemiology of human infection with the atypical acid-fast bacilli has remained obscure. No instance of person-to-person transmission of disease due to atypical mycobacteria has been verified, in spite of an intensive search for such cases. This apparent lack of communicability has led to the postulation of some source in lower animals and/or in nature, other than man, as the reservoir for these organisms. Search for the reservoir of infection due to Battey organisms has been especially important of the world-wide prevalence of cases, and of isolations of nonpigmented, slowly growing mycobacteria from lower animals and natural habitats; these findings suggested possible sources of Group III infections.

The literature has verified that atypical Mycobacteria, such as M. intracellulare, the closely related if not identical M. avium and M. scrofulaceum are distributed widely in nature. Atypical Mycobacteria occur in soil (Mallmann, et al., 1963; Schaefer, et al., 1973; Walinsky and Rynearson, 1968); tissues of cattle and frogs (Kazda and Hoyte, 1972), swine (Mallmann, et al., 1963), birds (Ferguson, et al., 1969; Karlson, et al., 1962; Schaefer, et al., 1973; Svrcek, et al., 1966); coastal waters of Alabama (Alabama Dept. Publ. Heal., 1969); and pond waters of Germany (Kazda and Hoyte, 1972). Mycobacteria have been isolated from pasture watering tanks, pools and brooks in West Germany, apparently aggregated on wasting algae (Beerwert, 1973). Kazda (1973a, b) isloated M. intracellulare and other Mycobacteria from West Germany moorland waters and showed that they could grow in these waters without addition of exogenous substrates. Suwankrughasn and Leat (1977) showed that some species of Mycobacteria (but no M. intracellulare) could grow in soil. Finally, Narain, et al., (1974) also found that the frequency of skin sensitivity to PPD-B increased with age.

The above information has led to the hypothetical model for epidemiology of human infection shown in Figure 4. This model addresses the assumption that the geographic distribution of human sensitivity to PPD-B and PPD-G relates to one or more primary sources of _M. intracellulare-avium_ and _M. scrofulaceum_. The high frequency of sensitivity of persons from the southeastern U.S. coastal region with decreasing frequency inland and with increasing altitude suggests such possibilities as human exposure to organisms from marine, estuarine, marshland or fresh waters in the Coastal Plain and Piedmont of this region. The exposure could be by direct contact or indirectly by natural production of bacterial aerosols, the possibility of the latter demonstrated by Gruft, _et al._, (1975). Our model (Figure 4) also suggests that soil and animals may be sources of atypical Mycobacteria, and the ability of these microorganisms to multiply in certain natural environments (Kazda, 1973a and b; Suwankrughasn and Leat, 1977) cannot be ignored.

In this first study, we have concentrated on water samples within the southeastern U.S. Most samples were of bulk water; a few were of the surface film or microlayer to test for probable concentration of microorganisms near the air-water interface, a phenomenon well-established for algae, fungi and bacteria, including coliform organisms (Hatcher and Parker, 1975). Also, some water samples were collected from outside the southeastern U.S. coastal region to seek confirmation for our hypothesis that a major source of atypical Mycobacteria exists uniquely within the geographic region of high frequency of human skin reactions to PPD-B and PPD-G. Finally, based on distributional and habitat data, we performed several experiments on isolates to learn more of their physiological ecology.

MATERIALS AND METHODS

Sampling

We have collected samples of subsurface and microlayer water from fresh waters and the sea coast from Virginia southward to Florida and westward along the Gulf and in the northeastern U.S. Microlayer samples generally contain higher concentrations of microorganisms (Hatcher and Parker, 1975). Our microlayer sampling procedure involved submerging a sterile glass plate vertically into the water, then withdrawing it. The thin layer of water and film which adheres to both sides of the plate was scraped off by means of a silicone rubber blade (Hatcher and Parker, 1974). A composite microlayer was collected in sterile bottles and transmitted immediately to the laboratory for processing.

Isolation

Microlayer samples collected by the above method and bulk water samples were treated for isolation of acid-fast bacilli, as follows: 20 to 40ml aliquots were centrifuged in the laboratory at 5,000 x G. The sediment obtained was then decontaminated by incubation with 1.0ml of 4% NaOH for 20 min. The NaOH was neutralized with 1N HCl and the samples were then centrifued (5,000 x G), supernates decanted, and the pellets resuspended in 0.2ml liquid and spread on the surface of plates containing Middlebrook 7H10 agar medium (BBL, Cockeysville, Md.) Middlebrook 7H10 was used because of the ability to spread samples on the surface of a petri dish and observe colonial morphology. Also we have been able to observe the transparent colonies of one putative Group III

Mycobacterium that are invisible on Lowenstein-Jensen. Because we sought acid-fast bacilli which might grow optimally at temperatures other than 35 C, some of these plates were incubated at 30 C to 37 C in the dark in either a CO_2-incubator (5% CO_2) or candle jar. Acid-fast bacilli growing on these plates were isolated and subcultured on Middlebrook 7H10 agar medium.

Identification and Characterization

In this preliminary report we describe the identification regimen used to place the acid-fast bacteria within Runyon groups (Timpe and Runyon, 1954) and to determine the temperature and pH ranges for growth. Each isolate will be identified to species according to procedures routinely used by the New York State Department of Health, Division of Laboratories and Research, Albany, and reported subsequently.

Each acid-fast isolate was transferred to two slopes of Lowenstein-Jensen medium (BBL, Cockeysville, MD). Slopes were incubated in separate candle jars at 37 C, one in the light and the other in the dark. Colonial growth was scored for pigmentation in the light and dark, and the rate of growth assessed. We report here only data for slow-growing Mycobacteria, namely those belonging to Runyon Groups II and III were run by streaking turbid suspensions of strains, on Middlebrook 7H10 medium then incubated at 40, 37, 30 room temperature (ca. 23), 14 and 10 C.

For other experiments to measure survival or growth of atypical Mycobacteria isolates and type culture strains, water samples from which the organisms had been isolated and Middlebrook 7H9 agar medium containing different concentrations of NaCl were used. The water samples or media were inoculated with suspensions of Mycobacteria grown in

Middlebrook 7H9. The water samples and plates were incubated at the desired temperature and viable cell counts measured (on Middlebrook 7H10) for various periods.

Total Bacterial, Total Coliform and Fecal Coliform Counts

On select samples, we conducted total bacterial, and total and fecal coliform counts (American Public Health Association, 1975) to seek possible correlations with the number of Mycobacteria in samples and/or the frequency of isolation of Mycobacteria at various sites. The data on total numbers of Mycobacteria per volume in each sample and the frequency of isolation of Mycobacteria for each sampling site also could be used to compare environments in the southeastern United States with those elsewhere in the U.S. However, due to the limited sampling in this initial survey, no statistical analysis for significance of any differences could be performed.

RESULTS

Two water sampling trips were undertaken in the Southeast, one in New England and one in New York. Of 28 water samples collected on the Gulf Coast from New Orleans, Louisiana to Panama City Beach, Florida, 17 (61%) yielded slow-growing Mycobacteria none of which belonged to Runyon Group I (Tables 1 and 2). Five samples yielded more than a single type of Mycobacterium spp., and of the 23 strains recovered, 14 belonged to Group II, and 9 to Group III (Table 1). Of 32 water samples collected on the Atlantic coast from Deland, Florida to Georgetown, South Carolina (Tables 3 and 4), 8 (25%) yielded slow-growing Mycobacteria. Four samples yielded more than a single type of Mycobacterium spp., and of the 17 strains recovered, none were members of Group I, 5 of Group II, and 12 of Group III. Of 10 water samples from sites in

New England, only two yielded slow-growing Mycobacyeria and of the 22 New York samples, only one yielded slow-growing Mycobacteria (data not shown). The positive sites in New England were associated with public bathing facilities in natural freshwaters.

Only 2 of 7 water samples collected on the Gulf Coast and only 2 of 15 samples collected on the Atlantic Coast having salinities of greater than 15% yielded slow-growing Mycobacteria, representing a lower frequency of recovery of Mycobacteria from water approaching seawater salinities (ca. 3.0%) relative to the fresher water samples. On measuring the growth rate (days per generation) of type strain M. intracellulare (Group III) in Middlebrook 7H9 liquid medium at different NaCl concentrations, we found the organism was curtailed by concentrations approaching that of seawater (Table 5).

Our limited sampling of surface microlayers suggested that Mycobacteria occur in approximately the same numbers in sub-surface as in surface microlayer waters of coastal fresh, brackish, and marine environment.

Characterization of 14 isolates, 13 from the Gulf Coast sampling run, revealed an optimum growth temperature ranging from 25°to 37°C (Table 6). While none of the isolates grew on Middlebrook medium in 30 days at either 4°or 10°C, several grew to form colonies in 30 days at 14°C (Table 7). One isolate formed visible colonies in 15 days at 14°C (data not shown). Although the strains were unable to form colonies at either 4°, 10°, or 14°C, they all developed colonies on plates following transfer from the low temperature incubations to 37°C for up to two weeks. The number of colonies on these streak plates was equivalent to those appearing on plates which had been incubated initially at 37°C, thus apparently all the cells originally streaked had survived the low temperature incubation.

Results of optimun pH range determinations for growth are shown in Table 6. All tested isolates had the same optimum pH range for growth as those atypical Mycobacteria recovered in cases of human infection.

We have also investigated the ability of strains of M. intracellulare as well as the isolates reported here to grow in waters from which the slow-growing atypical Mycobacteria have been isolated. In contrast to the results reported by Kazda (1973a and b) and Suwarkrughasn and Leat (1977), none of these Mycobacteria grew or survived prolonged exposure to waters from which they had been isolated. Because we have not surveyed a wide variety of different water samples, this finding constitutes only preliminary evidence that at least some natural waters in southeastern U.S. do not support growth of atypical Mycobacteria. Also, as we have not determined the species represented by our isolates, the growth phenomenon reported by Suwankrughasn and Leat (1977), which was clearly species dependent, cannot be compared presently to our preliminary data (See however, Figure 4).

DISCUSSION

Our preliminary results, while still too limited for statistical proof, support the contention that the geographic distribution of persons infected by atypical Mycobacteria probably relates to the regional prevalence of these organisms. Water samples of high salinity (>1.5% salinity) yielded Mycobacteria at low frequencies (23%). That the ocean probably is not a major source is further supported by our demonstration that growth of M. intracellulare was curtailed at salinities or NaCl concentrations approaching that of seawater. By ignoring all samples with salinity > 1.5%, 71% of the Gulf Coast transect samples and 30% of the South Atlantic transect samples yielded Mycobacteria.

These percentages are higher than the 10% frequency of isolation of atypical Mycobacteria from strictly fresh, inland waters of New England and New York. Thus, we have begun testing our hypothetical model (Figure 4) which suggests that waters associated with the southeastern land mass, notably the Piedmont and Coastal Plain, are sources of atypical Mycobacteria. As more information is obtained, our model may be improved and used for medical geography as well as epidemiology.

Characterization of these atypical Mycobacteria isolated from fresh, brackish and marine waters of the Gulf Coast transect demonstrated that they have optimal pH and temperature ranges for growth that are similar if not identical to the ranges shown by atypical Mycobacteria isolated in cases of human infection. Even though the slow-growing atypical Mycobacteria isolates survive exposure to low temperature, we feel that they do not grow in the coastal fresh and marine waters based upon our preliminary studies, which showed that the organisms gradually died in waters from which they had been isolated. A wider survey is underway to confirm this preliminary finding. However, with respect to temperature, it is obvious that the waters of the south-eastern U. S. Coastal Plain and Piedmont will be more compatible with the existence of Mycobacteria than those colder waters of New England. That the water collections in New England were taken in August, 1977 at their approximate summer maximum temperature also cannot be ignored in the absence of seasonal data.

In conclusion, fresh and brackish waters in the Southeast are one source of Mycobacteria although the numbers of cells in these waters rarely exceed 1 per ml. Thus, water may be one source of potential infection of humans in the Piedmont and Coastal Plain of the south-eastern U.S. However, we doubt that the waters are a primary source.

Other preliminary data has demonstrated that water cannot serve as a growth medium for atypical Mycobacteria.

We have not, as yet, examined other possible sources, such as, soils (Mallmann, et al., 1963; Schaefer, et al., 1973), swine (Mallmann, et al., 1963) or chickens and wild birds (Ferguson, et al., 1969; Karlson, et al., 1962; Schaefer, et al., 1973; Svrcek, et al., 1966). These likely candidates for primary sources of atypical Mycobacteria in the Southeast must be studied extensively to test and improve our model.

*(Contributors - Bruce C. Parker and Howard Gruft)

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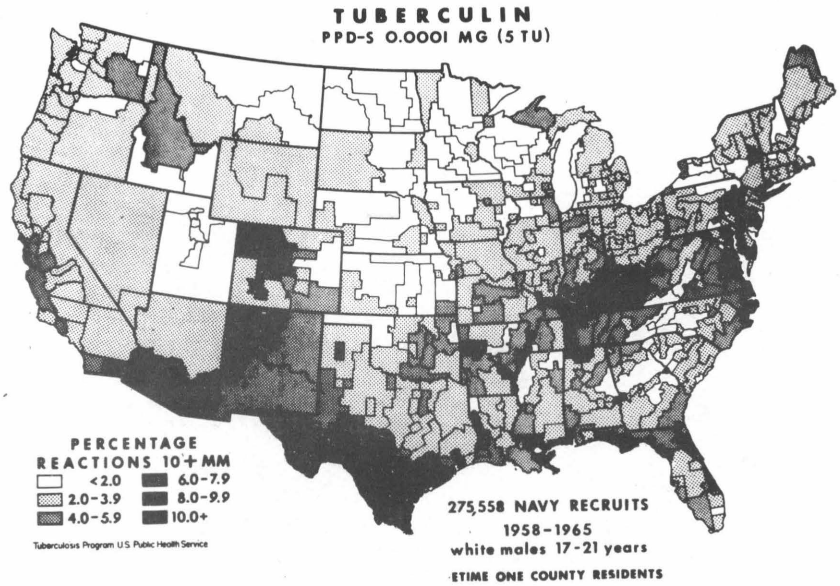


Fig. 1. Geographic distribution of the incidence of skin reactions >10 mm diam to PPD-S by white, lifetime single-county male residents between 17 and 21 years, reported by county. (Used by permission of the Editor of the American Review of Respiratory Disease, 1969, 99, Supplement, p. 1.)

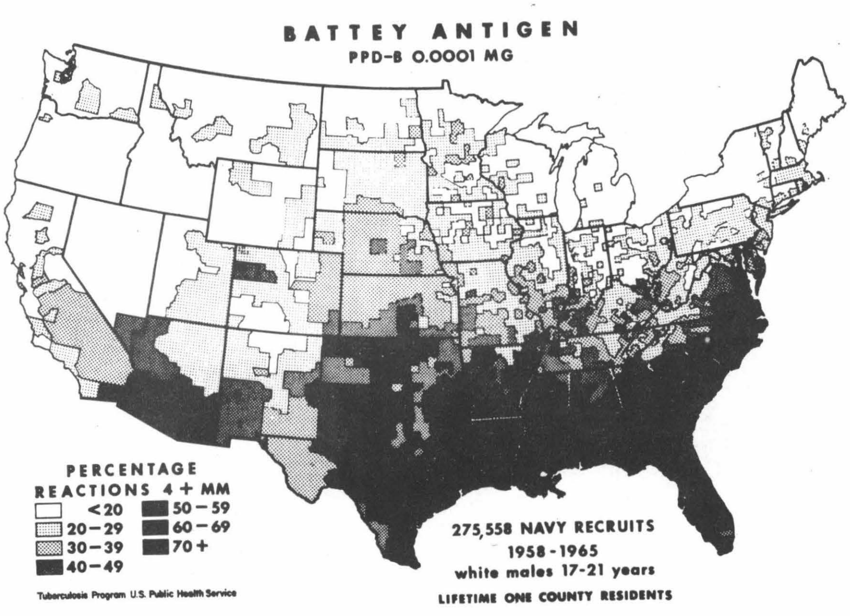
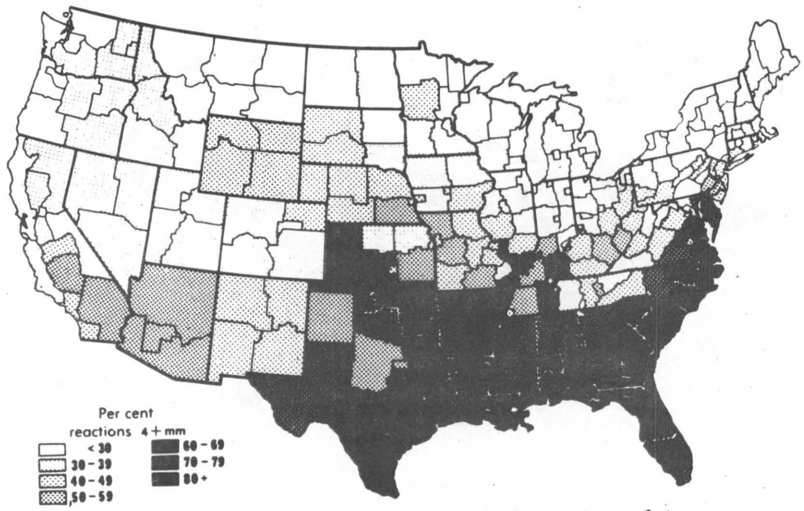


Fig. 2. Geographic distribution of the incidence of skin reactions >4 mm diam to PPD-S by white, lifetime single-county male residents between 17 and 21 years, reported by county. (Used by permission of the Editor of the American review of Respiratory Disease, 1969, 99, Supplement, p. 1.)



Percentage of 31,479 navy recruits with reactions of 4 mm or more to PPD-G. Recruits are white males, aged 17-21 years, and lifetime one-county residents.

Fig. 3. Geographic distribution of the incidence of skin reactions >4 mm diam to PPH-G by white, lifetime single-county male residents between 17 and 21 years, reported by county. (Used by permission of the Director of the University Presses of Florida, Phyllis Q. Edwards, 1970).

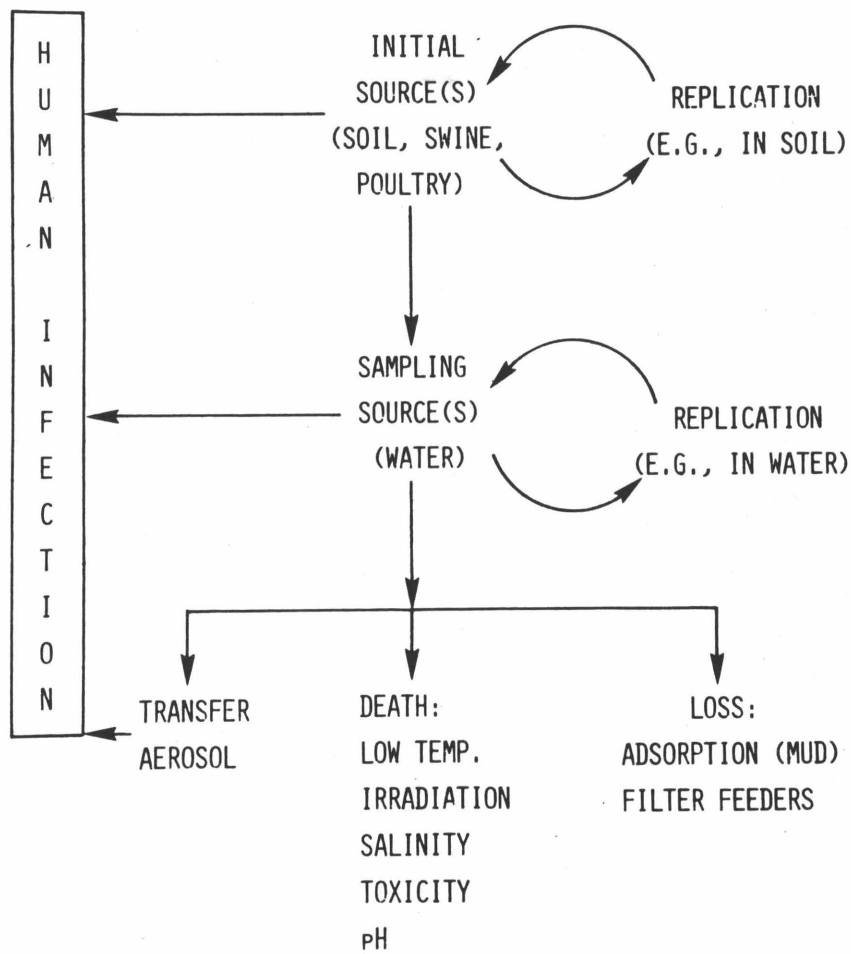


Fig. 4. Model for the geographic distribution and movement of Mycobacteria in the environment (Falkinham & Parker, unpublished).

TABLE 1

UNITED STATES GULF COAST SAMPLING SURVEY

SUMMARY OF *MYCOBACTERIUM* SPP. RECOVERIES

NUMBER OF WATER SAMPLES	28	
SAMPLES YIELDING SLOW-GROWING *MYCOBACTERIUM* SPP.	17	(61%)
TOTAL NUMBER OF SLOW-GROWING MYCOBACTERIUM SPP. ISOLATED	23	
GROUP I	0	
GROUP II	14	
GROUP III	9	

NUMBER OF WATER SAMPLES WITH SALINITY GREATER THAN 1.5% (w/v)	7	
NUMBER YIELDING *MYCOBACTERIUM* SPP.	2	(29%)

TABLE 2

UNITED STATES GULF COAST SAMPLING SURVEY

IDENTIFICATION OF SITES YIELDING SLOW-GROWING MYCOBACTERIA

SITES YIELDING GROUP II MYCOBACTERIA:	VENETIAN ISLES DEVELOPMENT, LOUISIANA; PASS CHRISTIAN, MISSISSIPPI; DAUPHIN ISLE PENINSULA, ALABAMA; POINT CLEAR, ALABAMA (BAY); DESTIN, FLORIDA (2); FORT PIKE, LOUISIANA; BELLE ISLE DEVELOPMENT, LOUISIANA; BAY ST. LOUIS, MISSISSIPPI; DAUPHIN ISLE, ALABAMA; POINT CLEAR, ALABAMA (GOLF COURSE); CHOCTAWHATCHEE BAY, FLORIDA (2);
SITES YIELDING GROUP III MYCOBACTERIA:	FORT PIKE, LOUISIANA; BLUE CONYER ROAD, MISSISSIPPI (BAYOU); BUCCANEER STATE PARK, MISSISSIPPI; BAY ST. LOUIS, MISSISSIPPI (2); PASS CHRISTIAN, MISSISSIPPI; U.S. NAVAL HOME, BILOXI, MISSISSIPPI; DAPHNE, MOBILE BAY, ALABAMA; DESTIN, FLORIDA;

TABLE 3

UNITED STATES ATLANTIC COAST SAMPLING SURVEY

SUMMARY OF MYCOBACTERIUM SPP. RECOVERIES

NUMBER OF WATER SAMPLES	32	
SAMPLES YIELDING SLOW-GROWING MYCOBACTERIUM SPP.	8	(25%)
TOTAL NUMBER OF SLOW-GROWING MYCOBACTERIUM SPP. ISOLATED	17	
GROUP I	0	
GROUP II	5	
GROUP III	12	

NUMBER OF WATER SAMPLES WITH SALINITY GREATER THAN 1.5% (w/v)	15	
NUMBER YIELDING MYCOBACTERIUM SPP.	3	(20%)

TABLE 4

UNITED STATES ATLANTIC COAST SAMPLING SURVEY

IDENTIFICATION OF SITES YIELDING SLOW-GROWING MYCOBACTERIA

SITES YIELDING GROUP II MYCOBACTERIA:	JAMES ISLAND, SOUTH CAROLINA (marsh); EULONIA, GEORGIA (river); JACKSONVILLE, FLORIDA (drainage ditch and fishing pier).
SITES YIELDING GROUP III MYCOBACTERIA:	DEEP CREEK, DELAND, FLORIDA; ST. JOHN'S RIVER, GREEN CAVE, FLORIDA; EULONIA, GEORGIA (marsh); SAVANNAH RIVER (at Rt. 17), GEORGIA; FOLLY CREEK, FOLLY BEACH, SOUTH CAROLINA; JAMES ISLAND, SOUTH CAROLINA (marsh); CHARLESTON YACHT CLUB, CHARLESTON, SOUTH CAROLINA; INTERNATIONAL PAPER COMPANY, SAMPIT RIVER, GEORGETOWN, SOUTH CAROLINA.

TABLE 5

EFFECT OF INCREASING SALT CONCENTRATION UPON THE GROWTH RATE OF MYCOBACTERIUM INTRACELLULARE

SALT CONCENTRATION (AS NACL)*	GROWTH RATE (DAYS/GENERATION)
0.085 %	3.5
1.0	3.8
1.5	5.0
2.0	11.0
2.5	11.0
3.0	13.5
3.5	12.5

*EXPRESSED AS NACL CONCENTRATION IN MIDDLEBROOK 7H10 WITH ENRICHMENT

OCEAN WATER = 3.0 % NACL (w/v)

TABLE 6.

GROWTH CHARACTERISTICS OF ATYPICAL MYCOBACTERIA AND ATYPICAL MYCOBACTERIA ISOLATED FROM THE ENVIRONMENT

Mycobacterial Strain or Site of Isolation	Growth Temperature Range [a]	Optimal Growth Temperature [a]	Growth pH Range [b]	Optimal Growth pH [b]
Group II				
M. scrofulaceum	25-37 C	37 C	4.0-8.5	5.0-6.5
Hopewell, Va.	25-37 C	37 C	4.0-8.5	4.5-6.5
Venetian Isles, La.	25-37 C	37 C	4.0-8.5	5.0-6.5
Pass Christian, Miss.	25-37 C	37 C	4.0-8.5	5.0
Dauphin Isle Peninsula, Ala.	25-37 C	25-37 C	4.0-8.0	5.0-6.5
Point Clear, Ala.	25-37 C	25-37 C	4.0-8.5	5.0-6.0
Pinacle Port, Fla.	25-37 C	25-37 C	4.0-8.5	5.0-6.5
Destin, Fla.	25-37 C	37 C	4.0-8.5	5.0-5.5
Group III				
M. terrae	25-37 C	25-37 C	5.0-8.5	6.0-8.5
M. terrae	14-37 C	25-37 C	5.0-8.5	6.0
M. intracellulare	25-42 C	42 C	5.0-8.5	5.5-8.0
Fort Pike, La.	25-37 C	37 C	4.5-8.5	6.5-8.5
Blue Conyer Rd, Miss.	25-37 C	37 C	4.0-8.5	5.0-6.5
Blue Conyer Rd, Miss.	25-37 C	37 C	4.0-8.5	5.5-6.5
Buccaneer State Park, Miss.	25-37 C	37 C	4.0-8.5	5.0-7.5
Bay St. Louis, Miss.	25-37 C	25-37 C	4.0-8.5	4.5-5.0
Pass Christian, Miss.	25-37 C	37 C	4.0-8.5	4.5-5.0
Destin, Fla.	25-37 C	25-30 C	6.5-8.5	7.0-8.5
Daphne, Ala.	25-37 C	37 C	5.0-8.5	6.5-7.0

[a] Mycobacterial strains were streaked on Middlebrook 7H10 with OADC enrichment and incubated at 14, 25, 37, and 42 C. Each strain was then scored for growth (0-4+) after 15 days incubation.

[b] Middlebrook 7H10 with enrichment was adjusted to pH 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0 and 8.5. The Mycobacterial strains were streaked on a plate at each pH and scored for growth (0-4+) after 15 days incubation at 37 C.

TABLE 7.

EFFECT OF LOW TEMPERATURE INCUBATION ON

ATYPICAL MYCOBACTERIA

Mycobacterial Strain	Growth at 14C [a]	Survival at 14C [b]	Growth at 10C [a]	Survival at 10C [b]	Growth at 4C [a]	Survival at 4C [b]
Group II						
M. scrofulaceum	0	+	0	+	0	+
Hopewell, Va.	0	+	0	+	0	+
Venetian Isles, La.	±	+	0	+	0	+
Pass Christian, Miss.	0	+	0	+	0	+
Dauphin Isle Peninsula, Ala.	0	+	0	+	0	+
Point Clear, Ala.	±	+	0	+	0	+
Pinnacle Port, Fla.	±	+	0	+	0	+
Destin, Fla.	0	+	0	+	0	+
Group III						
M. terrae	±	+	0	+	0	+
M. terrae	±	+	0	+	0	+
M. intracellulare	±	+	0	+	0	+
Fort Pike, La.	±	+	0	+	0	+
Blue Conyer Rd, Miss.	±	+	0	+	0	+
Blue Conyer Rd, Miss.	±	+	0	+	0	+
Buccaneer State Park, Miss.	±	+	0	+	0	+
Bay St. Louis, Miss.	0	+	0	+	0	+
Pass Christian, Miss.	0	+	0	+	0	+
Destin, Fla.	0	+	0	+	0	+
Daphne, Ala.	0	+	0	+	0	+

[a] Mycobacterial strains were streaked on Middlebrook 7H10 with enrichment and incubated for 30 days at the designated temperature. Each strain was then checked for growth (+), no growth (0) or slight growth (±).

[b] Mycobacterial strains were streaked on Middlebrook 7H10 with enrichment and incubated for 30 days at the designated temperature. Any strains which showed no growth (0) or slight growth (±) were reincubated at 37°C for 15 days and once again checked for growth (+).

EFFECTIVENESS OF MARINE POLLUTION CONTROL DEVICES
FOR PROTECTING SHELLFISH WATERS

Lester A. Balderson

When I think about the effectiveness of marine sanitation devices for protecting shellfish and for that matter for protecting general water quality, I feel we're hitting on the head the real controversy that has precipitated the long delay and the controversy in federal and state boat pollution regulations. In other words, we have two different points of view. Boatmen feel certain devices should be used and certain devices function properly. Health departments and water quality agencies say no; we need different regulations and different marine sanitation devices to do the job. So, in either case, marine sanitation devices or the effectiveness of those devices are synonymous with not only federal, but state boat pollution regulations. I will start with what the federal regulations require because I think it is very important to give us the background to understand the subject.

Federal boat pollution efforts started in 1970 with the passage of the Water Quality Improvement Act (WQIA). Under this Act EPA was directed to promulgate standards for marine sanitation devices and the U.S. Coast Guard to take these standards and place them into regulation form. In 1972, the federal statute was changed with Public Law 92-500, but the essential elements of the 1970 Act were carried forth into the 1972 Act with regard to adopting federal boat pollution regulations.

One additional requirement that came along with the 1972 Act was Section 312(f) (3). This Section added that where a state had a need to adopt regulations more stringent than those required under the federal regulations, such state could petition EPA for a no-discharge certification. In this petition, the particular state would need to designate the waters where they wanted the no-discharge certification, and to demonstrate the <u>need for more stringent regulations</u>, and <u>to provide adequate pumpout facilities</u>.

Under Section 312(f)(4), a state could petition EPA for no-discharge certification and simply demonstrate that there was a need for more stringent regulations. Under the federal law, a specific reference was made to the fact that this no-discharge certification concept was to protect such things as drinking water supplies, shellfish beds, and certain sensitive waters.

EPA proceeded with their public meetings and in 1972 adopted standards. These standards were no-discharge standards, except for flexibility for a particular time frame and circumstances which allow certain flow-through devices. Obviously these standards had high water quality objectives in mind. However, when the Coast Guard went to public hearings with these standards, they met with tremendous opposition from boating groups and boat men from across the country. The result was a compromise between EPA and the Coast Guard. What it eventually amounted to was that

EPA did, in fact, revise their standards in favor of weaker standards that would permit certain flow-through type treatment devices rather than a total no-discharge system of regulations. Finally, the U.S. Coast Guard adopted these regulations on January 30, 1975. They would be effective for new vessels in two years as of January 30, 1977 and for existing vessels in five years, which would be January 30, 1980. The Federal regulations would preempt all state regulations on the respective effective dates except where a state has gone through with this no-discharge certification idea.

The reason it will be difficult for a state to continue to impose its own regulations without going through this no-discharge concept, is that within the federal law there is a provision whereby a boatman who purchases the equipment approved under the federal regulations, individually becomes preempted from state regulations. Where a state has no-discharge regulations or where a state never adopted a no-discharge regulation, they need to go through EPA and obtain this no-discharge certification to enforce holding tank regulations. Otherwise, the moment you try to get someone to put a holding tank on the boat, the person could put a flow-through type device on and would be individually preempt. The federal regulations, in essence give a boatman a choice of two types of systems: (1) no-discharge, and (2) certified flow-through treatment type system.

The no-discharge system will include holding tanks, re-circulators, which are a type of holding tanks, and gas incinerators or else they could elect to go to the certified flow-through treatment, which is apparently what all the boatmen want.

There are five types of certified treatment devices that the boatmen can choose, Under the federal regulation, marine sanitation devices are divided into three types. Type I is a flow-through device which will produce a fecal coliform effluent not to exceed 1,000 per hundred milliliters (100ml) with no visible floating solids. And then the more advanced type, is Type II, which will produce an effluent with a fecal count not to exceed 200 per 100 ml, and no greater than 150 milligrams per liter suspended solids. The Type III is the no-discharge or holding tank. Existing boatmen will need to install the Type I device by January 30, 1978, if he intends to use that device for the service life of the MSD. Beyond January 30, 1978, Type I will no longer be acceptable. However, new vessels or those whose construction started after the adoption date or the regulations will have until January 30, 1980 to install the Type II device providing the 200 fecal coliform per 100 ml as a maximum, or it would have to be a Type III device, which is a holding tank. The Coast Guard, in their regulations made provisions and set forth requirements for testing and certifying devices and all such matters are spelled out in the use of treatment devices, certain vibration tests and shock tests, rolling tests, pressure tests, chemical resistance and all these sort of things that are necessary for a manufacturer to get his treatment device certified.

In the state of Virginia, we have had authority since 1968 to adopt boat pollution regulations. This has been a controversial issue all these years. The center of controversy is really the effectiveness of the available devices. What will these devices do? There are different points of view. In any case, we have held four series of hearings over the years. The first series of hearings resulted in no action. In the second series of hearings, we adopted Regulation No. 5, which is a no-discharge regulation across the state. We adopted a two year implementation period. After two years,we had accomplished practically nothing and we held a third series of hearings, to change the implementation date. We still had not accomplished our goal, so last year we went back to hearings and revised our regulations to require no-discharge, only in designated shellfish growing waters. The regu lation is written so that it is not effective until one year after receiving the EPA no-discharge certification. The idea in the state is to go through EPA and get the no-discharge certification, but the hold-up is that the boatmen and marina people have different thoughts on control and have yet to install holding tank pumpout facilities at marinas. Until we get the pumpout facilities, we can't even apply to EPA for this no-discharge certification.

There are five types of certified flow-through devices available at present to the boatmen under federal regulations for use. They are the (1) Lectra/San units, (2) the

Microphor unit, (3) the Montron 764, (4) the Nautromatic 1,000, and (5) the Delta Marine Head. These devices are basically chlorintor units except the Micriphor is an aerobic digestor. All of these devices are Type I, except that the Microphor or aerobic digestor is a Type II device.

In the Coast Guard requirements was a section for the certification of these devices and afterwards there were requirements that each of these devices would undergo an after-market testing. The certification is done by anyone of six laboratories around the country approved by the U.S. Coast Guard. Underwriters Laboratory and the National Sanitation Foundation are two of the more popular laboratories that do this. But the after-market testing is done by the Naval Research Development Center at Annapolis. The Lectra-San, which costs about $460, was certified a couple of years ago. But it was the first device tested by the Naval Research and Development Center for after-market testing and it ran into problems.

The Navy Facilites found that this device uses a tremendous amount of electricity. It is probable one of the more popular devices, but it has tremendous voltage drainage. In fact, the Coast Guard received many letters from boatmen who said that they bought this brand new, nice, beautiful Lectra/San unit and one weekend out at sea and they had a dead battery. The Lectra/San unit was tested by the Navy but it did squeeze by the after-market testing, so it is still a certified device. Then we have the Monotron 764, produced by Monogram Industries. This device is nothing more than an attachment on the standard Monogram re-circulating unit. Many have probably heard about the Monomatic unit, which is about two cubic feet in size. It starts with about three gallons of water and a chemical charge. Essentially you flush into the system and you are re-circulating the effluent in your operation. After about 80 flushes, you need to pump it, and put in a new chemical charge.

In the case of the Montron 764, you actually have an attachment to the Monomatic which allows for an overboard discharge for flow-through treatment. The way it is used is that when the Monomatic unit, which is really a re-cirulator, becomes full, you engage the switch and there is about an eight minute cycle with chemicals. The waste is treated and goes overboard. In this unit there's apparently an effervescent effect of certain disinfectants, such as Vanish, which is a standard toilet bowl cleaner. When this unit was tested, the Navy found trouble in the electric circuitry. The effluent samples would not meet the standard and to make a long story short, it was de-certified. In the case of existing vessels essentially you would not have to put equipment on until January 30, 1980, but some of the boatmen in good faith, are trying to put equipment on according to federal requirements and then all of a sudden one day this certified device becomes de-certified. Monogram Industries went to work on the circuitry, which seemed to be the big problem. They had one of the Laboratories test the device and it's back on the market re-certified.

However. it will still have to go through a second after-marketing testing to be all clear.

Then we have the Microphor device, which is the aerobic digestor. Basically this device comes in various sizes. The one tested by the Naval Facilities was a four-man unit. To give you an idea, it is 51 and 1/2 inches long, 22 inches wide and about 14 inches deep. Then of course, you need the toilet and flush pump with it. Then there is a discharge line and a chlorine contact canister. The point is that for a four-man unit, such as you would put on a 25-foot boat, it is a big awkward contraption. In simplest form it's nothing more than a tank with three compartments. The sewage is flushed directly into the upper chamber and then it comes in contact with a second chamber, which is nothing more than redwood bark filter chips. The effluent drains through the filter down into a third compartment, where it is deviated around to a 1 and 1/2-inch pipe. Then a quick passage through about a quart size chlorine contact tank, which has chlorine tablets in it, and overboard. That's the system. Obviously you can overload this system because the sewage solids build up. You stop until aerobic digestion takes place and the solids turns to liquid and filters through to the lower compartment and goes overboard. It's really supposed to be the most sophisticated device available, but it is just a privy. Microphor quickly went back and added what amounted to about a five gallon chlorine contact tank. The discharge hose runs through the middle of this tank, so under the discharge is a space for about two gallons which provides a certain amount of chlorine contact retention. The quality of your discharge depends a lot upon the frequency of the use of this equipment, but in any case the unit seems to be producing acceptable discharges and was re-certified and is back on the market. But, it has to go through another after-market testing by the Navy to be acceptable by the Coast Guard. The after-market testing is a two, three, or four month proposition, whereas the typical laboratory testing with regard to bacteria is simply a matter of running 40 samples and you have got to get 38 out of 40 samples to meet the standard. Which means that you need 95% compliance of your samples, in the case of the Type I devices, it would have to be under the 1,000 fecal coliform per 100 ml. The other 5% of tests could be skyhigh.

Then you have the Nautromatic 1000 certified unit and the Delta Marine Head. I have not seen either of the devices and therefore, I am not familiar with them, except the Nautromatic unit costs about $500 and the Delta Marine Head costs about $1,000. The Delta Marine Head passed its certification with very questionable tests. Averages were something like 971 fecal coliform which were practically to the 1,000 limit. As a consequence, Delta Marine Head has certification, but they have not manufactured units for distribution. So it is certified but not on the market.

The results of all this is to say that none of the flow-through marine sanitation devices tested by the Naval Ship Research and Development Center, were found capable of treating human waste effluent adequately to provide reasonable assurance that fresh fecal matter and/or pathogentic micro-organisms would not reach shellfish growing areas. All of the certified devices, at a minimum can be said to have doubt associated with their efficiency and reliability. Then operation and maintenance is a key point in the use of the flow-through type devices and it's also apparently a weakness found among the boatmen using these devices. None of the flow-through devices have fail-safe features. This is contrary to what many boatmen say, because all of the devices can be flushed and used without the proper disinfectants.

The other marine sanitation device and the other choice of regulations, is the holding tank concept. It is a concept, which I feel requires four important things to take place in order to be successful. It requires a boatman to (1) install the holding tank, (2) to pump out ashore, (3) it requires the marina operator to install pump-out facilities, and (4) to use discrimination in proper disposal of the waste. So, obviously in the holding tank concept, I think a little greater effort is needed to make the system work. There is absolutely no question about the system working, because we have visited a number of states, such Michigan, New York and the Lake Erie area and the people there want the system to work, because they want to protect drinking water supplies. They brag about the system. It is not a problem at all.

Obviously with the two systems, no-discharge and certified flow-through treatment, you can find problems with each system. You can have a holding tank with a no-discharge system and collect waste, and then go over the shellfish beds and pump out when you fill up the system, violating the spirit of the system, etc. On the other hand, with the certified flow-through device you can have equipment that does the job today, but unless it has a disinfectant and is properly functioning you are not sure what it is doing tomorrow. And how would you be sure? Even if an enforcement man looks at the device he still wouldn't be sure if it's doing the job. In order to find out if it is doing the job, you would not only need some sample data, you'd need a series of samples. What you end up with, if you want to know if either system is properly working, is an enforcement man on board every vessel. In the case of a flow-through device you would need not only an enforcement man, but someone taking samples. But I think the ultimate usefulness of any system of boat pollution regutions is going to be in direct proportion to the acceptance of the public and their desire to properly use the device.

This has been the problem in Virginia for nearly ten years. It is controversial, certainly with regard to its use in shellfish beds. A key issue is the position of the FDA. But we feel the FDA has been hedging on the matter. We are advised by the FDA that they look upon the use of certified flow-through devices as only providing partial treatment. And I think we have other statements by the FDA that simply say where there are raw discharges of sewage or inadequately treated discharges of raw sewage or partially treated discharges you cannot assure the public that the shellfish are satisfactory to eat. Therefore, a shellfish condemnation would be necessary. As long as the FDA will not fully accept a certified flow-through treatment device for use in shellfish waters, then if we end up with federal regulations and the use of certified flow-through devices, we are going to have to continue condemning shellfish beds, losing the shellfish beds and their economy.

This is why in Virginia, we have been proceeding for many years with the thought of a no-discharge concept. With all its faults and problems, we still feel it is the only system that is actually going to protect shellfish. We recognize there is a problem with making the public accept and properly use the system. But, anyway, it is a controversial issue as far as the state of Virginia is concerned. We want to go to a no-discharge concept strictly in designated shellfish waters. Beyond that we would follow the federal regulations for certified devices in other waters.

RECOVERY OF BY-PRODUCTS FROM SEAFOOD EFFLUENTS

Wayne A. Bough*

Introduction

In years past, the seafood industry has enjoyed the benefits of its coastal location for use of the surrounding waters as repositories for liquid and solid processing wastes. While certain wastes may be useful as food for marine organisms, the requirement of the Water Pollution Control Act Amendments of 1972 (PL. 92-500) mandate changes in the handling of waste discharges. Only in remote areas of Alaska do the Effluent Limitations Guidelines promulgated by the U.S. Environmental Protection Agency (EPA) allow for discharge of certain raw seafood processing wastes. Thus, we see changes resulting from development of state and federal regulations, initially prompted by an environmentally-minded U.S. public. As a result, recovery of by-products will become an economic necessity for seafood processors who try to defray the costs of complying with stringent environmental regulations.

Prior Research

In order to fully understand the magnitude of the problems facing seafood processors in the form of effluent limitations guidelines, one must first be acquainted with the volume of seafood processed in this country. For example, during 1976, the Gulf shrimp landings totaled 210 million pound heads-on (1). Of this amount, an estimated 76% (or 159 million pounds) was removed by mechanical heading and peeling. Clearly, such macroscopic by-products as shrimp heads and hulls comprise

*(Contributor - Brian E. Perkins)

the majority of the "wastes" generated by conventional Gulf coast shrimp canning and freezing operations. However, also included within the estimated 700 million gallons of water used by Gulf shrimp processors in 1976 were 10 million pounds (dry weight) of dissolved and suspended microscopic proteinaceous substances (2).

Historically, the earliest efforts performed in the direction of recovery and/or utilization of shrimp by-products focused primarily on the macroscopic, or head-and-hull portion of the discharged solids. Prior research (3) illustrated that significant levels of protein are present in such wastes. Dried shrimp meals have been shown to contain from 28.5% to 47.8% (corrected for chitin) protein. The rather large variation in percent protein found among the various shrimp meal preparations has been demonstrated to be a result of differing process techniques used when manufacturing such meals. Specifically, shrimp meals rendered by means of high-temperature or vacuum-drying equipment contain less protein than do those which are sundried.

Further research efforts (4) have shown that shrimp meal also provides an excellent source of lipids and fatty acids. Although varying in a manner which is inverse to the manner in which protein varies, the lipid content of shrimp meal is also affected by the particular method employed during its manufacture. For example, vacuum-dried shrimp contains only 3.5% lipids. Specific fatty acid concentrations are likewise reduced in the sundried product, especially the oxygen- and light-sensitive 20:5w3 and 22:6w3 acids, when compared to the vacuum-dried meal. Similarly, the carotenoid contents (also oxygen- and light-sensitive) of shrimp meals vary from a low of 1-2 μg/g in the sundried meal to 104 μg/g in the vacuum-dried meal (5).

Although such variabilities as those just mentioned exist among shrimp meals processed by differing methods, many types of meals with varied proximate analyses are nonetheless in demand. For example, to impart additional poultry flesh and egg yolk coloration, or to improve the flesh pigmentation of pond- and pen-reared trout and salmon, shrimp meals high in lipid and carotenoid concentrations may be added to the diets fed them (6,7). Whereas, for enhanced growth and mating behavior, shrimp meals with high protein concentrations may be utilized in tropical fish and aquacultured crustacean diets (7).

As mentioned previously, in addition to the abundance of macroscopic wastes produced by Gulf coast shrimp processors, significant quantities of microscopic dissolved and suspended proteinaceous materials are also routinely discharged. Effluent limitations guidelines imposed by the Federal government (8) have placed increased pressure on the processors to remove such organic solids from their effluents. Although the removal of such biologically active materials requires, in many cases, considerable capital investment, research efforts have pointed out the monetary value of these materials when they are recovered and utilized in economically viable food- and feed-grade commodities. In fact, recovery and utilization of microscopic dissolved and suspended proteinaceous substances could help to alleviate a portion of the expenses incurred because of effluent limitaions requirements.

Shrimp blanch water, the liquid in which the shrimp are briefly cooked prior to canning and retorting, has been shown to contain 43 g of dissolved and suspended protein per gallon (dry weight) (2). The nutritional characteristics of shrimp blanch protein, after recovery by simple acid precipitation and preliminary centrifugation, are noteworthy. Analyses have shown that shrimp blanch protein contains approximately 59% protein, and has a gross energy value of 5170 cal/g (9). Further, the shrimp protein has very little ash when compared to dried fish meals.

In addition to the overall attributes of shrimp blanch protein, several specific compounds of nutritional importance have been noted in significant quantities. For example, high concentrations of flavor enhancers such as IMP and the 5'-nucleotides have been indicated (10). Accounting for much of the sweetness of shrimp, flavor enhancers such as these, upon extraction from blanch water, may find uses as flavorings in both food and pharmaceutical applications. The amino acid profile of shrimp blanch protein has been shown to compare favorably with standard ANRC casein and isolated soy protein (10). In rat feeding studies, it was demonstrated that the overall nutritional quality of a soy protein-based diet was improved 74% when 50% of the soy protein was replaced by shrimp blanch protein (11).

Marine Extension Service Research

As mentioned previously, one of the major by-products recoverable from shrimp processing effluent is hulls. The amount of material collected is large since hulls account for approximately 15% of the weight of green headless (G.H.) shrimp. Also, the reduction of the wastewater discharge load, as measured by biochemical oxygen demand (BOD), will be significant. Table 1, which expresses BOD loadings on a production basis of lb BOD/1000 lb G.H. shrimp processed, shows results obtained by a large breaded shrimp processing plant using screening and dry clean-up practices to reduce its total waste load. Note that the processing load was reduced from 117 to 72 lb/1000 G.H. by screening, and the total unscreened load was reduced from 221 to 121 lb/1000 G.H. by passage of the effluent through a hydro-sieve screen which removed particles larger than 0.02 inches in diameter. The hulls from this particular plant are currently collected in a dumpster, picked up by a garbage truck, and hauled to a sanitary landfill. Before long, however, the shortage of available landfill sites and environmental restrictions placed upon highly putrescible substance may encourage the use of the protein and chitin materials in these hulls for animal feed or further manufacturing.

Table 1 also shows that the clean-up load was reduced from 104 to 49 lb BOD/1000 lb G.H. by screening. The majority of this reduction was realized by recovering waste breading, batter and solid wastes using dry clean-up practices. Floors, tables, conveyors tanks and machines were swept, scraped and initially cleaned by hand prior to the use of any water. The BOD load removed (104-49=55 lb BOD/lb dry breading) collected per 100 lb G.H. Thus, for a plant processing 10 tons G.H. shrimp per day, dry clean-up would generate approximately 2700 dry pounds of breading materials. The actual amount to be handled might be 5 to 10-fold greater, depending on the proportions of breading, batter and water scraped up off the floor.

Shrimp hulls screened out of effluents can serve as raw materials for manufacture of protein by-products. For example, the action of

TABLE 1

EFFECTS OF SCREENING AND DRY CLEAN-UP PRACTICES ON THE BOD[1] LOADING RATIOS FROM A BREADED SHRIMP PROCESSING PLANT

Operation	Before Screen	After Screen[2]	With Dry Clean-Up
Processing	117	72	71
Clean-up	104	49	21
TOTAL	221	121	92

[1]BOD loads in lb/1000 G.H. shrimp processed

[2]Effluent passed through hydro-sieve screening system which removed particles larger than 0.02 inches in diameter

natural autolytic enzymes in raw shrimp hulls was potentiated to hydrolyze proteins adhering to the hull, thus producing a soluble peptone digest. Further steps of concentrating and drying produced a product which showed promise as a nutrient medium for growth of microorganisms (12). In addition to the peptone product produced from shrimp hulls, chitin which remains after hydrolysis of the proteins adhering to the hulls can be used for the manufacture of chitosan.

Chitosan is a high molecular weight polymer derived by deacetylation (alkaline hydrolysis) of chitin. Hydrolysis of acetyl groups from the chitin polymer liberates amino groups which give the chitosan polymer a net positive charge. Thus, chitosan functions as a cationic polyelectrolyte when used as a waste treatment agent. Several applications of chitosan for treatment of food processing wastes including seafood, vegetable, meat, egg, poultry and dairy effluents have been demonstrated in research sponsored by the Georgia Sea Grant Program (13). In many cases, coagulated by-products containing significant amounts or protein are obtained by the use of chitosan. Chitosan has the effect of causing tiny particles of suspended solids to stick together (coagulate) and increase in size to the point that the particles can be recovered by settling, centrifugation or dissolved air flotation. Drying of these materials results in by-products having protein contents ranging from 30-70% and fat contents of 5-50%. Small animal feeding trials have demonstrated several of these products to be valuable protein supplements (14).

A major restriction to the commercial use of chitosan for recovery of coagulated by-products and subsequent use in animal feeds is that approval of chitosan by the U.S. Food and Drug Administration (FDA) as a "feed additive" is required. Apparently FDA will require feeding tests in the target species, i.e. chickens, hogs, or cattle. Our tests natural autolytic enzymes in raw shrimp hulls was potentiated to hydrolyze proteins adhering to the hull, thus producing a soluble peptone digest. Further steps of concentrating and drying produced a product which showed promise as a nutrient medium for growth of microorganisms (12). In addition to the peptone product produced from shrimp hulls, chitin which remains after hydrolysis of the proteins adhering to the hulls can be used for the manufacture of chitosan.

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The previously discussed examples of by-products from seafood effluents hold some economic promise and others appear to be of only academic interest. As mentioned in the introduction, many of the changes in waste management practices now being instituted by the industry are due to the 1972 water pollution laws enacted (P.L. 92-500). Four years following, the Resource Conservation and Recovery Act of 1976 (P.L. 94-580) will have equally far-reaching effects on practices of the seafood industry. The land fill sites of many coastal areas of the United States are filling up and alternative sites are scarce due to high water tables and land availability. As various provisions of this act are effected, seafood plants may find themselves excluded from land fill sites because of the putrescible nature of their solid wastes, or they may be forced to pay penalty rates. More likely than landfill, this act may mandate that seafood wastes be recovered. As the title of the act implies, emphasis will be placed in Conservation and Recovery. In Georgia, requirements of the act for hearings to designate planning agencies have been completed. Draft plans announced at these hearings call for designation of specific Resource Recovery Areas. The coastal counties of Georgia comprise one of the Recovery

Areas. We hope that by participating in these hearings and submitting the needs of the seafood industry for disposal of solid wastes that adequate considerations will be given to our industry in future phases of implementing the act. I would encourage all of you to obtain a copy of the act (P.L. 94-580) from the Library of Congress and familiarize yourself with its provisions.

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UTILIZATION OF CHITIN FROM SEAFOOD WASTES

Peter M. Perceval

Before I begin discussing the topic "Utilization of Chitin" there are a few remarks that I would like to make. First, the rapidly increased interest in chitin and it's derivatives during the last five years is almost entirely due to the fact that the Sea Grant Program of the United States Department of Commerce has stimulated this activity. It is important to recognize what prompted the Commerce Department to act in this regard.

The facts are that some far-sighted people recognized the inevitability of problems in satisfactory disposal of crustacea waste, when the time came for the new water and air pollution laws to be rigidly enforced by those State Agencies responsible for their implementation.

The Environmental Protection Agency commisioned an in-depth study of the likely impact on crab and shrimp industries in the event that no alternative usages could be found for the solid waste they generate. The study predicted that some seafood companies would probably be forced out of business by the increased costs of land-fill disposal of their wastes if this method continued to be an acceptable disposal procedure, and that the operating costs of others might be radically affected.

These findings gave even greater importance to Sea Grant's work, then funded at various Universities around the country at a cost of several million dollars.

However, with very few exceptions the seafood industry as a whole did not get interested in the project that was intended to aid it. Admittedly, there have been at least two attempts to commercialize the extraction of chitin during this five-year period, but while both have helped the cause they hurt themselves mainly because they originated from outside the seafood industry. Thus, they could not achieve sufficient raw material at reasonable prices to make the ventures economically feasible.

More recently some seafood industry leaders in the Chesapeake Bay area recognized what it might mean to them and their industry nationwide if they became involved. For the first time it was possible to bring together representatives of those who generate the waste in large quantities and those who need the assurance of large volumes in order to attempt commercialization of chitin production.

A couple of large chemical companies have now become quite interested in testing markets. There is a good possibility that a sizeable pilot plant will soon become operational in the Chesapeake Bay area in order to produce the quantities of chitin and derivatives necessary to do full-scale market testing.

If this does come about and if the tests are successful then it is equally likely that there will eventually be a chain of chitin plants around the coastline wherever there is enough crustacea waste to justify their existence. However, until all this happens the problems of waste disposal are increasing as was predicted. In some locations these have already had a serious adverse effect on the industry. It is somewhat ironical that while all this has been taking place in the United States, the Japanese have quietly gone ahead and commercialized the process. Thus, at the present time they are the only source in the world for meaningful quantities of chitin and it's derivatives.

Regardless, at this stage of the overall project's development, it is critically important for cooperation and for understanding of the true status of chitin's market position. Unfortunately, it is a long hard struggle and a very expensive project to commercialize any new chemical. Therefore, those who are primary producers of crab, shrimp, lobster and crawfish waste should not get false ideas about immediate high values for something which currently has a negative worth.

This may come in time with the development of ever more valuable markets for chitin and it's derivatives. It won't happen overnight and will assuredly never occur unless the project gets started somewhere on a sound basis with adequate low-cost raw material, especially during the initial high-risk period.

One might well ask what is it that industries see and research people have dreamed about that makes chitin so interesting. Without boring you with scientific details and at the risk of oversimplification, I think the best way of describing the whole thing is to point out that what cellulose is to plants, and a substance called collagen is to human beings, chitin is to crabs, shrimp, lobsters, crawfish, etc.

Cellulose has obviously become an essential part of our economy. It is extracted in tremendous volumes for use in all kinds of products, many of which are in use in this room today. Some of it's derivatives are very expensive specialty chemicals. Collagen is an essential substance in the human system and we are learning more about it's medical importance every day.

If then chitin, collagen and cellulose are so similar, and in fact were you to look at the chemical formula for each you would have difficulty in detecting any difference, then it logically follows that they may be almost interchangeable. Hopefully, this explanation may make it easier to understand why chitin has such potential importance in pharmaceuticals, in the paper and plastic industries, in veterinary fields and in various other industrial applications.

In actual fact chitin has some properties that collagen and cellulose lack and therefore it's potential applications are even more exciting. One of these unique properties has to do with it's origin and natural fate in the marine environment. Scientists are now beginning to understand that natural breakdown of chitin in the sediments has had much to do with the control of metals that exist in salt water. It even appears that nodule formation might be partially the result of chitin's ability to attract metallic particles in marine sediments. Thus, it is not surprising to find that a chitin derivative has recently been used to separate the valuable metals contained in nodules. It has also proved quite effective for collecting the uranium that exists in salt water, recovering nickel and chromium from plating solutions, removing silver from waste streams and in controlling nuclear power plants effluents.

Getting back to the human side of things, chitin's similarity to collagen in the human system made it logical to look for and find such uses as wound-healing, coagulating blood, arresting leukemia cell growth, controlling release of substances that exist in or need to be applied to humans, isolating thyroglobulin, healing ulcers and even in fertility control. All of these things chitin and it's derivatives do or help do exceptionally well.

Other unique properties that chitin possesses enable it to be used in such diverse applications as controlling ticks and fleas in dogs and cats, removing salt from sea water, rapid determination of imbalance in the chemicals that are essential to our health, making cows milk as nutritious for babies as human milk, thickening deep drilling muds for oil exploration and recovery, imparting special properties to shampoos, making special surgical sutures, controlling blood clots, making new red dyes for foodstuffs, removing nasty substances from cigarette tobacco, stabilizing enzymes, making wool shrinkproof, improving the dyeability of synthetic fabrics, etc., etc.

Almost daily scientists around the world are finding exciting new uses for this chemical which is not yet available in quantity in the United States. However, we all hope that with the assistance of the seafood industry this situation will soon change.

In closing, I would like to mention a couple of specialized uses for chitin, and one of it's derivatives, chitosan, that will likely have a very definite and positive impact on your industry. First, is in the encapsulation and timed release of insecticides and herbicides. Chitosan has been used very successfully for this and what it might mean eventually is that the frequency and strength of pesticide and herbicide applications to farming areas could be radically reduced. As this comes about the reduction in application of these substances would obviously mean that there would be less likelihood of run-off into rivers and bays. Also as less toxic materials find their way into the seafood producing areas everyone will benefit. A second use that would have double benefits for the seafood industry is in the manufacture of more efficient and longer lasting antifouling paints.

As you may be aware much work has been going on in search for antifoulants that would remain active for at least five years, yet still be environmentally acceptable. It is very difficult to achieve both of these goals simultaneously, but recently there have been reports of success through the use of polymeric coating systems which permit slow release or leaching out of the active chemicals. Chitosan has been tested for this purpose and found to be quite promising.

Finally, the seafood industry has had considerable problems world-wide because of the presence of mercury in some products. I do not intend to go into the details of the Japanese tragedy or the swordfish fiasco in this country. However, it is perhaps a fitting conclusion to these remarks to point out that chitin and chitosan have a tremendous affinity for mercury and various tests have proved over and over again that they do a superlative job of cleaning up even the minutest traces of mercury from effluent streams. Perhaps when chitin and chitosan become available in quantity it will never again be necessary to go through the sort of agony that so many suffered from concern about, and in the Japanese case the reality of, seafood contamination with excessive amounts of mercury.

ESTIMATED IMPACTS OF THE PHILADELPHIA DUMPSITE ON THE SEA CLAM FISHERY

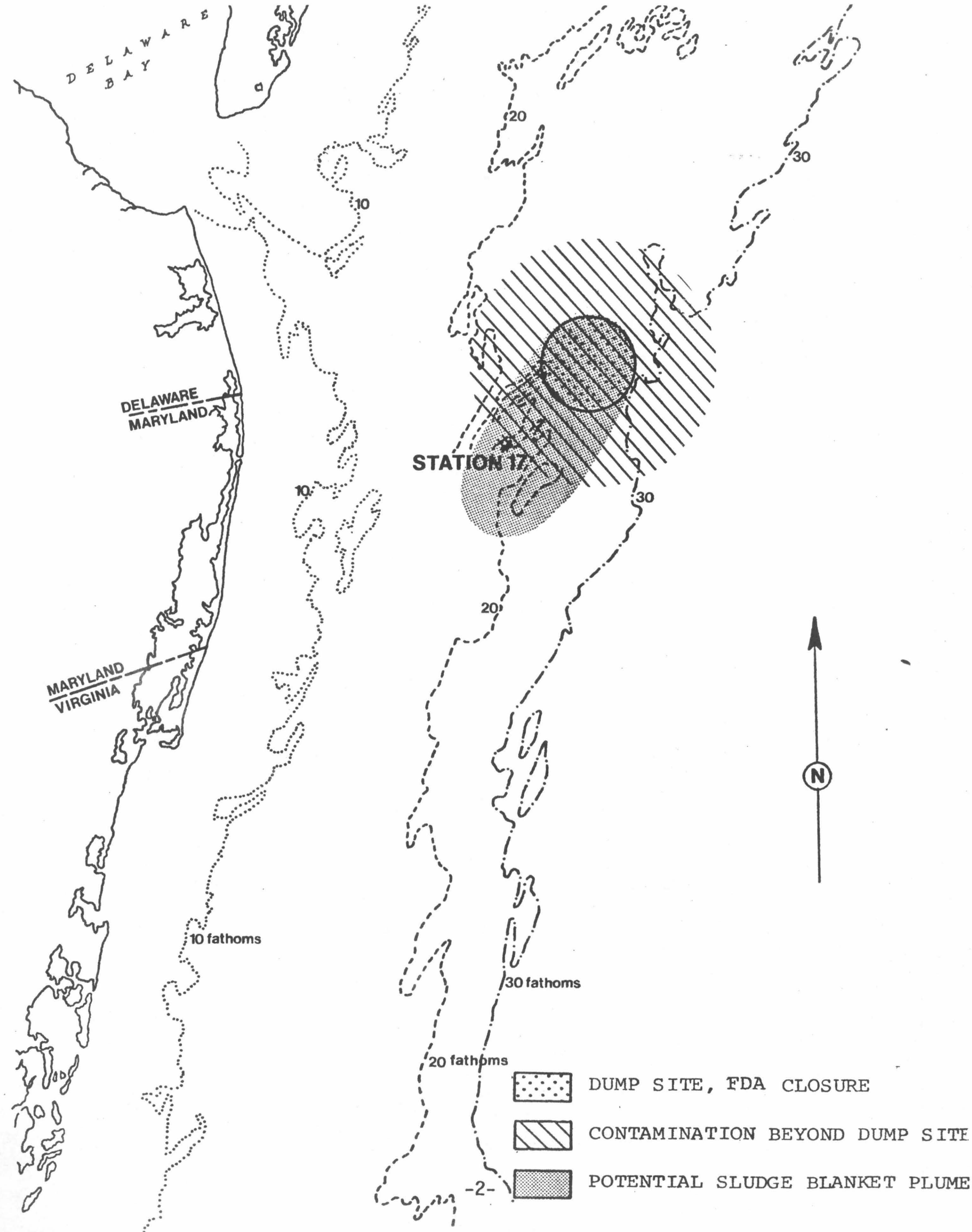
Robert H. Forste

Introduction and Objectives

On December 10, 1976, the Shellfish Sanitation Branch of the U.S. Food and Drug Administration issued a "notice to harvesters" that closed a shellfishing area of the Atlantic Ocean 9.5 nautical miles in diameter. The designated polluted area is 35 miles off the Maryland coast at 38^{o} 23'N, 74^{o} 15'W (Figure 1). Shellfish in the area are contaminated, since the City of Philadelphia is permitted to dump its sewage sludge on this location.

The closure of this "Philadelphia Dumpsite" to harvesting the shellfish contained in it directly affects both economic and biological aspects of the fishing industry and the fishery resources. In addition, continual ocean dumping of sludge wastes by the City of Philadelphia poses a more extensive concern: potential enlargement of the ocean and fishery resource contamination beyond the present dumpsite. During the summer and fall of 1976 an anoxic condition existed off of the New Jersey coast that resulted in a loss of 53,500 tons of surf clam meats (Steimle, 1976). This anoxic area extended (on its southern fringe) to a point just north of the Philadephia Dumpsite. Sampling by the National Marine Fisheries Service during the summer of 1977 indicated that the anoxic conditions of 1976 were again evident in this coastal area. Maryland fisheries managers and biologists are concerned that continued sludge disposal at the Philadelphia Dumpsite will nurture and exacerbate the process which depletes oxygen, and result in the extension of anoxic conditions into the valuable surf clam (*Spisula solidissima*) and ocean quahog (*Arctica*

FIGURE 1
PHILADELPHIA DUMP SITE AND AFFECTED AREAS OF CONTAMINATION



islandica) fishing grounds off the Delmarva Peninsula.

The surf clam and ocean quahog stocks constitute the "sea clam fishery" treated in this paper. While these two species are overlapped in their distribution, they tend to inhabit different depths in the substrate off the Maryland coast. The greatest concentration of surf clams is found in the bottom area between the shore and the 20-fathom line; greatest concentrations of ocean quahog occur in the grounds between the 20- and 40- fathom contours.

The objectives of this paper, therefore, are to:

1. estimate the biological impacts that the Philadelphia Dumpsite and the projected extension of its contaminants have on the sea clam fishery;

2. estimate the economic impacts that result from the Dumpsite and extension of contamination on the harvesting sector of the sea clam industry; and

3. estimate the cost of land treatment of sewage sludge to the City of Philadelphia compared to the current practice of ocean disposal, in the context of the value of the sea clams that are affected by the ocean dumping.

Biological Impacts

There are five environmental situations or cases that affect the sea clam fishery:

1. the Philadelphia Dumpsite, an area actually closed to shellfish harvesting (Case I);

2. an extension of the contaminated area by almost 11 miles beyond the Philadelphia Dumpsite (Case II);

3. an extension of the sludge blanket plume that encompasses an area 100 square miles beyond the Philadelphia Dumpsite (Case III);

4. an extension of anoxic conditions into fishing grounds off the Delmarva Peninsula (Case IV); and

5. "short dumping", where sludge is discharged onto surf clams in the area enroute to the Philadelphia Dumpsite proper (Case V).

The first three cases are illustrated in Figure 1, and the biological ramifications of each case are discussed below.

Case I: Contamination of the Philadelphia Dumpsite

There are no studies that document the effect of sewage sludge on the physiology of the ocean quahog, but levels of contaminants in this species are being monitored in the Philadelphia Dumpsite by the U.S. Environmental Protection Agency (Lear and Pesch, 1975; Lear, O'Malley and Smith, 1977). Lear and Pesch (1975) found evidence of elevated cadmium and zinc concentrations in ocean quahogs, but indicated that definitive long-range effects could not be determined at the time of their study. There is the possibility that long range effects may preclude the harvest of ocean quahogs from the Philadelphia Dumpsite for an indeterminate number of years.

Because of the contamination, the commercial fishing fleet cannot harvest ocean quahogs (the species of major commercial value) from the area. The density of ocean quahogs in the closed area was estimated using data obtained by Ropes (1977). The number of quahogs was determined for each station in the closed area. The density of clams in the substrate was then calculated and expanded to estimate the standing crop[1] at 600,000 bushels of ocean quahogs contained in the Philadelphia Dumpsite.

Case II: Extension of contamination by 11 miles

In February, 1977, fecal coliform contamination in ocean quahog samples at the EPA sampling station #17 (Figure 1) was found to be at the dangerously high level of 91 MPN/100 g (Lear, O'Malley and Smith, 1977). As a result, it cannot be assumed that contamination will remain confined to the closed area; station #17 is almost 11 miles beyond the Philadelphia Dumpsite.

Delineating the outer fringe of the contaminated area at station #17 raises the possibility of an additional closure, with the exclusion of commercial harvesters of ocean quahogs, the species commercially abundant in this area. Using data on two samples obtained from stations in the area, there is an estimated standing crop of 3.0 million bushels of ocean quahogs in the affected area.

Case III: Extension of contamination by sludge plume

In addition to sludge contaminants that have been detected outside the Philadelphia Dumpsite (i.e., at EPA station #17), the sludge has moved to the south-southwest and formed a "blanket". Lear, O'Malley and Smith (1977) reported the spread of "dark" sediments beyond the Philadelphia Dumpsite, covering an area of about 100 square miles (Figure 1). Encroachment of this sludge blanket "plume" will continue southward since there are no ocean floor obstructions. The prevailing current pattern will move the sludge blanket further to the southwest, and it could extend up to 10 miles beyond EPA station #17 by 1979.

The sludge blanket plume resulting from current-borne dispersions will cover both commercial ocean quahog and surf clam beds. Surf clams are heavily concentrated in this area; the standing crop that would be affected by area closure is estimated at 2.0 million bushels. In addition, a standing crop of over 500,000 bushels of ocean quahogs would be excluded from harvestable populations.

Case IV: Extension of anoxia into Delmarva region

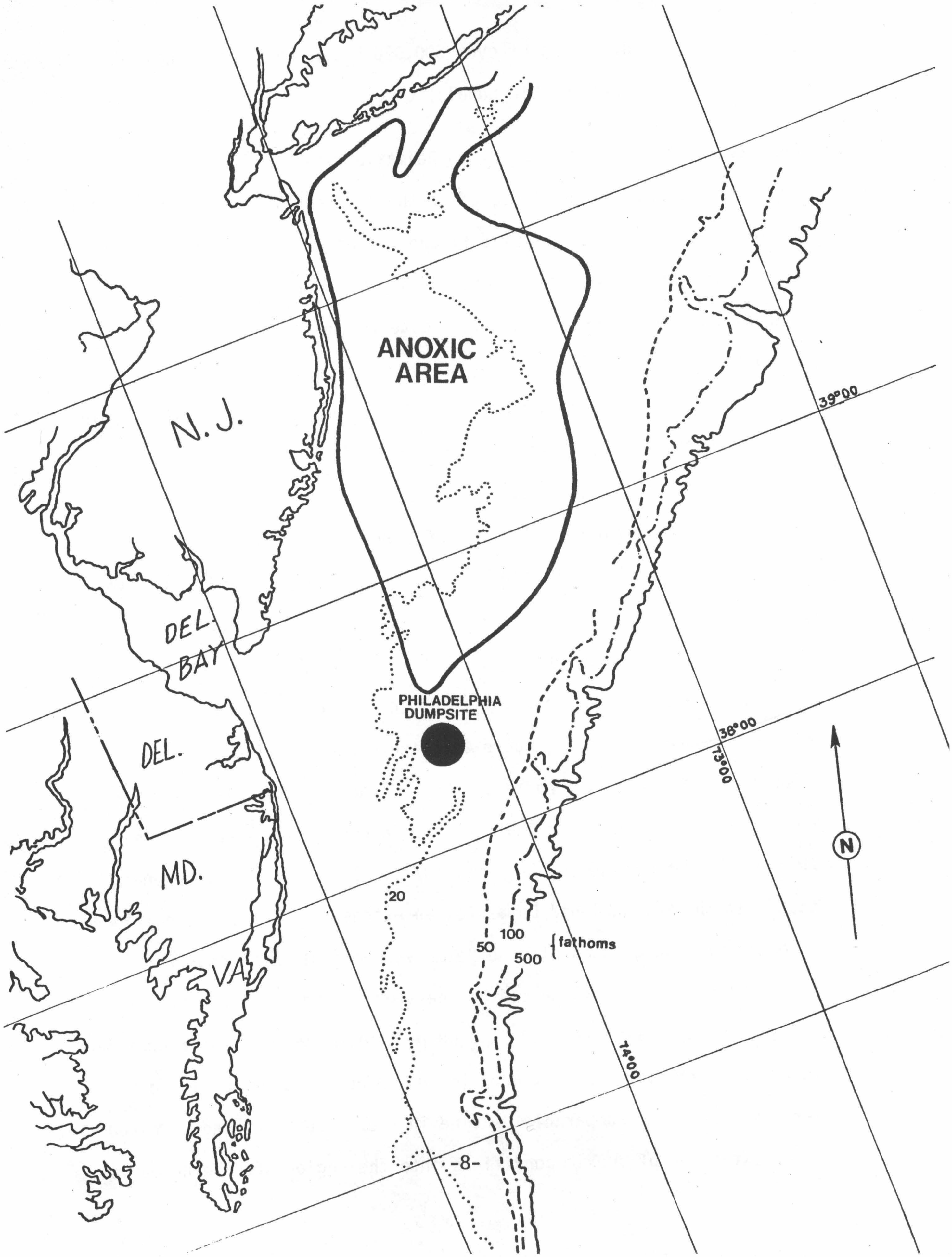
Our discussion has centered on the loss of clams from harvestable populations due to actual (Case I) and potential (Case II and III) harvesting restrictions. In the cases discussed, it was assumed that these clam stocks would continue to contribute to the replenishment (recruitment) of clam populations.

One environmental situation that poses a distinct threat to (particularly) the surf clam population and the associated industry, however, is high mortality of clams due to stress from anoxia. This phenomena has decimated spawning stocks of surf clams, and may render large areas of the ocean bottom an unsuitable habitat for survival and growth for years to come.

During the summer and fall of 1976, an anoxic condition existed in an area 40 miles wide and 100 miles long, located about four miles off the New Jersey coast (Figure 2). The southern fringe of this anoxic area was at a point just north of the Philadelphia Dumpsite. Surveys during 1977 found evidence that the anoxic conditions were re-forming (National Marine Fisheries Service, 1977). If sludge dumping continues at the Philadelphia Dumpsite, an extension of anoxic conditions into the fishing grounds off the Delmarva Peninsula may occur.

The surf clam kill caused by the anoxic conditions of 1976 off the New Jersey coast resulted in a 68 percent decline in the recruitment index for surf clams in that area (Brown, Henderson, Murawski and Serchuk, 1977). A comparable decline in the recruitment index caused by an extension of anoxic conditions into the region off the Delmarva

FIGURE 2
AREAL EXTENT OF OXYGEN DEPLETED BOTTOM WATER (ANOXIA)



Peninsula would decrease the annual yield of surf clam meats by 800,000 bushels. The surf clam industry currently harvests and processes about 1.18 million bushels of surf clams every year from this region that would be affected.

Case V: Contamination by "short dumping"

On four known occasions, barges hauling sludge to the Philadelphia Dumpsite have dumped the sludge prior to arriving at the specified discharge area; additional undetected instances of "short dumping" are entirely possible (Lear, 1977). Sludge dumped along the 35-mile route to the dumpsite settles directly on beds of surf clams that are presently being harvested, processed and sold for human consumption. There is no monitoring of the ocean environment in this area; hence, the extent (or level) of contamination and the biological/economic impacts cannot be estimated at this time.

Economic Impacts

In September, 1977, the EPA granted an extension of the permit that allows the City of Philadelphia to dump its sewage sludge at sea. As a result, there will be unharvestable quantities of ocean quahogs (in the dumpsite proper) and possible reductions in the harvestable stocks of both ocean quahogs and surf clams from the neighboring areas previously described. There are two aspects of concominant economic losses/costs involved:

1. Immediate reductions in available sea clam stocks mean that the harvesting (and processing) industry must either reduce its output in the short-run or substitute supplies of sea clam meats from other fishing grounds that necessitates greater travel costs (e.g., Georges Bank off the New England coast.) The availability/extent of such stocks is

presently unknown. The magnitude of the reduction in output or the alternative input costs will depend upon the ease with which fishermen can travel to/obtain alternative stocks.

2. Long-run adjustments to operate with continued lower levels of sea clam supplies implies technological adjustments by fishermen (and the associated industry), with accompanying cost increases. A major adjustment would be the conversion of sea clam vessels by vessel owners to harvest other species. Vessel conversion is relatively simple if ocean quahogs are to be fished instead of surf clams (and vice versa). However, re-rigging a sea clam fishing vessel to harvest scallops (for example) requires an investment of $3,000 to $10,000 (depending on the vessel size and type).

The closure of the Philadelphia Dumpsite and ocean quahog harvesting from it is of particular concern, given the present status of the surf clam fishery. Landings of surf clams have declined from over 5.6 million bushels in 1974 to less than 2.9 million bushels in 1976. Plans have been prepared by the Mid-Atlantic Fisheries Management Council that would impose a quota on the surf clam fishery of about 1.8 million bushels in 1978; smaller quotas are probable in subsequent years in this effort to rebuild the surf clam stocks. Ocean quahogs are viewed (and have been used) as a substitute for surf clam products. The closure of the ocean quahog fishery will exacerbate the economic impact on the entire sea clam industry.

The magnitude of the economic impact of ocean dumping on sea clam harvesters is indicated by both (a) the annual dockside value of the sea clam harvests foregone because of the actual and potential area closures and (b) the capitalized value of the affected resources in the first four cases cited under "biological impacts".

Case I: Contamination of the Philadelphia Dumpsite

There is an estimated standing crop of 600,000 bushels of ocean quahogs in the Philadelphia Dumpsite. Based on previous rates of exploitation of surf clams (Brown, 1977), an estimated annual harvest of 20 percent of the standing crop was assumed. An annual harvest of 120,000 bushels of ocean quahogs, therefore, is precluded due to the closure. The price of a bushel of ocean quahogs averaged slightly over $3.00 (ex-vessel) from January through July, 1977 (National Marine Fisheries Service, 1977). At this price, therefore, an estimated $360,000 annually cannot be realized due to the closure.

The official interest rate to be used for discounting future benefits is presently set at 6 & 3/8 percent by the U.S. Water Resources Council. The capitalized value[2] of the ocean quahog resource in the Philadelphia Dumpsite, therefore, is over $5.6 million. The capitalized value, in this instance, can be viewed as the long-run capital investment that would be required to provide compensation to the fishermen for the loss imposed by sludge contamination.[3]

Case II: Extension of contamination by 11 miles

If closure due to contamination from the present dumpsite is extended to EPA Station #17 (Figure 1), a standing crop of 3.0 million bushels of ocean quahogs would be affected. At the estimated harvest rate previously described (20 percent) and average price per bushel of $3.00, a harvest of 600,000 bushels of ocean quahogs worth $1.8 million would be foregone annually. The capitalized value of this resource is over $28.2 million, using the interest rate and procedure previously described in Case I.

Case III: Extension of contamination by sludge plume

The extension of the sludge blanket plume generated by the Philadelphia Dumpsite presages contamination of extensive surf clam and ocean quahog populations. Assuming an annual harvest rate of 20 percent, 400,000 bushels of surf clams and 100,000 bushels of ocean quahogs would be excluded from the commercial catch annually. The average price of surf clams was $10.60 per bushel for the period January through July 1977 (National Marine Fisheries Service, 1977). Thus, surf clams worth over $4.24 million (dockside value) would be excluded from annual landings. Additionally, ocean quahogs worth $300,000 would be unharvestable each year.

The capitalized values of the surf clam and ocean quahog resources in this area are over $66.5 million and $4.7 million, respectively.

Case IV: Extension of anoxia into Delmarva region

If the anoxic conditions that caused a 68 percent decline in the recruitment index for surf clams off the New Jersey coast were to occur in the region off the Delmarva Peninsula, an estimated 800,000 bushels of surf clams worth $8.48 million annualy would be lost to commercial exploitation. The capitalized value of this resource is over $133.0 million.

There are two other aspects of continued sludge disposal at sea that merit mention, and are applicable to each of the cases described.

First, there are twelve major species of finfish and three species of shellfish (in addition to surf clams and ocean quahogs) that are found in the Philadelphia Dumpsite and the areas described in this paper. These species are commercially important sources of food and sport fishing (Table 1). In addition, there are nine major species of pelagic

TABLE 1. FINFISH AND SHELLFISH FOUND IN THE PHILADELPHIA DUMPSITE 1/

Species	Season
Bluefish	Year-round spawning
Yellowtailed flounder	Spring
Winter flounder	Winter
Summer flounder	Fall
Red hake	Year-round
Atlantic herring	Spring
River herring (four types)	Seasonal
Atlantic mackerel	Year-round
Menhaden	Seasonal
Scup	Year-round
Black sea bass	Fall
Whiting (silver hake)	Year-round
Northern lobster	Fall
Sea scallop	Year-round
Squid	Occasional

1/ Excluding surf clams and ocean quahogs.

Source: W. F. Gusey, The fish and wildlife resources of the Middle Atlantic Bight. Shell Oil Company, Houston, Texas. 1976.

birds and a dozen species of marine mammals (including a threatened whale species) that frequent the Philadelphia Dumpsite. We have no data or studies that document the effects continued sewage dumping might have on the physiology and/or the suitability of relevant species as food sources, nor is it possible to estimate the impact of sludge contaminants (e.g., heavy metals) on the food chain that these animals depend on.

Second, the possibility of irreversible effects from the present dumping practices cannot be ascertained at this time. The synergistic effects of high and persistent concentrations of metals in bottom sediments; wide distribution of polychlorinated biphenyls; fecal coliform contamination; and the threat of extended/repeated anoxic conditions raise the possibility of extinction for sensitive species in the affected areas. Our rather meager knowledge of environmental effects that are reversible and those that are not should dictate a great deal more caution than is now exhibited by permitting the dumping of over 90 million pounds of sewage sludge annually into a rich area of our marine environment.

Land Treatment of Sludge as an Alternative

From June 1976 through June 1977, the City of Philadelphia dumped about 45,000 dry tons of sewage sludge in the Philadelphia Dumpsite at a cost of $45 per ton; the cost of the sludge dumped at sea, therefore, was over $2.0 million (Horowitz, 1977). Efforts have begun to (gradually) "scale down" the amount of sewage sludge dumped at sea by composting techniques. Nevertheless, another 45,000 tons of sludge will probably be dumped into the ocean during 1977-78 at an increased cost of $60 per ton (i.e., about $2.7 million total cost).

Horowitz (1977) estimated the cost of a sludge composting operation for the City of Philadelphia at an average of $40 per dry ton. The total amount of sludge generated annually by the City is 70,000 tons (including the 45,000 tons currently dumped at sea at $60 per ton). The estimated cost of land treatment for all of the sludge, therefore, is $2.8 million compared to the combined cost of ocean dumping and land treatment estimated at $3.7 million for 1977-78. Excluding the costs (and possible revenues) of the marketing/disposition of the composted product, estimated costs for the two methods can be summarized as follows:

I. Ocean dumping and land treatment (present method)

Ocean dumping:	45,000 tons @ $60 per ton......	$ 2.7 million
Land treatment:	25,000 tons @ $40 per ton......	$ 1.0 million
		$ 3.7 million

II. Land treatment (projected method)

	70,000 tons @ $40 per ton......	$ 2.8 million

III. Difference.................................... $ 900,000

A major difficulty in the production of a compostable/usable sludge product stems from high concentrations of heavy metals in the Philadelphia sludge (Albrecht, 1977). The application of compost produced from the sludge to home gardens, for example, would probably be unacceptable for health reasons.

The answer to this problem turns on the willingness of Philadelphia officials to require manufacturers to install in-plant recycling/recovery systems for industrial wastes produced. The private costs of manufacturing firms to "upgrade" their process residuals that are discharged (and subsequent sludge) would increase in some instances. Conversely, many studies have demonstrated the cost reductions that are possible in various industrial processes through in-plant water re-use and chemical input recovery (e.g., Forste, 1973). "End-of-pipe" treatment of industrial sewage is both difficult and expensive; the externalities (or "spillover" effects) of individual manufacturing plants should be no more acceptable to the city of Philadelphia than the City's external diseconomies that impair ocean resources are to other coastal states.

The above estimates indicate that land treatment of sewage sludge would cost the City of Philadelphia $900,000 less than the present practice utilizing ocean dumping. Table 2 provides a summary of the estimated values of the sea clam fishery. When the projected lower treatment costs to the City of Philadelphia are combined with the fishery values foregone because of the ocean dumping, one is hard put to justify continuation of the externalities that the City of Philadelphia is imposing on our marine environment and resources.

Summary and Conclusion

This paper estimated the biological and economic impacts on the surf clam fishery attributable to the Philadelphia Dumpsite. There were five environmental cases examined.

The first case treated the Philadelphia Dumpsite proper, located 35 miles off the Maryland coast, where a standing crop of 600,000 bushels of ocean quahogs is contaminated. Because the area has been closed by the U.S. Food and Drug Administration, an annual harvest of 120,000 bushels of ocean quahogs worth $360,000 dockside is precluded. The capitalized value of this fishery was estimated at $5.6 million.

The second case treated the extended area almost 11 miles from the Philadelphia Dumpsite, where fecal coliform counts are high and may

TABLE 2. SUMMARY OF ESTIMATED ANNUAL AND CAPITALIZED VALUES 1/ OF THE SEA CLAM FISHERY AFFECTED BY THE PHILADELPHIA DUMPSITE.

Area/environmental situation	Annual harvest value foregone	Capitalized value
	Million dollars	Million dollars
Case I: Philadelphia Dumpsite	0.36	5.6
Case II: Extended contamination, 11 miles beyond Philadelphia Dumpsite	1.80	28.5
Case III: Extended contamination, 100 square miles	4.54	71.2
Case IV: Anoxia extended into Delmarva Region	8.48	133.0

1/ Based on dockside values (ex-vessel prices).

necessitate future closure to ocean quahog harvesting. Contamination and closure would affect a standing crop of 3.0 million quahogs; an annual harvest of 600,000 bushels would be foregone worth $1.8 million. The capitalized value of this resource was estimated to be $28.2 million.

The third case treated the movement of the sludge "blanket" from the Philadelphia Dumpsite, which affects an area about 100 square miles to the south-southwest. Standing crops of 2.0 million bushels of surf clams and 500,000 bushels of ocean quahogs would be excluded from harvestable stocks by closure of this area. The annual values of the surf clams and ocean quahogs were estimated at $4.24 million and $300,000, respectively. The capitalized value of the surf clam fishery was estimated to be $66.5 million; that of the ocean quahog fishery $4.7 million.

The fourth case treated the possible extension of anoxic conditions into the region off the Delmarva Peninsula. An estimated harvest of 800,000 bushels of surf clams each year would be foregone, based on comparable declines that occurred as a result of anoxia off the New Jersey coast in 1976. The annual value of surf clams foregone was estimated at $8.48 million; the capitalized value of this resource is over $133.0 million.

The fifth case treated instances of "short dumping", where sludge discharges occur enroute to the Philadelphia Dumpsite. The biological and economic impacts of these discharges on harvestable surf clams were not estimated, in that no monitoring of the ocean environment is presently undertaken in this area.

In addition to the impacts of Philadelphia sewage on the sea clam fisheries, the indeterminate effects of the sewage sludge on finfish, shellfish and other marine resources were discussed. The possibility of irreversible effects on the marine resources and food chain was noted.

Finally, the costs of land treatment of sewage sludge by Philadelphia were compared to the present practice which utilizes ocean dumping. If the City of Philadelphia were to require in-plant treatment of manufacturing wastes, a usable compost could be produced at an estimated cost reduction of $900,000.

FOOTNOTES

[1] The standing crop includes the spawning and post-spawning stocks, the young/maturing individuals, and the recruits to the fishery.

[2] Using the formula $K = \frac{R}{r}$, where K = capitalized value; R = annual return; and r = prevailing rate of interest.

For a discussion of the income-capitalization approach, see Raleigh Barlowe, Land Resource Economics: The Economics of Real Property, second edition, pp. 316-324. Prentice Hall, Inc., Englewood Cliffs, NJ. 1972.

[3] The annual earnings and capitalized values estimated in this paper provide a measure of the gross income that could be earned by the fishermen and expended in local economies, and the associated investment base. A thorough economic analysis of factor earnings, multiplier effects and opportunity incomes using (for example) input-output analysis is beyond the scope of this paper. It is clear, however, that significant losses are imposed on the fishermen and the region by the contamination of the sea clam resources.

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Robert J. Rubelman, Administrator, Maryland Fisheries Administration, Department of Natural Resources, Annapolis, Maryland.

Author Identification:

Robert H. Forste, Ph.D.
Assistant to the Secretary
Program Policies and Management

Ronald G. Rinaldo
Fisheries Oceanographer &
Surf Clam Manager
Fisheries Administration

Department of Natural Resources
Tawes State Office Building
Annapolis, Maryland
21401

MANAGEMENT OF THE SURF CLAM INDUSTRY

Ed Tolley

The surf clam management plan which was recommended to the Secretary of Commerce by the Mid-Atlantic Fishery Management Council: That they would restrict the surf clam landings to the quota of 1,800,000 bushels, which would be approximately 30,000,000 pounds of meats for each 12-month period following the enactment of the plan. The quota to be further subdivided by quarters and the fishing efforts to be regulated by restricting the day's catch. Naturally there were quarterly quotas involved. Then it was also recommended and approved unanimously by this council that there would be a fishing week of no more than four days, Monday through Thursday, which would help to spread the quarterly catch evenly throughout the entire quarter. And then with the proviso that day's catch per week may be adjusted upward or downward whenever 50 percent of each quarterly quota was reached. Then they were to restrict the ocean quahog landings to an annual quota of 3,000,000 bushels which would be approximately 30,000,000 pounds of meat for each 12-month period following the enactment of the plan. Also, they would prohibit the entry of additional vessels into the surf clam fishery, which would be effective upon the adoption of the plan by the Secretary of Commerce. At any event, this moratorium point was approved. It was approved that there would be a possible closure of the surf clam beds to fishing wherein over 60 percent of the clams would be under four and one half inches in length and less than 15 percent over five and one half inches. Lastly, they would require the registration of surf clams, ocean quahog vessels, processing plants, and record keeping on a weekly basis. The is basically the plan recommended to the Secretary of Commerce.

What is the present status of the plan? I won't go into the biological or the economic or the ecological questions. The important thing is to give you the status of the plan. The way it is right now, and I'd like to back up a moment and say on September 27-28, 1977, the Mid-Atlantic Fishery Management Council met and approved a change in the moratorium. The New England Council had recommended that there be a consideration by the Mid-Atlantic Council, to the effect that the surf clam and ocean quahog management plan be amended, by removing the new and entry moratorium provision north of the 41st parallel for new stops. Also that the action taken at the request of the New England Council be forwarded to the Secretary of Commerce. So what happened at that meeting was the New England recommendation was taken into account, approved and sent on to the Secretary of Commerce.

Now, what's the status? At the moment, the attorneys for the Department of Commerce are holding up the plan. They are hung up, I understand, on the moratorium provision. There are problems in that connection. I understand, talking not only to the attorneys, but to the Department of Commerce people, there is a concern that they don't have enough facts. They want the capacity of the U.S. fishing fleet for one thing. They want other things. They want to know about the impact that would take place if this happened, etc., etc. A justification for all of this, to the best ability of the Mid-Atlantic Council, has been sent on to the Secretary of Commerce lawyers. Alright, now they're still holding it up. When it will come out, when it will go into effect; people are trying to guess. No one knows. But that's where it is at the moment. Now, the next action we'll be taking on October 11-12, 1977, the New England Council will act on the recommendation that they made and make it official as to the changes in the moratorium. They may change it. They may change a lot of things, or they might say fine; that's what we want.

Then October 19th, 20th, 21st, one of those days, the Mid-Atlantic Council will meet in Woodshole in a joint meeting with the New England Council. At that time they will take any action which may be necessary which will help to expedite the whole kettle of fish out of the hands of the lawyers of the Department of Commerce. I might add that this particular plan was recommended to go in as an emergency regulation for two 45 day-periods, in line with the 200-mile limit. Then it was in that period, of course, that sufficient information would be developed or whatever would have to be done in order to make it permanent, of course when I say permanent, I must retract a little bit and say it's not permanent, it would be put in effect for a longer period and then the Mid-Atlantic Council at any time can make an amendment, etc.

Now a brief word regarding a summary of the figures. I have some information about the past history of the landings. As a matter of information, in August of 1977, the landings on surf clams totaled 4,975,000 pounds. The value of that was about $37,256,900; that's only the landing value. The guahogs for the same period of August 1977, were 1,319,300 pounds. In August 1977, the pounds landed were 4,978,808, whereas, for the period through the 31st of August, or eight months, were 37,256,923 pounds. Now the quahogs for the same period were 1,319,000 pounds for the month of August, with the eight month total being 13,233,940 pounds.

How does that compare with 1976? The surf clam landings for August 1976 were 4,225,000 pounds. In 1977, for the same month, it was 4,975,000 pounds. In 1976, the landed value was $2,371,000 compared with August 1977 of $2,220,000. Now for eight months for 1976 the landings were 33,130,700 pounds at a value of $14,378,598. The 1977 statistices for eight months was 37,257,000 pounds, at a landed value of $20,395,000. The quahogs in 1976 showed 566,910,000 pounds landed. In 1977, there were 1,319,300 pounds. The value for 1976 was $166,300; for 1977, $86,713 landed value.

It's interesting to note that for a period of eight months in 1976 it was 2,295,130 pounds with a value of $593,398 and for the eight months 13,233,940 pounds with a landed value of $3,953,300. Now for the eight months I've just mentioned, ending the 31st of August, there was an increase in the volume of 477 percent of quahogs and in the landed value of 566 percent. These figures come out of the Department of

Commerce. Now what does this mean? This means that the management plan under consideration is being held up by the attorneys. You've heard some of the facts on it and you can see that from these pictures of the figures and what I've just said that the matter is serious. The chances are that this will finally go through the Department of Commerce and into effect. But I think the main concern that the attorneys have is that they are concerned about the moratorium issue not only on this plan but on other plans.

The difficulty is that when these things are held up for a long time, like this happened, it's now up to the Mid-Atlantic Council and the New England Council. I feel that everything has been done with the money that was made available by the government to do the resource assessment that had to be done. Now some things are lacking, some things are not complete and some of the landings are not entirely accurate as has been brought out in public hearings because there are some on a voluntary basis who do not supply the information,it is estimated. But it is fairly accurate for over the years the same thing is hot. I mean, by that, some of those concerned do not give the data.

SCALLOPS: PROCESSING ON LAND AND SEA

John A. Peters

Introduction

There are three species of scallops that are currently of commercial importance in the United States - sea scallops (*Placopecten magellanicus*), bay scallops (*Aequipecten irradians*), and calico scallops (*Argopecten gibbus*).

The sea scallop fishery began on a small scale about 1880 when some of the inshore beds along the New England Coast were fished. By 1900, landings were about 400,000 pounds of meats probably worth less than $20,000 to the fishermen. By the late 1930's landings were about 7 million pounds of meats worth just under $1 million or about 14 cents per pound. And in 1976, landings were 20 million pounds worth $35 million or $1.77 per pound, making the sea scallop fishery the 10th most valuable in the United States and the second most valuable bivalve (oysters are, of course, number one).

Bay scallops have been harvested since Colonial times when the settlers on Cape Cod picked them up by hand at low tide. Landings of bay scallops in 1976 were over 2 million pounds worth $2.20 per pound.

Calico scallops have been harvested only since 1960 when the Bureau of Commercial Fisheries discovered the beds off Cape Canaveral. Landings in 1976 were about the same as for bay scallops, but the value was only about one-third or $0.70 per pound.

Harvesting

Sea scallops are caught by towing dredges or modified otter trawls over the beds. The dredges may be as much as 14 feet wide, and two are towed simultaniously. The scallop trawls are fished in the same manner as that used for ground fish.

In the New England area bay scallops are usually harvested by small dredges towed by outboard motor boats. Dip nets or tongs may also be used. Calico scallops are caught by trawls or by dredges, depending on the type of bottom.

Handling aboard

Sea Scallops

Dredge boats. --In the sea scallop fishery, the dredges are dumped on deck, the trash culled out, and the meats are shucked out by hand. The meats are washed and then put in new cotton bags which hold 35 to 40 pounds, and the filled bags are well iced in the hold.

Trawl boats. --These do not ordinarily shuck out the meats aboard the vessel. The larger trash is culled out, and the shell stock plus a few flounders, starfish, etc. are stowed in the pens with ice.

Bay Scallops

In the bay scallop fishery, trips are short, only a few hours; and about the only handling is to sort out the trash.

Calico Scallops

Calico scallop vessels remove the trash and ice the shell stock in the hold. At one time, there were four vessels equipped with machines for processing scallops aboard the vessel; but for some reason, it did not work out, and the machines were removed.

Handling ashore

Sea scallops meats shucked aboard the vessel. --On unloading, the bags of meats may be repacked with ice in boxes or barrels to be held for a short period before processing or may go directly from the vessel to the processing line. Processing in the New England area consists primarily of washing the meats, cutting the large ones into "bite-size" pieces, applying batter and breading, then freezing either before or after packaging. Considerable quantities of meats are simply packed in containers and sold fresh.

Shell stock processing. --Sea scallops that are landed in the shell are processed either by hand shucking or by machine shucking. Hand shucking appears quite simple but takes considerable practice to become proficient. The shucked meats are washed and packed into containers for either the fresh or frozen scallop meat market. The weight of the contents will vary from about 10 ounces to 10 pounds, depending on the market.

Machine shucking involves several distinct steps each with its own "hardware". In general, (as each plant has its own variation), the scallops go into the plant via a conveyor with one or two people culling out most of the trash, they then go into a tank containing water heated to 80 to 100^{o}C where they remain for only a few seconds before being removed by a conveyor. The main variation in processing occurs in the means of entrance and egress from this tank. In some systems, the scallops are fed into the tank by way of two soft rollers revolving rapidly in opposite directions; the rollers grip the shells and sling them against a steel baffle slanted at a 45 degree angle; on exit from the bath, they are subjected to the same treatment. Three other systems are (or have been) in use: entrance slinger roll only, exit slinger only, and no slinger rolls. On exit from the tank, the scallops fall onto an inclined shaker screen that separates the meat and viscera from the shells. The meat plus viscera of the scallops go to the eviscerator which consists of a large number of paired rollers. The rollers in each pair rotate first toward each other then away. The rough plastic surface tends to grip the viscera and pull it away from the meat. Then, as the series of rollers are inclined downwards, the meats are propelled along to a brine tank where any remaining shell fragments sink, and the meats are removed by a conveyor to the inspection and packing tables.

Bay scallops are shucked in what might be called a "cottage industry". Much of the production is sold fresh, the rest is packed in cartons and frozen.

Calico scallop processing was originally very much a cottage industry in Carteret County, North Carolina. Trucks would drop off the shell stock at various homes, it would be shucked the next day by the housewives and any children unfortunate enough to be available. The shucked meats would be picked up that evening when the next batch of shell stock was delivered (I understand that not much ice was used).

Quality Problems

Regulations regarding sanitation in the shucking process aboard the vessel vary from state to state. In general, it is required that stainless steel or plastic containers, wash boxes, and sometimes shucking benches be used. Regulations are not as strict, however, on the quality and condition of the hand coverings, which may be rubber, plastic, or cloth gloves - or even bare hands.

When the shuckers aboard the vessel fill their pails with meats, they dump them in the wash box where they may soak in seawater for as long as six hours. In the summer, the temperature of the wash water may be 20^{0}C or even more. When the bags are iced down, the meat temperature begins to drop slowly. The filled bags contain 3-½ to 4 gallons of meats and measure about 16 to 18 inches high by 6 to 8 inches thick. To cool this bulk in melting ice (which is about the most efficient chilling agent known) will take many hours. It could be as short as 8 hours - but it could also be as long as 36 hours. The time depends on meat temperature and thoroughness of icing.

The landing of sea scallops in the shell from the offshore banks is relatively new. And the problems may not yet be fully known or evaluated. Some processors are, in fact, concerned that the icing may not be adequate to properly cool the catch.

Sea scallops cannot close their shells tightly and, thus, die quite rapidly (in contrast to oysters and hard shell clams) when taken out of the water. When they die, the shells tend to gape open. The gaping exposes the interior of the scallop to the melt-water from the ice used to cool the product. The melt-water may contain various amounts of mud washed from the shells as it flows over them. It is very difficult (if not impossible) to get the shell stock clean before icing in the hold. To do a really good job would require equipment specially designed and constructed for shipboard installation. A brief rinsing with the deck hose will not do the job. It would be very interesting to know what are the species of bacteria and their numbers that are present in the bottom sediments on the offshore beds. Reports show that numbers decrease with distance offshore, but the data are not as consistent as could be desired. Species probably include pseudomonads and achromobacter; and these, of course, are great spoilers of seafoods.

It is doubtful that bacteria of public health significance are present in the offshore environment unless the discharge from the head is just forward of the seawater intake! But, there is no guarantee that the scallop meats do not pick these up during subsequent handling.

Conclusion

In conclusion, it can be seen that the trend toward landing sea scallops in the shell might very easily result in serious quality problems for this very important fishery. It is entirely possible, however, that the problems may be easily solved by application of the basic principles of sanitation. But to do this, we must first find out about times, temperatures, initial bacteria counts, bacteria growth rates, etc., etc. An exellent project for a resourceful researcher.

LEGAL ASPECTS OF FOOD REGULATION

Leonard Vance

This talk will cover some of the legal aspects of food regulations. Generally, governments have exercised their broad police powers to regulate the food industry. These regulations were designed to achieve a variety of different purposes. The fundamental goal of food regulations has been the protection of the public health. But other reasons exist as well. Some statutes, e.g., the federal Food, Drug and Cosmetic Act, 21 U.S.C. 301, are designed to protect the public from fraud and to inform consumers of the precise nature of the product they receive. Other regulations are designed to serve the interest of a particular segment of the food industry. For example, milk regulations are frequently designed to eliminate competition, increase the price of milk to the consumers and thereby, increase the security of the people who are in the dairy industry. Government uses its police power in cases like this in order to protect an entire industry from economic collapse. At the same time, there are anti-trust laws at the federal level designed to do exactly the opposite; to increase rather than decrease competition.

Who is it that regulates food? All three levels of government, federal, state and local government, have some regulatory responsibilities over food. How is the regulatory program carried out? All food regulation statutes whether the federal Food, Drug and Cosmetic Act, the Virginia state statutes governing the regulation of food, or local ordinances, have several common elements. Such statutes always start out by assigning responsibility for food regulation to some particular governmental agency. For example, the federal Food, Drug and

Cosmetic Act assigns responsibility to the Secretary of Health, Education and Welfare. It says he shall, through certain acts, carry out the provisions of this chapter.

Our Virginia statues assign food regulatory responsibility primarily to the Virginia Commissioner of Agriculture and Commerce with some responsibilities to the State Health Commissioner. At the local level, this is ordinarily assigned to a local department of health. Once a statute assigns regulatory responsibility, it next creates a list of prohibited acts or authorizes the adoption of regulations that prohibit certain kinds of acts. Typical of the kinds of acts that are prohibited are the manufacture, sale and delivery of adulterated or misbranded foods, the actual act of adultering or misbranding goods, false advertising, counterfeiting of required governmental stamps or the violation of some type of duly promulgated regulation that the responsible agency has issued by the procedures that are set forth in the statutes giving that agency the authority to promulgate regulations.

After the statute creates a list of prohibited acts, then, in order to get people to actually obey the law, it provides for sanctions. After all, people who obey laws either have a naked fear of the consequence of getting caught or they obey out of social custom. If the state does not impose sanctions it will not get any kind of compliance. The sanctions ordinarily can be criminal laws, civil or they may involve the seizure of adulterated foods.

The federal Food, Drug and Cosmetic authorizes a penalty of one year in jail or a $1,000 fine for violating any of the provisions of that statute. Willful or intentionally fraudulent or deceitful practice in violation of one of the Food, Drug and Cosmetic Act regulations may trigger a penalty of up to three years in jail and a fine of up to

$10,000. In Virginia, generally speaking, violation of any of our food laws or any of our food regulations is a misdemeanor carrying a penalty of up to 100 days in jail and/or a $10 to $100 fine. See § 3.1-361 et seq. and §3.1-418 of the Code of Virginia. Local ordinances, when they provide any kind of criminal penalty, usually are about the same as the state penalty. Generally, local ordinances mirror the state statutes, but they are frequently adopted in order to allow the fines or penalties that are assessed to go into the local treasury.

In addition to criminal penalties for violating food statutes or food regulations, civil penalties may be assessed. In reading through the Food, Drug and Cosmetic Act, I find no provisions for civil penalties comparable to the ones we have in Virginia. But in Virginia, violation of any State Health Department regulation is a civil offense, and can subject a person who is found guilty of violating that offense to a penalty of up to $10,000 per day. See § 32-6.4 of the Code. Naturally, the courts rarely impose it, but its possible imposition exists. The only time such penalties are likely to be imposed would be in a Kepone-type situation where a vast amount of economic damage has affected an entire industry. Furthermore, violation of some food regulations may result in injunctive action. A defendant also has the right to compromise on any kind of claim that the state makes against him and to avoid court proceedings. Civil penalty provisions of §32-6.4 parallels the civil penalties that are available to the people who violate the federal Water Pollution Control Act. For some reason, the Food, Drug and Cosmetic Act doesn't have that, but most other modern state and federal environmental regulations has that. The Virginia Public Water Supply Act, OSHA statute, the State Water Control Law and the air pollution control laws have such provisions.

This third type of sanction that is available when people violate the food regulations is seizure. At the federal level, seizure is available through the Food, Drug and Cosmetic Act by an action very much like Admirality proceedings where the United States actually files an action in the Federal District Court against 100 cases of oysters or clams. The proceeding is directly against the property. Anyone who has an interest in that property has the right to intervene if he wants to protect his interests. But the proceedings are directly against the property itself and if the government makes its case, it seizes the property and destroys it as it sees fit. Some state statutes have this kind of provision, other state statutes don't. Virginia does authorize the seizure and destruction of food. There are procedural prerequisites before the state does that kind of thing. Generally speaking though, the state must give notice to the owner if it can find him, and must hold a hearing before any destruction takes place.

Incidently, state regulations over food vary vastly from place to place. In Virginia, primary responsibility for food rests with our Department of Agriculture; in other states, it rests primarily with the Department of Health. There is no uniformity at all and it is largely a matter of historical accident as to which agency is assigned this kind of responsibility. A fourth consequence of violating food laws is the possibility that one can have a common law negligence claim assessed against him - a person who sold the contaminated food. There isn't any statutory basis for this kind of action. It is an ordinary common law negligence action. This kind of action is brought exactly the same way one would bring an action against somebody for negligently driving a car into him.

How is the power to regulate food divided up? We have seen that three different governmental entities are involved in the regulation of food: federal government, state government and local government. Who can regulate at any given time? To answer this question, you have to go back and look at our constitutional framework and the way the government is organized in the U.S. We have a government of divided powers. Our constitution sets up a federal government with enumerated powers and leaves all remaining powers to the state or to the people respectively. Article I, Section 8 of the United States Constitution gives to the federal government the authority to regulate interstate commerce. The federal Food, Drug and Cosmetic Act is primarily directed to regulating, as far as foods are concerned, food that will be distributed in interstate commerce. If one wants to avoid the application of the FDCA, one could avoid selling anything in interstate commerce.

The fact of the matter is, that almost anybody who is involved in any kind of commercial food activity is going to get his products involved in interstate commerce. So most people in the food industry are subjected to two simultaneous levels of regulation, one from the federal government and one from the state government. Both of the sovereigns jealously preserve their rights and their powers and the extent of cooperation varies from one federal program to another federal program

The federal statute prohibits only those acts that involve interstate commerce. The reason for that goes right straight back to the U.S. Constitution. The state, on the other hand, have broad police powers and they can regulate in virtually an identical manner anything that is not going to be distributed in interstate commerce. What happens when there is a conflict between state and federal regulations? It depends whether or not the impact is on interstate commerce or not. If a state adopts a regulation and attempts to regulate an industry that is involved in interstate commerce and impedes the ability of that industry to sell products or move products in interstate commerce because of the conflict in regulations between the two, the federal regulation will pre-empt that state regulation. The federal regulations will invalidate the state regulations to the extent there are conflicts. On the other hand, suppose the state and the federal government attempt to regulate different areas. The states have complete power to regulate and fill in all the gaps that may exist in the federal statute. Where the federal statute regulates one particular part of the food industry, the state can regulate all the rest.

What kind of powers do the local governments have? It varies tremendously from state to state because different states have different common law rules on the powers of local governments. Virginia follows the tightest possible construction, called the Dillon Rule. In Virginia, local governments have no intrinsic powers. They are creatures of the state and of the General Assembly. The local government has only those powers the state legislature delegates. So, if specific state statutes that authorize the local government to regulate food do not exist that local government can't regulate. Other states though, don't operate this way. Other states follow a much more generalized rule wherein local governments have intrinsic powers, states have intrinsic powers and you have situations like the one between the state and federal government. A local government can do anything except those things that are specifically prohibited in some states. In Virginia, it is exactly the opposite rule. Local governments, in Virginia, can do only those things which are specifically allowed. When local governments attempt to regulate food in Virginia, they generally implement state statutes. Local inspection in the locality of Virginia is frequently done by people who are state personnel anyway, so in effect almost all the regulations in Virginia are implemented by state people, who are in part, paid by the local governments.

In order for a federal or state agency to regulate any area of food production or sale or anything like that, a certain procedure has to be followed to promulgate regulations. The reason for this is the basic concepts of administrative law. One of the most basic concepts of the administrative law is that no agency of state or federal government has any intrinsic powers whatsoever. State agencies, whether the federal Food and Drug Adminstration, the Virginia Department of Health or whatever, have only those powers which are specifically granted by some statute. So, if a state agency lacks a statute authorizing it to act, the agency can't do anything. Further, the agency must follow exacting procedures in adopting regulations. In Virginia, state agencies follow the Administrative Process Act, §9-6.14:11 et seq. of the Code. The Administrative Procedures Act at the federal level applies to federal rulemaking. This requirement of a procedural tightrope has led to some of the conflict between state shellfish regulators and their counterparts at the FDA. Virginia, for example, has long taken the position that FDA does not have the power to decertify state shellfish programs because it's never gone through the process of formally promulating the regulations to do so.

Now, what I have told you about so far is the form of regulations and the distribution of power to regulate food generally. We haven't talked at all about the actual detailed account of any of the regulations.

All of the federal regulations governing food are found in Title 21, Code of Federal Regulations. The parts governing FDA take up six volumes, close to a thousand pages each. All the material governing food for human consumption is found in titles 100 to 199. On March 15, 1977, FDA formally promulgated in the Federal Register, regulations governing smoked fish, smoke-flavored fish, frozen and raw breaded shrimp, fish and shellfish and a seafood inspection program. The March 15th regulations set standards governing the size of oysters. The regulations define, for example, the size of an extra large oyster. This is the way a typical regulation is written: "Extra large oyster, oyster counts or plants, extra large red oysters are the specie *Crassostrea virginica* and conform to the definition standard that has been prescribed for oysters by previous sections and are such size that one gallon contains not more than 160 oysters and a quart of the smallest oysters contain not more than 44 oysters." It's a very detailed regulation. It sets out the exact definition of the size of large oysters, extra large oysters, medium oysters, small oysters and even has very small oysters. Many of you may not be aware of this regulatory scheme. It's a fairly new regulation.

What I've done is give you a brief guideline and overview of governmental schemes for regulating seafood. We, in Virginia, are in the process of completely rewriting all of the health statutes and I'm interested in receiving any suggestions you might have for including in the shellfish sanitation statutes or crab sanitation statues what you think would be beneficial that may not be in these statutes now.

THE IMPORTANCE OF EELGRASS IN THE CHESAPEAKE BAY AND RECENT PROBLEMS ASSOCIATED WITH ITS DECLINE

Robert J. Orth

What is eelgrass? Well, if you were a boater in the lower Chesapeake Bay, eelgrass is something that messed up your propellor and you'll have to stop your boat every often to clean the propellors. If you were a landowner, and wanted some waterfront property, eelgrass is something that always washes up on your beach and you have to clean your beach as it begins to decay and starts smelling. If you were a swimmer it would be something you would try to avoid getting into because you don't want to go through it. But to a fish or crab, eelgrass is very important because it provides the vital link in its cycle.

Where do you find eelgrass? Eelgrass is a plant that requires sunlight, so it's going to be found in shallow water where sunlight can pentrate to the bottom. It's primarily a temperate species. It's found from North Carolina to Canada on the east coast of the U.S. It's also found on the west coast of the U.S. from approximately lower California to Alaska. It's also found in Japan, Europe and parts of Asia. So it has a fairly wide distribution.

Where would you find eelgrass in the Chesapeake Bay? Eelgrass tolerates salinity as 10 parts per thousand. Since salinity limits its distribution, you would find it primarily in the lower York and the Rappahannock Rivers and up the Chesapeake Bay, into the Maryland section of the Bay. It's only found in shallow water and since light is a main factor limiting its depth distribution you find it in depths of one meter and at the most two meters. Eelgrass is primarily limited in distribution and occupies only a narrow fringe of the coastal area, but this doesn't belie its importance to the Bay.

Why is eelgrass important? What are some of the properties that make the eelgrass ecosystem perhaps one of the most important in the Chesapeake Bay? First, eelgrass, the plant, has the ability to buffer and baffle currents. So it primarily plays the role of sediment stabilizer and an erosion control buffer. This is very important to the Chesapeake Bay because of all the problems that are now associated with trying to stabilize shorelines.

Another very important function of eelgrass is that the grass bed supports one of the densest and most diverse macro-invertebrate communities in the Chesapeake Bay. The leaves of eelgrass provide a suitable substrate for a large number and variety of invertebrate species. This large density of species is important because it most likely serves as a source of food for other fish and invertebrates which may be commercially important, e.g. the blue crab.

Let's look at the numbers of individuals that you find in different portions of the eelgrass bed. There aren't many animals that live out in bare sand. Go across to the edge of the eelgrass bed, no more than a meter away, you find more animals. In the densest portion of the eelgrass bed, the general trend is that there are more animals. The same thing is true with different types of animals. So just the physical presence of eelgrass alone, is causing this tremendous increase in the numbers and different types of animals.

One of the studies we're conducting now at VIMS is an examination of the abundance of fish and more motile invertebrates. We have been comparing the types of animals that occur in bare sand and in eelgrass using an otter trawl. The samples that are taken outside the eelgrass have very few and in some samples, no animals at all. For example, we took six samples in eelgrass beds on the Eastern Shore and in those samples, we collected 23,000 small grass shrimp. In the bare sand just outside the bed, similar samples revealed almost no animals. We found 200 to 300 bluecrabs in the beds, whereas outside, we found very few bluecrabs. The predominant fish we collected were juvenile spot with lesser abundances of many other species.

Thus, eelgrass is providing a nursery, a feeding ground for many young and different types of fish and invertebrates. One of the interesting things we're finding in the grass beds are brown shrimp, which are of commercial importance further south. We're finding them in large quantities but unfortunately, not large enough to support a commercial industry. Again, we were finding all of these shrimp in vegetated areas and none in the unvegetated area.

Another important characteristic of eelgrass is that, just like wetlands, eelgrass breaks down into detritus. Eelgrass is not eaten by many species but when it dies and decomposes, it is colonized by bacteria and fungi, which serve as a source of food for higher consumers. Eelgrass serves as the base of a detritus food chain. However, unlike most wetlands, eelgrass detritus is almost immediately available into the system while in most cases wetland detritus is going to remain in the marsh for some time.

Eelgrass also acts a nutrient pump, pumping nitrogen and phosphorus from the sediments, through the leaves and into the water column, and vice versa.

In the 1930's, eelgrass populations along the east coast of the United States and west coast of Europe experienced a dramatic decline. This was one of the most documented declines of any marine species.

The decline of eelgrass had serious consequences on many important species of invertebrates and vertebrates. Many species of waterfowl which were almost totally dependent on eelgrass as a source of food, e.g. the brant, declined precipitously. The bay scallop industry on the seaside eastern shore of Virginia was devastated. In 1930, almost 2 million pounds of scallop meat were harvested there. In 1931, it fell to 1.2 million pounds, in 1932, 0.6 million pounds and in 1933, none were harvested. To this day, there have been no scallops harvested commercially there.

The decline of eelgrass severely affected the scallop because its life cycle depends on eelgrass. The young swimming larvae of the scallop need a substrate to attach to and eelgrass was an ideal substrate. Without the substrate and the fact that the scallop lives no longer than two years, the loss of eelgrass led to this large decline in a relatively short period of time.

Recently in the early 1970's, eelgrass in the Bay has again declined to low levels. Many of the large grass beds in the York, Rappahannock and Piankatank Rivers are now absent. Many hypothesis have been suggested for this decline, ranging from the impact of large schools of cownose rays which feed on shellfish in the grass beds, to the input of large amounts of herbicides into the Bay as more farmers turn to no-till and minimun till farming with accompanying increase in the use of herbicides. A more probable cause may be more environmental, such as a change in climatological patterns in the Bay region. The early 1970's were characterized by warm winters and warm summers. Since the life cycle of eelgrass is temperature dependent, this factor may be much more important than has been stated in the past. However, one should not overlook man's impact on the Bay ecosystem, especially in the shallows where eelgrass occurs. Man may have a more subtle effect which may be cumulative and that may in the long run, be of a much more critical nature than other naturally induced factors.

The eelgrass system is a vital link in the life cycle of many species in the Bay and provides so many other important functions in the Bay, that this is a system that should be protected, as are wetlands. Grass beds are dynamic in nature and unless we understand how they respond to purturbations, the fate of the grass beds may ultimately be under man's decision-making policies. Eelgrass beds are too important to the Bay ecosystem for them not to be protected.

PROBLEMS IN CLASSIFYING THE GREAT SOUTH BAY

Bruce McMillian

I gues by now some people are aware that we did have a few problems in trying to recertify some particular waters located in the Great South Bay in the state of New York. What I would like to do basically is give a quick overview of the New York State Shellfish Sanitation Program, with emphasis on our water quality certification; followed by a brief background and summary of the industry we have in New York. Secondly, I will give an overview of the Great South Bay as a major producer of shellfish in the state of New York. Finally, I'll go into a review of the situation that resulted from attempting to recertify portions of shellfish lands located in the Great South Bay.

As far as the New York State Shellfish Sanitation Program goes, I like to think we are fortunate in some respects. 1. Our total program is located in one agency. The total New York State Shellfish Sanitation Program is found under the Department of Environmental Conservation. And with exception of our enforcement activites, the total program is located within one particular division, and that happens to be my responsibility. As far as the legal basis for our program is concerned, that may be found in our New York State Environment Conservation Law. I think one section is quite important, at least it is to us, in attempting to run our program. It is entitled "Sanitary Surveys" and it states, quite briefly, "the department periodically shall examine all shellfish lands within the state to ascertain the sanitary condition thereof. 2. It goes on to state that the department, following an examination, "shall certify which shellfish lands and the product thereon are in such a sanitary condition the shellfish thereon may be taken for use as food. Such lands shall be designated as certified areas and all other shellfish lands as uncertified areas." That's the law. We have one small problem which we found out about this year. The law very clearly states that we have the right and actually the responsibility to carry out the sanitary surveys. However, in our case and nowhere else, neither in law or in regulations, does it indicate the criteria that shall be met or shall be used to certify these lands. That's our problem.

Let's go on to a brief summary of statistics. At the present time, our industry is composed of two sections. We have the greatest number of people involved in individual harvesting on public lands. Looking back to 1976 for our latest complete records, we issued 9,792 individual harvesting permits. These were issued to individuals in the state of New York to harvest shellfish from certified waters. In addition to that, on the south shore and on the Great South Bay, there are four large companies that either own or lease lands; the largest, I am sure most of you are familiar with, would be the Blue Water Seafood Company. That company actually owns in excess of 13,000 acres of underwater land in the Great South Bay. In addition, we have three large companies involved in oyster operations. These are all located on the north shore of Long Island and on the eastern end of Long Island. Finally, we have two firms harvesting surf clams from waters of the Atlantic Ocean, basically within our three-mile limit. As far as the reported landing and value of our resource are concerned, again for

1976, for hard clams we had a reported landing of 9 million pounds of meat of hard clams, with a dockside value of $18,120,000. Next would be our surf clams with a reported landing of 3,450,000 pounds with a reported dockside value of $1,090,000 and third, oysters reported landings, 1,900,000 pounds, dockside value reported, $4,760,000.

As far as the Great South Bay itself is concerned, it's located on the south shore of Long Island. It is bounded on the north by the mainland of Long Island and on the south by our barrier beaches. The length of the Bay is approximately 30 miles; the average width varies from about 4 to 4½ miles and has an average depth of about 6 to 7 feet. The total surface area is approximately 63,800 acres of which, at the present time, 9,800 acres are closed to the taking of shellfish. We have a couple of other complicating factors in our program, especially in the Great South Bay, involving jurisdiction. We are responsible for certifying the quality of the waters and the quality of the products ultimately taken from these waters.

We do not have the jurisdiction over the underwater lands in this Bay. That is shared jointly by three local townships and the Blue Water Seafood Company. To give you some impact to the involvement they have in our total shellfish program by way of diggers or harvester, check their records. There are three towns: Babylon, Icebrook and Brookhaven. For 1976, the town of Babylon had 1,467 licensed baymen. Next to it, the town of Icebrook had 3,306 licensed baymen and the town of Brookhaven had 1,734. That's a total of 6,506 licensed baymen that would be legally licensed by the state and by the respective townships to harvest shellfish from the waters of the Great South Bay. Again, keep in mind, that's out of the total of 9,792 diggers for the state.

The major emphasis of our industry is in the Great South Bay. As far as the resource from the bay is concerned, the primary shellfish resource would be the hard clams; periodically we do have influxes of the bay scallop. We also have a small oyster industry that one company in particluar, Bluepoints, is attempting to revive. These are both very small in comparison to the hard clams. Again, by way of statistics, I note that by our own record approximately 93 percent of the total hard clam production reported in New York for 1976 came from the waters of the Great South Bay. So it is extremely important to both us as a state and especially to our industry.

Now, I would like to get into some our our problems involved with the recertification of waters in the Great South Bay. Going back to 1973, we continued a program in the bay to gather data and related information to complete a sanitary survey. We had just completed one in 1972. At that time we moved the line of closure in the western portion of the bay from the shore to off-shore at a point where we had no natural momuments or anything else to tie into. So we installed a series of buoys to identify the new line of closure. That in itself was quite a situation. Segments of the industry felt a line of buoys could be destroyed and then there would be no closed area line. So we had buoys with eye-bolts cut off; we had buoys with the chains cut off, and buoys that drifted on to the beach, which put sort of a flying wedge into the line. Each time we intended to redesign and come up with a better buoy. We now have buoy that can't be moved. We can anchor any large vessel to it and it can hold for the next 24 hours.

A year ago, one week before the 4th of July, we got a panic call on a Monday morning that the whole east end of the line was gone. We didn't know what had happened, so we went out as quickly as we could. We only had about an estimated 300 boats inside and it looked like a small island when you sailed up to it. We did put one or two buoys back up and we found out through various sources that apparently on that Sunday evening a group of persons, one person or persons unknown, had gone out. They couldn't pull out the mooring systems any longer and couldn't cut the chains because they were case-hardened. So what they did was to latch the buoy along side the boat, take a chain saw and effectively cut the tops right out of them and sink them.

In the meantime, starting in 1973, through 1974 and the first six months of 1975, we continued to gather data, primarily bacteriological data, from designated sampling stations throughout the western portion of the bay. In June of 1975, we completed the total analysis of all of our data and related information and as a result determined that additional areas in that portion of the bay had to be recertified. I put great emphasis on the word, recertify, because we ourselves have been rather careless in using the words reclassify and certify, and using them interchangeably. We were recertifying underwater land in waters of this portion of the bay. In the latter part of July, 1975, through the month of August and the early part of September, we had a series of meetings with both local governments and the industry in this particular area to advise them of the situation and of the options we were proposing to take. This has become a matter of policy. Again, in retrospect, I think it was a very good thing we did meet with these people, as it turned into a court situation, and at that time, they advised that they would take legal action if the state of New York attempted to close one square inch of additional bay bottom. On September 10, 1975, we put together a series of orders which would re-certify shellfish lands, not only in the Great South Bay, but in other bodies of water including portions of Oyster Bay. Ironically, in the same group of orders we had two that actually reopened some areas; one area in the far eastern end of the South Bay and another in the north shore of Long Island. We submitted those orders to Albany to the Commissioner on September 10, 1975. At that time we ran into the first little change in the way we routed information to our Commissioner for final adoption. Ultimately nothing happened.

What this did require was that the area in question, and especially in the western section of the Great South Bay, was a relocation of our infamous line of buoys. We had to go further offshore. We had to establish a longer line; we were actually running through a portion of the bay approximately seven miles in length. Without one natural boundary, Coast Guard navigaitional aid or any other device we could put in. The way we anchor the buoys is to have two poles or pilings that are eight feet in length jetted into the bay bottom and bridle the buoy on case-hardened steel chains to the pole. If we do it right, we can put the pole out of sight on the bottom of the bay, but we have divers to guide the pilings in.

About December 1975, I advised the Commissioner's office that since he hadn't signed them by this particular point in time, he could now wait until the spring because there was nothing further we could do in relocating the lines. In February 1976, the Deputy Commissioner requested additional information; we supplied that. It did not change the original recommendation or the area to be re-certified. We then went through a series of changes, among other things we had a change in Commissioners. Again, all through 1976 nothing happened. In December 1976, I called them again, told them to forget it until spring of 1977.

Finally in the spring of 1977, I think most people at Albany and the Commissioner's office were well aware that they had to do something. The FDA, through their consultant, had made recommendations; we had the data. We didn't have to listen to anyone else, we knew what action was necessary. In the spring of 1977, following a series of meetings, Commissioner Burley, in this case, recognized that he had no alternative. He had nothing to do with the original involvement of these orders. But having made that decision, it was then a matter of timing if he wanted to go through with this. Also, everyone recognized what an economic impact this would have on the industry in that area. It is an extremely productive part of the bay. As far as alternatives, recognizing that we had to close the area, the only choice to try and offset that from an economic point of view, was to consider expanding a transplant program we had going on in the area. The second alternative was to consider instituting a conditional area program. Having considered the conditional area approach, it was decided by the Commissioner that it was something we should go with. So along with everything else, we also started our first, pre-conditional area program. Finally, the decision was made in the Commissioner's office to adopt the order, on May 5, 1977, to be effective on May 20, 1977. At this time our problems began.

On April 30, we had an action filed by one attorney representing two baymen by name, and I guess the baymen in the area in general.

That action was instituted against the Commissioner and against our regional director. Action 1: The complaint by the individual plaintiffs in Action One seeks a judgment declaring the actions of the defendant, (that's us), to be both constitutionally illegal, abritrary, capricious and abuse of discretion. Plaintiffs further seek a permanent injunction preventing the closing for the harvesting of the shellfish from the waters of the Great South Bay adjacent to the town of Babylon. The decision was made then to close the area on May 20 at daybreak. Again, timing is very critical here depending what side of the fence you are on. On May 18, a second action was filed on behalf of four towns against the Commissioner and the regional director of the Department. That was Action 2.

In the second action brought by the towns of Icebrook, Babylon, Brookhaven and Huntington, the plaintiffs were seeking an injunction which would order the suspension of the utilization of the coliform test on grounds that it was aledged to be scientifically and illegally invalid. The actual data accumulated by such testing by the defendants should be declared null and void in that it was not gathered by scientific procedures and that such collection procedures were in violation of the Environmental Conservation Law under regulation of the Commissioner.

The morning of May 20, we did close the area at daybreak. We almost had a large-scale riot; the baymen in the area and again I point out not all baymen, but those in that area, had decided prior to that date to have a gathering as a show of force. It was a critical situation. At the same time, Justice Bracken of the State Supreme Court had convened a hearing to hear the two actions. A number of points were raised and at that time, as I understand it, Judge Bracken did take notice of the fact that it had taken the department approximately a year and a half to make the decision to close the area. It probably wasn't that critical so that we couldn't take an additional couple of days or weeks to try to answer some of the questions by the plaintiffs in this situation. As a result of that, Justice Bracken issued a temporary restraining order against the state. Again, I might point out that it was ironic that as a result of the temporary restraining order, we were not allowed to close the areas in question. Those areas that we had recommended for reopening were allowed to remain open. As a result of the action, at approximately 12 o'clock noon on May 20, a real serious confrontation was avoided between state and local enforcement officers and members of the industry itself. Following the temporary restraining order issued, Justice Bracken then announced that a hearing on a preliminary injunction. Basically, in that decision he vacated the temporary restraining order and idicated that the area would be closed on the morning of July 11 at sunrise. This was on the 5th. On the 6th, we went into court and started trial. The first thing the attorney for the town did was to file a notice of appeal he, and the town, in this case, were entitled to an automatic stay on the Judge's decision. The trial continued July 7, 8, 11 and 12.

As a result of the towns filing a notice of appeal, the Attorney General's offfice recommended that our agency request an opinion from the Attorney General's office and they in turn would respond. We did this. The Attorney General's office responded that the towns were not entitled to the automatic stay and therefore advised us to proceed with our action. We then picked the date of July 20 to close the area. It was closed at sunrise on July 20, but the attorney for the towns obtained a second restraining order. I think we had it open one hour longer than the first time so we were gaining. By this time there was quite a bit of confusion, not only in the state, but with a lot of other states.

The state of Connecticut, on July 22, sent a letter to Commissioner Kennedy of the FDA requesting the FDA to consider taking some kind of action against the City of New York to protect its citizens from consuming shellfish that might be coming from the areas in question. On August 2, the state of New Jersey sent a telegram to our regional director advising that if the state could not control the situation further action would have to be considered by that particular state. I then had a series of discussions with people from the state of Maryland, I think the letter was typed and ready to be signed by the Commissioner of Health to go to our Commissioner again if nothing could be done to control this particular situation.

In the state of Maryland, there was one individual I talked to who raised an interesting legal point. We have, as an agency, recommended that the area be closed. The judge would not allow us to close the area, therefore could that state take an action saying that shellfish were coming in an uncertified area since it was never closed, either officially or legally? It was a question to consider. We went through another filing and so forth, and the court of appeals. The state of Connecticut sent the original letter to Commissioner Kennedy in July and finally in the early part of August, they sent our directives to their dealers and local health agencies advising them not to accept any shellfish from New York state with the origin indicated as parts of the Great South Bay and several other bodies of water in question in this action. As a result of that, it's the first time that I'm aware of, at least in the state of New York, where we actually had products returned to New York by out-of-state dealers. It was no longer just a situation involving the politicians, the civil service and so forth, it had started to affect the industry. Finally, on August 4, another attempt was made to close the area and this time we kept it closed. We did get the Attorney General's office to give a favorable opinion indicating that the state was entitled to keep the area closed. We then awaited the decision. That decision came down on September 26 and there was one particular statement in there that I think summarizes all of the findings as a result of the trial and hearing. From Justice Bracken's decision: "I find therefore, based upon all of the evidence introduced in trial that the orders of the Commissioner had a rational basis for their issuance." It was a twenty-one page decision.

Looking back, maybe I might just identify a couple of the major issues that were considered at the hearing and the trial. One: question of the validity of the total coliform standard used by all of us to certify shellfish growing waters. Excerpts from the judge's decision: "The burden of establishing that the standard in question is illegal rests with the plaintiffs." In fact it has been established that the coliform testing method is the only valid testing standard which may be utilized in a case of this nature, while the present coliform indicator test has the credentials of valid criteria, standardized methodology and economy. Second, there is the question that the towns were trying to cover up bases first, they say the standard is unconstitutional, invalid, etc. But then they stated if the standard is valid, then the DEC (our agency) did everything wrong. We didn't collect the samples properly, we didn't analyze them in the laboratory properly, we didn't analyze the data properly, and we didn't reach the proper decision. We got by that one. And then, also, there were some other technicalitites, in that we failed to meet requirements of stated administrative procedure, and the requirements of a state environmental quality act. This was interesting. The State Environmental Quality Review Act is patterned after federal legislation and basically requires the preparation of an environmental impact statement (EIS) on any action any state agency in New York might undertake by regulation. A couple of alternatives, you can either prepare an EIS if you are going to propose an action that will have an adverse impact on the environment, etc., or there are a couple of exemptions which will allow you to go for a negative declaration. I made the decision to for the negative declaration. I didn't feel like writing an EIS. As it turned out, at least from the Attorney's General point of view, it was the weakest point in our whole case. One of the overriding factors that the judge apparently was deeply concerned with during the entire hearing and trial was a matter of economics. It was first and foremost in his mind. It was the one thing that had the Attornery General's office really concerned, that merely by not preparing and filing an EIS, we might jepordize the entire case. As it turned out the judge ruled in favor of us on that particular point.

Thinking back over it, the first result of this action, we destroyed or undermined a great deal of confidence in our own state shellfish sanitation program not only on behalf of the industry that we have to deal with, but also by the consuming public, especially in the state of New York. People read in the paper or see on television: here's an area the state's recommending be closed. After awhile, people who are not totally familiar with our program start wondering. You don't have to eat clams and you don't have to eat shellfish from the Great South Bay. It reached a point, not only did we have products returned, but we finally had pressure that started to build on our industry. That started to effect the total economics of the whole industry in the state of New York.

Going beyond that, though, I think the judge's decision on the positive side, did reaffirm the state's program and, in fact, actually strengthened our program, at least from our point of view. As a result of this, we did learn. I think anyone going through a situation like this has to learn something. As I indicated before, we had a law that says we shall certify shellfish lands, we had not criteria. We now have regulations for the certification of waters not only for certified, but conditionally certified and for seasonally certified. We have gone through and completely rewritten our entire set of regulations for the sanitary control of shellfish in the state of New York. Hopefully, they will be adopted in the next month or so. They are in the Commissioner's office now. I think these things were positive.

Third, it did reaffirm the position of the FDA relatively to the coliform standard. I will state that I still feel very strongly about this issue. I have read the judge's decision and its impact on us and our total program. But thinking back, I still feel very strongly that it is still the responsibility of any agency that is either directed or elects to administer a program of this nature to undertake certain responsibilities. I also feel strongly that whatever responsibilities in a program such as this where we have criteria that are this important, it is a responsibility of that agency to periodically re-evaluate. That's all I ask for, a re-evaluation of criteria to make sure it is the absolute best we have to work with, especially where we are controlling an industry and actually the livelihood of thousands of people.

THE LIFE HISTORY OF THE AMERICAN EEL, *ANGUILLA ROSTRATA*, IN CHESAPEAKE BAY

Charles A. Wenner

The American eel, *Anguilla rostrata*, is a catadromous species which is found in estuaries along the east coast of the United States. This species is harvested commercially and forms the basis of a minor fishery with most of the catches being exported overseas.

The life cycle of the American eel is relatively complex. Adult maturing eels (termed silver eels) migrate from the Chesapeake Bay during the dark of the moon in November and December. Spawning takes place somewhere in the Sargasso Sea in the later winter-early spring. The larvae (called leptocephalus) are transported by the Gulf Stream system north. The extent of the larval period is about one year. These larvae metamorphose into glass eels which have the characteristic shape of adult eels but lack any coloration. These elvers are positively attracted to fresh water and migrate into bays and estuaries along the east coast. In the Chesapeake Bay system they enter in the late winter-early spring. After establishing residence in fresh and brackish water areas, the elvers become pigmented and start feeding and growing. The eels at this stage are called yellow eels. They reside in rivers and estuaries for about 8 to 18 years before sexual maturation and seaward migration takes place. While in fresh water eels feed on insects, molluscs and fishes and in the saltier, brackish water areas they feed on polychaetes, clams, crustaceans and fishes.

Yellow eels are fished by baited pots whereas silver (migrating, maturing eels), since they stop feeding, are harvested by pound nets on the Chesapeake Bay side of the Eastern Shore. Elvers are collected by fine mesh fyke nets and dip nets. Although some eels are eaten by certain ethnic groups in larger U.S. cities, most yellow and silver eels are exported for sale to Europe. Elvers are shipped to the Orient for aquaculture.

At present there is insufficient information for the rational management of this fishery.

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extension division
virginia polytechnic institute
and state university
blacksburg, virginia 24061