

Proceedings

Ninth Annual Sea Grant Lecture
and Symposium

Georges Bank: Fish and Fuel

Massachusetts Institute of Technology

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Ninth Annual Sea Grant Lecture
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Georges Bank: Fish and Fuel

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Massachusetts Institute of Technology

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Program

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E R Pariser
Associate Director
Education and Training
MIT Sea Grant College Program

Lecture

Ronald C Lassiter
President
Zapata Corporation

Panel Discussion

Moderator

Ira Dyer
Head, Department of Ocean Engineering
MIT

Panelists

Morris A Adelman
Professor of Economics
MIT

Douglas I Foy
Executive Director
Conservation Law Foundation

Paul M. Jacobs
Managing Partner
Basic Development Services

Don E. Kash
Chief, Conservation Division
U.S. Geological Survey

Audience Questions and Discussion

Closing Remarks

Ronald C. Lassiter



Ronald C. Lassiter has been with the Zapata Corporation for ten years. He joined Zapata in 1970 as a Senior Vice President-Corporate Development. Elected Executive Vice President in 1971, he became a Director and Chief Operating Officer of the natural resource products group in 1974. He has served as Zapata's President and Chief Operating Officer since August 1978.

Previous to his experience with Zapata, Mr. Lassiter was a Vice President of Marathon Manufacturing Company, and held a number of executive positions with divisions of Continental Oil Company.

A native of Houston, Texas, Mr. Lassiter received a BA from Rice University in 1955 and an MBA from Harvard Business School in 1964.

Zapata's diversified interests in marine industries began in 1954. After the passage of the U.S. Outer Continental Shelf Lands Act in 1953, which established a federal system for determination and assignment of offshore mineral rights, the first lease sale for the Gulf of Mexico was held. Zapata Off-Shore Company, supported by the Zapata Petroleum Corporation, an on-shore oil drilling company, was one of a few drilling contractors that, with major oil companies, was attempting to develop the technology required to move oil exploration seaward. Using an innovative design in off-shore "jack-up" rigs, Zapata Corporation's drive for development resulted in 1959 in what was then the world's deepest well, a drilled depth of 19,000 feet. Zapata has been active in the North Sea oil development since the early 1970s.

Zapata Corporation currently maintains a world-wide rig fleet of 19 units, operable in 20 to 2,000 feet of water at drilling depths of up to 25,000 feet. Zapata also maintains a 49-vessel marine service fleet.

In 1972, Zapata acquired Haynie Products of Virginia, the oldest menhaden fishing company in the United States, dating from the 19th century. The menhaden fishery began in the Chesapeake Bay area in the early 1870s, and the fish oil and meal used in soap and fertilizer were a profitable industry. Today, Zapata is the world's largest private fish meal producer, with a fleet of 39 menhaden fishing vessels. Fish meal is used in poultry feeds as well as in fertilizer, and oil is used in paints, edible oils, and cosmetics. Zapata also acquired the E.A. Holmes commercial sardine cannery which opened the first such factory in the United States in Eastport, Maine in 1876.

Zapata is committed to wise fish resource development. With fish food processing plants in Maine, Canada, and Costa Rica, Zapata's fish interests cover tuna, sardines, and pet food production. Aircraft owned by Zapata's fisheries development division are used to study the potential of various fish resources for commercial use, using a special low-light level sensing process perfected by Zapata to determine fish populations.

Morris A. Adelman



Professor Morris A. Adelman has been with MIT for over 30 years in the Department of Economics. In 1979 he was awarded the Mineral Economics Award of the American Institute of Mining, Metallurgical, and Petroleum Engineers. He has served as the court-appointed expert in a case determining the possible application of U.S. laws to the world oil monopolies, and has been with the Gas Research Institute Advisory Council since 1977. He has recently been elected as President of the International Association of Energy Economists.

Professor Adelman studied at the City College of New York and received his PhD from Harvard University. Currently with the MIT Energy Laboratory, he has continued studying all aspects of the international petroleum market and the implications of control on supply and demand.

Other advisory appointments have included eight years with the American Petroleum Institute Coordinating Committee (Statistics and Economics), and three years with the Energy Forecasting Advisory Committee of the former Federal Energy Administration. He is the coauthor of an MIT Energy Laboratory Policy Study Group paper, "Energy Self-Sufficiency: An Economic Evaluation." Professor Adelman has published, among other books, *The Supply and Price of Natural Gas*, *Alaskan Oil*, and *The World Petroleum Market*, and papers on elements of the petroleum market, such as oil import quotas, oil shortages, and studies of the politics of world oil.

Professor Adelman was on the advisory panel for the MIT Sea Grant 1973 report, *The Georges Bank Petroleum Study*. This report explored the Georges Bank regional resource development question from both economic and environmental viewpoints. The first volume deals with the real income impacts on New England as a result of the projected petroleum development, and the second volume explores the possible impacts on New England environmental quality. State and federal authorities, fisheries groups, and environmentalists have all used the report as a resource base for discussing the Georges Bank alternatives.

Douglas I. Foy



Douglas I. Foy joined the Conservation Law Foundation as staff attorney and Director of Litigation in 1975. He was appointed Executive Director in 1977.

The Conservation Law Foundation of New England, Inc. (CLF) is a multi-service organization dedicated to environmental protection of the region. Begun in 1966, CLF has argued for environmental quality before the courts, agencies, and legislatures. The organization serves in an advisory capacity to numerous boards and agencies concerned about environmental regulation. CLF is also committed to the public at large; one third of its staff attorney time is spent answering legal environmental questions for individuals, municipalities, and corporations.

Mr. Foy served with Hill and Barlow Boston for two years before joining the Conservation Law Foundation. He previously earned his BSE in engineering-physics from Princeton University in 1969 and was named a Churchill Scholar, studying at the University of Cambridge, England, for a year in geophysics and cosmology. He graduated from Harvard Law School cum laude in 1973. Since 1973, Mr. Foy has been a Lecturer and Visiting Professor at Harvard Law School and the Institute of Technology, Yale School of Forestry and Environmental Studies.

The Conservation Law Foundation was the lead environmental participant in the New England Energy Congress of 1979, which included builders, banks, govern-

ment, fuel suppliers and consumers, utilities, and environmentalists. The congress met to study energy growth and fuel supplies. In response to the Energy Congress's findings, that same year the CLF began a three-year Energy Project to plan for rational energy policies in New England based on conservation, energy efficiency, and alternative fuels.

The lead plaintiff in a coalition of fishermen, communities, municipalities, and the Commonwealth, the organization has helped bring to court the environmental questions connected with the Georges Bank development. CLF has consistently urged marine sanctuary status for Georges Bank as the best long-term multi-use management tool.

Paul M. Jacobs



Paul M. Jacobs is currently a managing partner of Basic Development Services, management consultants. He is assisting the seafood industry in resource evaluation, production, distribution, and marketing of fresh fish; advance planning for seafood corporations, and evaluating the seafood restaurants market. Mr. Jacobs has throughout his career melded innovative technology with market development to produce a competitive, quality advantage. BDS is also evaluating systems to improve the value of fish byproducts, such as upgrading fish meal and oil, and planning new directions for the seafood market.

Mr. Jacobs received his BA from Williams College and attended Harvard Law School in 1938. He was with the North Atlantic Packing Company of Maine for six years as Vice President and President, and as Executive Vice President and Director of the Gorton Corporation of Gloucester, Massachusetts, was instrumental in that company's growth. During his eighteen years with Gorton, he initiated plant inspection standards, Gorton processing plants became the first in the country to have voluntary government inspection. He developed products and acquisitions consistent with quality seafood processing and development.

As Associate Commissioner of the Massachusetts Seafood Advisory Commission for three years, and President-Chairman of the National Fisheries Institute, Washington, D.C., for two years, Mr. Jacobs

assisted industry development statewide and nationwide. In 1970 he joined H. P. Hood, Inc. as Vice President in charge of new product development, corporate development, and the formulated food division. In 1974 he was named Executive Vice President and Director of Milk Proteins, Inc.

Mr. Jacobs is on the Board of Directors of National Sea Products Company, Inc., of Tampa, Florida, and the Belmont Savings Bank of Belmont, Massachusetts. He is a Corporation Member of Boston College and a Vice President and Director of Greater Boston YMCA.

Don E. Kash



Dr. Don E. Kash was appointed Chief of the Conservation Division, United States Geological Survey (USGS) in 1978. The USGS is charged by the Secretary of the Interior to participate in selection and evaluation of offshore continental shelf (OCS) tracts for sale; approval of proposed exploration, development, and production plans; and inspection of operations to insure compliance with regulations in the development of OCS oil and gas.

Dr. Kash's career has involved energy and public policy since he received a PhD degree in political science from the University of Iowa in 1963. From 1960 to 1970 Dr. Kash held teaching posts at Texas Technology University, Arizona State University, University of Missouri, and Purdue University. Currently he is on leave of absence from the University of Oklahoma at Norman, where he served as Director of the Science and Public Policy Program and George Lynn Cross Research Professor of Political Science, with special research interests in energy policy. He has been with the University of Oklahoma since 1970.

In recent years, Dr. Kash has served on several panels at national scientific symposia and conferences, including committees of the Office of Technology Assessment, and the Assembly of Engineering of the National Academy of Sciences. He has discussed the role of federal agencies in social problems research and the operation of OCS oil and gas. He has been a co-

author of *Energy Under the Oceans: Technology Assessment of OCS Oil and Gas Operations*; *Energy Alternatives: A Comparative Analysis*; *North Sea Oil and Gas: Implications for Future U.S. Development*; and *Our Energy Future: The Role of Research, Development and Demonstration in Reaching a National Consensus on Energy Supply*, as well as more than 20 scientific and technical papers dealing with natural resources, the environment, and public policy.

Dr. Kash is a member of the American Political Science Association, the American Association for the Advancement of Science, and is on the editorial board of the *Marine Technology Society*.

Introduction

Mr. Partser

Each year, the MIT Sea Grant College Program sponsors a lecture and debate on a topic that is of general interest to the marine-oriented community. So far, we have had eight lectures in this series. Looking at the content of these past discussions, it strikes me as significant that with one or perhaps two exceptions, we have dealt almost exclusively in these lectures with problems of worldwide dimension and importance: the extraction of energy and other resources from the seas, ocean pollution, the use of the oceans as waterways, international ocean management, etc. If there exists one unique aspect that can be regarded as specific to the era in which we live, I suggest that it may be the rate of change we witness as taking place in almost every aspect of our lives. The problems and challenges we face are accelerating exponentially in magnitude; they are also coming ever closer to home. It is, therefore, most appropriate that we address, on this occasion, a topic that is both urgent and on our very doorsteps; the harvesting of energy and food resources from Georges Bank.

We are most fortunate in having as our lecturer today, on the tenth anniversary of the MIT Sea Grant Program, the president of a large corporation engaged in both of these pursuits, Ronald Lassiter.

Lecture

Mr. Lassiter

Good afternoon. I'm honored to be this year's Sea Grant Lecturer.

During the past eight years, the MIT Sea Grant College Program has performed a vital academic and public service by focusing on topical issues that affect the world's oceans. None is more important than today's topic: Whether it's reasonable to assume that the Georges Bank can produce both food and energy to meet this nation's needs. This issue is of supreme importance for two reasons:

One, because of the vast bounty of fin- and shellfish—and possibly, oil and gas—offered by the Georges Bank area.

Two, because the debate over the best utilization of the Georges Bank is a microcosm of the concerns that separate environmentalists and developers in many areas.

Much of this debate involves more fiction than function. It is more the product of misunderstanding and misinformation—on both sides—than concrete issues. When the mass media portrays meetings between environmental and energy groups, it often paints a picture of two scarred boxers circling one another warily, watching every move. Frankly, this is too often true. Neither side seems to want to take the time to understand the other's position. And that is sad. If they looked at the facts, they would find that their objectives are not mutually exclusive. I firmly believe that offshore drilling and fishing can coexist peacefully and productively. I make that statement with conviction, and my beliefs are based upon a unique perspective. I'm president of a

company that is a major offshore drilling contractor and also has extensive commercial fishing operations.

Zapata was founded in 1954 as an offshore drilling company. At that time, offshore drilling was an infant industry, struggling to develop equipment that could withstand the ocean environment. The pioneering efforts of Zapata and other companies during the past twenty five years have resulted in the development of incredibly sophisticated technology that has enabled us to responsibly tap energy resources from the oceans. Today, Zapata operates a fleet of eighteen drilling rigs—with three more under construction—which represents a total capital investment of more than 400 million dollars.

Zapata entered the fishing business in the late 1960's and early 1970's by acquiring existing menhaden fishing operations in Louisiana, Mississippi, and Virginia. Since then, our fishing interests have expanded to other species, and our operations currently stretch from the northern border of Maine to the Gulf of Mexico, as well as from the Pacific Coast of Mexico to Panama. Zapata operates a total of fifty-five fishing vessels—more than any other U.S. company. These vessels catch more than half a million tons of fish each year. Our fishing businesses represent a total capital investment of about 150 million dollars.

We are not suffering from corporate schizophrenia. Offshore oil and gas exploration and fishing are both maritime operations. They share many of the same problems and they require much of the

same knowledge and expertise. Last year, Zapata entered the U.S. food fish industry by acquiring five sardine canneries in Maine. Our major reason for doing that was to establish a base of operations for the possible future utilization of fish resources in the Georges Bank area.

We are not concerned that Georges Bank is also being considered for oil and gas development. Our experience has definitely demonstrated that the two industries are compatible. That conclusion was supported in detail by a report compiled last fall by Rice University. Called the "Offshore Ecology Investigation," the nearly 600-page document is one of the most complete studies of the effects of oil drilling and production on the coastal environment. The volume actually is a compilation of twenty-four separate studies by members of the Gulf Universities Research Consortium. Its findings can be summed up by a quote from Dr. C.H. Ward, chairman of Rice's Division of Environmental Science and Engineering, and senior editor of the report.

Dr. Ward says: "The small effects of oil drilling lie within the normal variability [of the offshore ecosystem]. Natural changes in the system over time cause greater effects than oil drilling or production."

Let me share some excerpts from the study that address common concerns—excerpts that give a flavor of the work. Addressing the concern that minor leakages could over time result in significant contamination to the marine environment, J.M. Sharp, president of the Gulf Universities Research Consortium, writes: "The cumulative effects of sublethal petroleum discharges from drilling and production appear to be insignificant when compared to other sources of contamination or disturbance."

This is not to say that the existence of offshore drilling operations is utterly without effect. The Rice study did show a significant effect of drilling platforms: In a study of biofouling communities on rigs in the Gulf of Mexico, Robert Y. George and Philip J. Thomas of the University of North Carolina's Institute of Marine Biomedical Research found that rigs serve as artificial reefs. They create an entire environment that contributes to increased sports fish populations. At various levels on a rig, you can find algae, barnacles, anemones, bivalves, bryozoa and more. Together, they form a mat of sessile animals and plants

that attracts a variety of mobile organisms including crabs and fish. George and Thomas write: "The growth attracts grazing fishes, which provide a renewable food supply for carnivorous fishes that are of recreational and commercial importance."

Writing in the December 1979 edition of *Fisheries* magazine, Ronald Dugas, Vincent Guillory and Myron Fischer reinforce this finding. They note that a body of research indicates that many fish—king mackerel and red snapper among them—are attracted to oil rigs by the presence of prey fish. Dugas, Guillory and Fischer state that the growth of the sportfishing industry in Louisiana is a direct result of the presence of so many drilling rigs. Louisiana sport fishermen today typically have their best luck fishing near rigs in the Gulf of Mexico. To quote the authors: "The evolution of the petroleum industry and the emergence of the innumerable oil platforms over the past forty years have been of great significance to the development of the offshore sport fishery."

In considering the effects of petroleum exploration and development on the fishing industry, we have to consider the situation that has occurred in the Gulf of Mexico. During the past twenty-five years, offshore drilling has grown from nothing to extremely heavy development in some areas, especially offshore Louisiana.

There are perhaps 3,100 offshore structures located off Louisiana today. During the same twenty-five year period, we have seen consistent increases in the menhaden harvest in the same area, growing from a total of 213,000 metric tons in 1955 to a peak of 820,000 metric tons in 1978. This fact is of key importance, because menhaden are a delicate species, as are shrimp and other shellfish, and depend on a clean estuarine system for survival.

Unlike sportfishing, the increase in our menhaden harvest is not related to the presence of oil rigs. A larger fleet and better fishing techniques largely account for the increased catches. But the fact remains that fishing, in general, continues to be very good in the Gulf—even in areas of heavy offshore petroleum development. To me, one would have to conclude that the presence of rigs has not been detrimental to the fishing industry.

The Gulf of Mexico is not the only area where commercial fishing has continued to flourish side-by-side with the oil industry. Look at the fish catches of recent years in

the North Sea, offshore West Africa, and even along the U.S. Pacific Coast. Fishing remains rich in all those areas, despite extensive offshore petroleum development. When there is a problem with a particular species it can generally be attributed to overfishing. No causal link to gas and oil exploration and production has ever been proven.

Clearly, an important reason that the petroleum and commercial fishing industries have been able to coexist peacefully is because both industries have matured in recent years. The oil industry has discovered that fishermen are good marine neighbors, and realizes that fish are an ocean resource just as important as oil. The oil industry has become much more careful—both of its own volition and because of regulations—to keep the ocean environment as clean as possible. On the other hand, fishermen have enjoyed many benefits from the presence of the petroleum industry. Improved ports and harbors, better vessel maintenance and repair facilities, and stronger local economies normally are by-products of petroleum development activities.

One recurring concern of the fishing industry boils down to competition for physical space in offshore areas. Many times, it is assumed that thousands of oil platforms suddenly will dot the offshore horizon, constituting a navigational hazard.

A forest of oil platforms is not going to spring up overnight on Georges Bank. It took more than forty years for the offshore Louisiana oil industry to develop the concentration of activity it has today. We are never going to see a concentration of platforms, well heads and other equipment like that on the Georges Bank. Drilling and production techniques have become increasingly sophisticated over the decades. Today, thanks to directional drilling and other techniques, many wells can be drilled and produced from a single platform.

There is also the cost factor. The engineers at Zapata Exploration Company—our oil and gas development division—informed me that a "typical" twenty-four-slot platform in the Gulf of Mexico, in 200 to 250 feet of water, costs something on the order of fifteen to twenty million dollars to build. That figure does not include the cost of drilling the wells which can run more than fifty million dollars.

Citing figures for a typical platform can be misleading because there is no such thing; each is unique. Water depth alone causes the cost of a platform to increase exponentially.

We cannot precisely estimate the cost of a production platform on the Georges Bank because we really do not know exactly what we are up against until we begin exploratory drilling. We do know the costs are going to be higher than Gulf costs because at a minimum the water is deeper and the storm intensity is greater on the Georges Bank. A platform costing in excess—possibly substantially in excess—of fifteen to twenty million dollars is not something you build a lot of. These cost constraints are strong constraints, and they will limit the development of the Georges Bank.

I cannot foresee a significant spatial problem caused by platforms and temporary rigs on the Georges Bank. My conclusion is supported by a 1976 study by the Woods Hole Oceanographic Institution entitled *Effects on Commercial Fishing of Petroleum Development Off the Northeastern United States*. The study focuses on a worst case scenario for development of Georges Bank.

In that worst case (or best case in the petroleum industry's view), the study estimates that platforms, grouped in clusters, would preempt approximately sixty-two square miles out of the 20,000 square miles of the Georges Bank. That loss of space would result in a reduction in total catch of no more than one-third of one percent—and probably much less. In the Gulf of Mexico, in the North Sea, and elsewhere, platforms and temporary mobile rigs actually aid mariners by serving as navigational aids.

Many fishermen complain that the biggest problem they have is with pipelines snagging nets and trawls. I believe this problem is more perceived than real. In many cases the actual obstruction is never really identified and the pipeline is blamed.

There is considerable evidence that a standard trawl can cross a twelve-to-fifteen-inch pipeline lying on the sea floor with no more difficulty than crossing a rocky stretch of bottom. There are thousands of miles of pipelines in the Gulf of Mexico, but comparatively few actual accidents between trawlers and pipelines. This is an area that could benefit from additional research. This might be a good topic for future Sea Grant Program attention.

Another concern voiced by fishermen and others is whether or not the drilling process clouds the water with sediments. The answer is "yes." Oil and gas exploration and development do stir up sediments and add additional mud to nearby waters. But the situation is only temporary and, to be honest, it's not really much of a problem. By any measure the mud discharge from drilling operations is only a fraction of the amount discharged into the water by natural forces, such as rivers and storms. It has been estimated that the rivers of North America alone dump nearly two billion tons of mud and other discharges into the oceans every year. To match that the oil industry would have to drill two million wells or lay 400,000 miles of pipeline a year. The Mississippi River alone carries nearly 400 million tons of mud and sediments into the Gulf of Mexico every year. This is substantially more than all the mud and sediments discharged into the Gulf by oil and gas operations since oil exploration in the area began.

The Georges Bank bottom is hardly pristine. For many years trawls and drags—especially those favored by the bottom fish, clam and scallop industries—have stirred

and restirred the mud on the Georges Bank without noticeable effect on the ecosystem.

Another related concern about the offshore petroleum and gas industry involves possible chemical pollution from the release of drilling mud into the water. Drilling mud is a man-made substance that is circulated in the drill hole to, among other things, maintain proper pressure control and remove cuttings from the hole. Most drilling mud is composed of inert materials such as barites and bentonite clay that can be released without ill effect. Other chemicals are used, however, including caustic soda, iron, chromium and sulfur. Some drilling mud also contains oils and other materials that are added as lubricants and which, if lost overboard, can cause pollution in some shellfish.

Drilling mud is not dumped wantonly into the marine environment. Quite the contrary, every effort is made to reclaim and recycle it because it is extremely expensive. An average well required some 200,000 to 300,000 dollars worth of drilling mud. When unusual pressure conditions are encountered that figure can easily run as high as one million dollars.

No recovery operation is perfect. Despite the industry's best efforts some drilling mud, together with drill tailings, are inevitably released into the ocean. The Woods Hole study finds, however, that this does not constitute a major ecological problem. To quote the report: "Effects [of drilling mud and well spoils] are very localized and would not have significant effects on fish stocks."

I have purposely saved for last the hottest issue concerned with offshore oil exploration. This is an issue so laden with emotion, prejudice and sensationalism that it is sometimes difficult to discuss objectively. I am talking, of course, about oil spills.

It is not my intention to brush aside the reality of an oil spill. At their worst, oil spills can foul beaches, kill waterfowl and make fin- and shellfish inedible. Oil spills are disasters, but they are not catastrophes of the magnitude or the frequency believed.

The record of United States offshore oil operations is truly outstanding. During the last thirty years, nearly 25,000 oil wells have been drilled in U.S. waters. We are now drilling more at the rate of 1,000 a year.

Despite this increasing level of activity, there has only been one major U.S. spill that has reached the shoreline in any significant amount during the last three decades. That was in 1969 in the Santa Barbara Channel. No permanent damage resulted from that spill.

The largest oil spill in recent years was from the now infamous *Ixtoc 1* well in Mexico's Bay of Campeche. That spill reached as far as Padre Island in southern Texas. Testimony before the United States Senate last December showed that the Campeche spill could have been avoided if modern technology had been used.

This still leaves the question of what an oil spill would do to the marine ecology of the Georges Bank. There would be an immediate localized impact that could include the killing of fish eggs and larvae and other disruption in the ecosystem in a certain area. Contrary to popular presumption, there is little proof of any long-range environmental impact due to oil spills. The Gulf of Mexico provides a historic case in point. Oil production on the coast of Louisiana in onshore and near-shore waters was totally unregulated until 1950—and offshore until the mid-1950s. In addition, tanker sinkings by enemy ships off the mouth of the Mississippi during World War II subjected the Louisiana coasts to what possibly was the greatest oil bath of any area of its size in the world. Yet Louisiana fisheries production has remained constant, and in some cases, has increased considerably.

Dr. Ward of Rice University, whom I mentioned earlier in connection with the Offshore Ecology Investigation, notes that when oil hits water, the toxic parts evapo-

rate. In a week, fifty percent will have evaporated, been degraded by bacteria, or broken down by wave action.

Recently, we were all horrified to learn that some 20,000 tons of residual fuel oil had been spilled by the *Argo Merchant* off Georges Bank. Apparently there have been no adverse effects on the fish population, according to a study presented at the 1978 Conference on the Assessment of Ecological Impact of Oil Spills. The Woods Hole report also speaks to this issue. While stating that there is not adequate evidence to demonstrate that there are no effects from oil spills, the report notes that: "The evidence does suggest, however, that the effects due to chronic pollution are not dramatic except in a very localized situation where the level of contamination is unusually high."

That opinion is supported by *The Georges Bank Petroleum Study* published here at MIT in 1973. Considering the possible effects of an oil spill on marine larvae, the report says: "It appears extremely unlikely that a single large spill will have a noticeable effect on the population of an individual species, especially in view of the fact that these species produce many more offspring than the environment can support at adulthood."

Obviously, I am not advocating unrestrained spilling of oil into the oceans, nor am I suggesting such an event is without environmental consequence. But I am suggesting that the danger is overstated. I am also suggesting that the oceans of the world have an immense and vastly underestimated capacity for regeneration. Natural processes release many times the amount of pollutants into the marine environment as offshore oil operations, yet the oceans survive without noticeable change.

A 1976 study by the National Oceanic and Atmospheric Administration states that 1.3 percent of all petroleum hydrocarbons entering the marine environment are due to offshore production. Nearly ten percent came from natural seeps. Some twenty-six percent came from river runoff. The single largest contributor of marine petroleum hydrocarbons—thirty-five percent is marine transportation. And, I should note that spills from ships and other vessels often involve refined products that tend to be more toxic and less degradable than unrefined crude oil.

Nothing I have said today is an argu-

ment for pollution. An oil spill is the very last thing an oilman wants. Oil companies make preventative measures their number one priority. And that is the way it should—and must—be.

In my remarks today I have tried, through my perspective as president of Zapata Corporation, to present a balanced view of the "fishing versus drilling" question. That balance is not perfect, and I know I have leaned in the direction of defense of offshore drilling. But that is only appropriate. We know the fishing industry is strong and sound on the Georges Bank. The oil industry is the newcomer and, as such, must prove that it can be a good neighbor.

I believe the facts show that fishing and drilling can coexist with little problem. The record of more than forty years in the Gulf of Mexico certainly bears this out. I think it is germane to point out here that that record was established without any significant regulation. I am not advocating that there be no regulation of the two industries on the Georges Bank. Today, we have a rare opportunity through enlightened legislation to establish a landmark use pattern. A pattern that will support the traditional fishing industry, yet at the same time, allow us to develop a vital energy resource.

It is almost a cliché to say that the United States is a hostage of foreign oil, yet it remains true. We must continue to develop—safely and scientifically—our nation's vast energy resources. Georges Bank holds perhaps 900 million barrels of oil and 4.4 trillion cubic feet of natural gas. It is not a question of whether this nation should develop its available energy reserves. Dire necessity makes the question not *if* but *how*.

That necessity is not an abstract national goal—nor is it an issue far removed from Georges Bank. The fishermen of the Georges Bank are as profoundly affected by the spiraling cost of marine fuel as the motorist is of gasoline. Small fishermen who operate on a tight profit margin are forced to watch helplessly as scarce supplies and high-priced, foreign imported energy push the cost of fuel even higher. We all have an interest in the development of the oil and gas potential of the Georges Bank, just as we all have an interest in the preservation and promotion of fishing on the Georges Bank.

I maintain that the two can exist as good neighbors both doing their part to meet vital national needs. We need only to have the vision and the understanding to make it a reality.

Thank you.

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Panel Discussion

Mr. Pariser

Thank you very much Mr. Lassiter for a very fascinating and provocative paper. We now come to the battle stage: Our panel discussion in which five remarkable men will participate. They are: Professor Morris Adelman of MIT, Mr. Douglas Foy of the Conservation Law Foundation, Mr. Paul Jacobs of Basic Development Services, Dr. Don Kash of the Conservation Division, U.S. Geological Survey, and Professor Ira Dyer of MIT, who is going to be the moderator. This discussion promises to be most lively and informative.

Dr. Dyer

Thank you. I feel that my job as moderator is not to be moderate, but to help create some tension. Doug Foy is known as a very eloquent spokesman for those concerned with the conservation of natural resources. Doug, I would ask you first to give your opinion of the Georges Bank controversy; where are we, where ought we to be going from your perspective?

Mr. Foy

Let me summarize my reaction to Mr. Lassiter's very interesting talk and raise a few issues for discussion. It's interesting that the study Mr. Lassiter used to document most scientific and ecological conclusions in his talk today is from the Gulf Universities Research Consortium Study (GURC), which is now being subjected to intense scientific attack by many who work outside the Gulf Universities Research Consortium. It was recently reviewed in detail by a special National Academy of Sciences panel set up to study the best available technology standards in oil and gas operations. I think it's fair to say that the panel's conclusion was that the GURC studies, of which there are more than twenty, are seriously flawed, and in many instances, simply don't meet the accepted standards of scientific research.

Let me give you an insight into what is wrong with those GURC studies before you assume that the assertions concerning the pristine quality of the Gulf of Mexico are accurate. None of those studies was subjected to peer review. In fact, they were not published in responsible scientific journals, nor reviewed by disinterested scientists outside of the institutions at which they were prepared.

The major GURC conclusions were incorporated in a twenty- or thirty-page document called the "consensus document." The most significant conclusion was that there was no appreciable difference between the test sites, where they were measuring effects of oil and gas activity, and the control sites. The control sites

were set up to monitor the differences between test activities and control. But GURC scientists concluded that between those two sites there were no differences in environmental quality and, therefore, no harm.

Well, it's interesting that those studies commenced nearly thirty-five years after oil and gas activity began in the Gulf. So even to suggest the Gulf was in a pristine state when the study began is a little ironic. But setting aside the fact that we didn't have any studies before oil and gas started in the Gulf, and therefore have no way of dealing with what effects had already occurred, the control sites were in the oil field, and, in fact, the main control site was in Timbalier Bay. That control site was surrounded by 650 oil wells. It was also directly down-current from several thousand other active wells. Many of the investigating scientists in the GURC studies questioned the validity of those control sites; their comments were eliminated from the consensus report.

More recently, scientists at Woods Hole, led by Dr. Howard Sanders, one of the leading benthic ecologists in the world, have reviewed the GURC studies in an effort to understand and assess their use and reliability. Let me quote Howard Sanders' analysis of the GURC conclusions. Dr. Sanders reviews whether the Gulf is in good ecological health and whether the studies reveal good ecological health for the areas they focused upon. He concludes that most ecologists define a healthy marine ecosystem as having sufficient oxygen, and not having oil, toxic materials, or opportunistic species. These were the standards that GURC used, and Howard Sanders accepted. He goes on to say: "None of these conditions is met in the bottom of the Timbalier Bay or offshore Louisiana. We conclude that this area is one of ecologic decrepitude."

He also goes through the control and test sites to analyze their benthic content, i.e., the bottom species present. His conclusion: "The fauna found in the benthos is about as poor in density and quality as that under the sewer of Miami. The fauna is composed of opportunists, the most notable of which is characteristic of the feces- and waste-rich Kingston Harbor in Jamaica."

I don't want to go into this in much greater detail but let me suggest that the oil industry has used the GURC studies for years to support the proposition that oil

does not damage marine ecosystems. I think it's fairly clear at this time that the GURC studies do not sustain that conclusion.

Let me go on to compare the Gulf of Mexico with Georges Bank. Much has been made of the suggestion that the location of rigs and oil facilities in the Gulf has greatly improved fishing, at least sportfishing. It is true that any artificial reef—whether it is a tire reef or an oil facility—in the ocean attracts and concentrates marine life. Sportfishing, however, is basically irrelevant to Georges Bank. We're not interested in concentrating sport species around rigs 185 miles off the coast of Massachusetts, for very few sport fishermen can even reach the area. What Georges Bank is, is a commercial fishery of enormous importance. Commercial fisheries do not require concentrations over artificial reefs; they require the capacity to trawl over large areas for great distances without having to maneuver in and out of facilities. The "concentration effect" on Georges Bank will be largely irrelevant to current fishing activity and may in fact seriously harm traditional fishing activity.

A second feature of the Gulf that does not apply to Georges Bank is that of pipelines, which are universally used to move oil off the Gulf and onto the shore. It is predicted that pipelines will not be used on Georges Bank, and that, in fact, it will be the first offshore continental shelf (OCS) frontier area in the United States to use tankers as a primary means to move oil ashore. Given the anticipated size of the field and its value, it simply isn't economical for the oil industry to build a pipeline 150 or 200 miles to the New England coast. What that means is that you will be loading tankers with crude oil on Georges Bank in February in thirty-foot seas, at ten degrees below zero. And regardless of what the oil industry says about great advancements in technology on offshore loading, no one really knows how successful that is going to be. In terms of activity, no one has the slightest idea what the chances are of those tankers colliding with the rigs, dumping oil, or incurring major damage. It's impossible to know. The comparison with the Gulf here is thus irrelevant; the Gulf doesn't use tankers.

An interesting feature about the fishery in the Gulf—the dominant fishery, which is the one Mr. Lassiter's company pursues, is for menhaden, a widely used fish that is not

processed for human food. It is referred to by fishermen as a "trash fish;" it is primarily ground up into fish meal. Menhaden is not a significant fishery on the Georges Bank. Georges Bank is roughly eighty-five percent high quality food fish that we all eat—sole, cod, and haddock.

Intriguing developments and trends in the Gulf fishery are also worth noting. The oyster yields in 1945 were 500 pounds per acre in the Gulf of Mexico. They are now fifty-seven pounds per acre, a reduction by a factor of ten in yield. The reason the fishery remains so large is that the effort expended to extract those fish has gone up enormously. The actual quantity, the actual concentration of fishery resources in the Gulf, has dropped dramatically. The shrimp catch is down from fourteen tons per boat, per day in 1950 to three tons per boat, per day in 1972. No one can tell you how much of that is attributable to oil and gas. But no one, including the oil industry, can rightly assert the fishery is healthy and unchanged over the life of that oil field. It simply isn't true.

I would like to address briefly the question of technology standards. Much has been made of the industry's elaborate capacity to deal with oil and gas operations in a frontier area; and it is true that the industry is very impressive technologically. I've had the opportunity to serve on a National Academy of Sciences panel looking at OCS technology for the past year, and it is often impressive. The industry has the abilities and technology to deal with some of the problems they encounter in frontier areas. But let me give you a few examples of where they don't have technology, because I think this is particularly relevant to the Sea Grant Program and to your interest in technological development in ocean engineering.

Chronic, continuous discharge from oil and gas operations is given. Despite what Mr. Lassiter says about industry's desire to recycle drilling fluids, tens of thousands of tons of drilling fluids are discharged into the ocean from an oil field continuously. Those drilling materials include highly toxic constituents that are used to lubricate the whole drilling system. When the muds are used up, or spent, or worn out, they are typically poured into the ocean. That is the technology applied to that system. There is no attempt to bring them ashore; there is no attempt to reprocess them and neutralize them; they are poured into the

ocean—not a particularly high quality technology

Our maximum capacity to clean up and contain spills is currently operational in five-foot seas. Georges Bank has seas that exceed five feet, fifty percent of the year. That means for half the year you won't be able to clean up anything spilled into the water.

Blowout prevention: it's interesting that the *Ixtoc* spill has generally been described as an example of Mexico's poor technology. Well, of course, that rig was an American rig; it was owned by SEDCO, a Texas company that is a defendant/intervenor in the law suit surrounding the Georges Bank lease sale. It was an American rig with American technology on it. The reason that rig failed was not the technological limitations, it was the fact that the Mexicans did not operate it properly. And, in fact, that's why most blowouts occur anywhere. It's not a function of technological failure, it's the fact that people don't do a good job. That's what happened in Mexico: it can happen on Georges Bank.

What can you do from now on? The issue is no longer, can fish and oil coexist on Georges Bank? The issue is, they must coexist. We have a lease sale; there will be oil and gas operations, we have to make those industries coexist. What can MIT and Sea Grant do to help? You can help develop technological standards that will make coexistence possible. You can deal with some problems where there appears to be no industry development to improve in clean-up or containment equipment. We need a monitoring system on Georges Bank that can effectively measure damage and effects—not what we have now, not what was done in the Gulf, but a detailed, comprehensive long-term effort to monitor impacts. And finally, we need credible and responsible scientific research on the fate and effects both of oil and drilling fluids—not what we have in the GURC study, not what you see going on in the Gulf or in many industry-sponsored studies, but studies on the effects of oil upon fish that everyone can believe and trust. Until we have those studies and until we have those programs, we simply can't be certain that the two industries can coexist. Thank you.

Dr. Dyer

We of course will get back to each of the panelists, including Doug. Among the important points in Doug's message to us is that some dreadful things might happen on Georges Bank, but then again hopefully we're saved, because down in Washington we have Don Kash in the U.S. Geological Survey. And one of Don's responsibilities is to regulate the oil industry in such a way that dreadful things are less likely to happen. Would you tell us what can be done to prevent Georges Bank from being damaged, Don?

Dr. Kash

I appreciate the opportunity to be here today for the 1980 Sea Grant Lecture. In general I find it to be more fun when I'm asked to comment on a paper or lecture if I can disagree with at least parts of the presentation. Unfortunately, I can find nothing in Mr. Lassiter's presentation to disagree with.

As he indicates, there are no instances in which man intervenes in the marine environment where there are not some impacts. There is, however, simply no credible evidence, known to me, of any serious major long-term negative impacts on fishing that result from offshore oil and gas operations. In truth, the evidence is compelling that, with the exception of on-shore oil and gas operations, offshore operations have fewer negative impacts than any other hydrocarbon production operations, e.g., coal, oil shale, tar sands, and even biomass for synfuels.

I've watched the debate about the impact of oil and gas on the marine environment, and specifically on fisheries, for about ten years. I have one really solid conclusion. The state of environmental sciences, the life sciences and the biological sciences, when looked at in systemic terms, is a new-born baby. That is, we don't have a science which offers much precision. I've listened to experts from even august institutions like MIT speak about this, and I can speak with authority on one set of facts—every time we seek advice, we get scientific disagreement. That doesn't bother me; that's exactly the way to develop a science. What I have to conclude is that debating detailed scientific studies always leaves me in a position where I cannot make decisions based on a consensus of scientific opinion.

With regard to fisheries, I can now draw one solid conclusion. That is, time after time my organization spends money and participates in conferences and I can find no convincing scientific evidence that offshore oil and gas operations have been demonstrated to have long-term negative impacts on fishing any place in the world. What I'm saying is that science doesn't really tell me. Doug comes up with one set of figures that say per boat production is less; other people cite another set of figures that total tonnage is up in the Gulf of Mexico. Someone else argues about the content of that tonnage, the quality of the seafood, the quality of the fishery. I always

find myself left more than a little puzzled. I believe the confusion comes because the debate gets skewed by arguing over the studies.

The U.S. Geological Survey funded the study, mentioned by Doug, that is reviewing the GURC findings. And he is quite correct. There is a great deal of criticism of the way in which some of those studies were done. I would also add that I have credible scientists who think the GURC studies are fine. My essential point is that you can become disconcerted by arguments about methodology, or how to construct experiments, or about the sociology of the scientific community. To try drawing conclusions from one source—even if it is a scientific study—is a very, very shaky business.

The Geological Survey exercises the government's primary regulatory responsibilities for OCS oil and gas operations. I head the Conservation Division, the component of the Survey which is its regulatory arm. Our responsibility is to ensure that a floor of high-quality performance is maintained under all OCS operations. We take this responsibility terribly seriously on Georges Bank, as we do in all areas.

So far as the Survey involvement in offshore oil and gas activities is concerned, Genesis was 1953, and the Book of Genesis was the Outer Continental Shelf Lands Act. I am going to make the assumption that there are some people here who cannot immediately recall the history of OCS oil and gas activities, or the U.S. Geological Survey's regulatory activities in this area.

Consistent with everything that is happening in our lives, initial OCS regulation by the Survey involved a small, relatively straightforward and simple program. Roughly stated, the Survey started by picking up the techniques and style of the State of Louisiana. With minor exceptions in this initial period, the regulatory system remained relatively simple and the number of Survey people devoted to OCS oil and gas regulatory activities remained small until 1969. The year 1969 is in the minds of most people a major turning point for OCS oil and gas regulation. It was the year of the Santa Barbara oil spill. Triggered by the Santa Barbara blowout, the Survey undertook a fundamental reassessment of its offshore regulatory regime. I would note that prior to that spill, roughly 8,000 wells had been drilled on the OCS, with no major polluting accidents resulting from the drilling. In the period following the Santa

Barbara spill, the Survey thoroughly revised and strengthened its safety and pollution-control requirements for OCS operations, and by June 1971 had established a set of specific regional orders tailored to address the conditions encountered in the California OCS. Additional impetus for changes occurred following the 1969 Santa Barbara incident when three other major polluting incidents occurred in the Gulf of Mexico. It was a time in which a great deal of public attention was focused on OCS, and you will recall that it was the beginning of what some people have called the "environmental decade."

The Santa Barbara event, and the pollution events immediately following, created a widely held notion that OCS oil and gas operations were particularly threatening to man's environment. As is always the case when a major event happens, a number of outsiders began to get into the ballgame and tell people how to run their business. I can speak to this with a good deal of authority because a group of people I was working with at the University of Oklahoma undertook a study of OCS oil and gas operations and produced a book that addressed some of these problems and made recommendations. Some of my colleagues at the Survey say that it is just retribution since I now find myself implementing some of those recommendations. On one point, however, my views have not changed over time, and that is that the Survey has consistently given the most serious consideration to all the external reviews of its activities, and has implemented all of the recommendations that were in fact defensive and within its power to implement. During the decade of the 1970's, the nation's handling of OCS oil and gas activities was a continuous focus of debate. In particular, Congress debated possible amendments to the OCS Lands Act for five years. In September 1978, amendments to the act finally evolved to a point where both houses of Congress could pass them and the President sign them into law.

The 1978 amendments specify much more detailed regulation on the part of the Survey than did the original Act. In truth, the amendments don't require much more than the Survey already had in its regulations, but many of the more specific regulatory requirements are now in the legislation. The drive of this legislation was to improve environmental protection, ensure a

larger role for the states, and provide greater access to the policymaking process for various interest groups. In addition, the legislation widened the range of ways in which it is possible for the Department of the Interior to make OCS lands available for oil and gas exploration and development. So far as the Survey is concerned, the year following the passage of the 1978 amendments was one of revision of our OCS regulations, and a very major revision of the various OCS orders for the different regions of the United States. We are now in the process of implementing those modified and changed regulations.

I think it is important to emphasize that one of the really impressive achievements of the Department of the Interior in the late 1970's was the reestablishment of stability in carrying out OCS lease sales. It is quite clear that this administration has been more successful in carrying out its proposed lease sales than any of the two or three previous administrations. I want to underline that part of this success results from the fact that there is now an opportunity for interested parties to participate in the OCS decision-making process.

I believe it's reasonable to hypothesize that as we look at the decade of the 80's, we will see an approach to OCS exploration which one of my colleagues has referred to as the "elephant-hunting approach." That is, acreage will be made available and the companies that acquire rights to the acreage will go out and test large structures. If in the initial few tests a substantial quantity of oil and gas is not found, the pattern will be to move on to another frontier area. This is unlikely to happen because it is the only way the nation is going to be able to develop oil and gas resources of sufficient size to have a real impact on the import problem. The Survey's resource people and many people in the industry see the potential for very large resources on both the Alaskan shelf and along the much-talked-about reef on the slope off the Atlantic shelf.

At the same time that the nation moves toward what I referred to as an "elephant-hunting policy," we are going to find we have even more stringent requirements for protecting the environment. Certainly as we move into frontier areas, there are very great concerns expressed about the adequacy of the technology, the adequacy of the procedures, and in fact, the adequacy of our regulations. In this connection, we

have recently produced a program which addresses the use of the best available and safest technologies (BAST). I am really quite enthusiastic about this program. Rather than establishing procedural and regulatory requirements that are rigid and a straightjacket, what we are seeking to do within the Survey is set up a flexible and dynamic system which will learn with the industry and which will require that industry meet strict standards. In putting together this BAST program, we were lobbied by parties with quite different views. The views of some people were that we had to establish very specific standards and requirements for each piece of hardware. Others had the view that we already had the best available and safest technologies and nothing more needed to be done. What the Survey tried to do was to come up with a program that strives to assure that we are abreast of rapidly evolving technologies. Our purpose is to enforce strict and responsible standards without becoming an impediment to the evolution of new technologies which are required if resources in these frontier areas are going to be developed in anything like a useful period of time.

Now let me suggest to you that we're also going into a number of new environments, and we're taking that pretty seriously in my organization. We've got a lot of learning to do. We generally try to insure that the industry is kind of unhappy with us because we squeeze them a little too much, and I can comment to you with certainty today that we must be succeeding since they object rather strenuously. Doug and some of his folks periodically come down and visit with us and it's not always in the best of humor. And what I have to say to you in that context is that there is, in fact, a system in place; it is a system which is an integral part of the American political, social system which requires those of us who are the responsible regulators to stay on our toes, particularly when people are concerned. We know people are concerned both about energy and the environment. We are trying to do the best job of accommodating those concerns that we know how to do.

Dr. Dyer

Don Kash talked principally from the perspective of the regulator. There is a fishing industry on Georges Bank, which Paul Jacobs can tell us about. Paul, what is the thinking of the industry, their concerns, their approach to the reality that has been presented to us, namely the two industries coexisting?

Mr. Jacobs

Professor Dyer, Mr. Lassiter, fellow panelists, ladies and gentlemen. It is an honor and pleasure for me to be present today to honor ten years of ocean development at MIT. The subject, of course, is timely and provocative. What subject could have greater impact on us here in New England than energy and seafood? My interest in this entire subject comes from a lifelong career associated with the seafood industry, its problems and its opportunities. When Ray Pariser suggested that I join your panel to present the point of view of the commercial fishing interests in discussing the controversial subject of oil drilling and the fishing industry on the Georges Bank, it was my pleasure to accept.

Our industry would have been pleased and satisfied if in its infinite wisdom the United States government had decided to ban oil drilling on Georges Bank. Now that the controversy has been waged and the tumult has died down, there is one clear fact which remains for us to live with—that is, as Mr. Lassiter suggested, *the petroleum and seafood industries must live together on the Georges Bank for the benefit of all.*

There are many risks and few trade-offs. It is now obvious to all that both New England and the United States today and tomorrow need what Georges Bank has to offer—oil and seafood.

There have been endless debates and discussions concerning the risks. I won't repeat any detail except to state emphatically that the oil companies and energy producers must—I repeat must—leave no stone unturned to prevent spills, blowouts, wastes, and errors of any kind. Petroleum activity cannot jeopardize the valuable marine resources on the Georges Bank.

I do not agree with Mr. Lassiter that the "danger of oil spills is overstated." I am suggesting that we really don't know—I suggest we ought to find out, and until we know for sure we better avoid the risks.

The oil companies must spend whatever funds are necessary to eliminate the risk of pollution or destruction. Without going into technical detail, I have been assured by competent engineers that various risks of mechanical failure at the wellhead, carelessness in disposing of pipes, equipment, and mud, can be virtually eliminated. We have been told repeatedly that where pollution from petroleum activity is concerned, technology, engineering, and the best of intentions can virtually eliminate the risks

we know today.

I would like to suggest that good intentions with technology and engineering are not enough. There must be intense and thorough education among everyone concerning *all* aspects of pollution elimination. I am talking about the same kind of care and protection as is now required for nuclear energy plants since the Three Mile Island disaster. Only with that degree of care and perseverance will the seafood industry secure the kind of protection it needs.

My basic problem as a member of the seafood industry is trying to assess the risk of what we don't know. This stems from the fact that for the most part we are deprived of tremendous amounts of biological information we need in understanding the growth and development of our seafood populations and marine life systems.

We are learning slowly how to assess marine resources, the characteristics of their spawning habits and their environment, but we know surprisingly little about some of the environmental factors which affect growth.

I have been most surprised to learn upon looking into all the major oil spills which have occurred recently that there is no authority to document conclusively any lasting damage to a resource.

In the case of the *Argo Merchant*, the wind held offshore for sufficient time to eliminate any problem. The winds in the Gulf of Mexico gyrated continuously for days until the millions of gallons of oil had been dispersed. A south wind in this case would have been lethal for the Gulf Coast.

Maybe it has been the luck of the gods, the wind, the waves, and the tides. But this isn't the type of quality of protection I am discussing here today.

Here are several suggestions I would like to make at this Ninth Annual Sea Grant Symposium:

I believe that food from the sea is going to be more important in the future than it has been in the past, perhaps as important as energy.

Presently, the seafood industry is having a struggle competing with other foods. A technologically backward industry, its challenge is to meet the consumer's expectations for fresher and higher quality seafood. Fortunately prospects for our industry seem bright because of the continuing increase in consumer demand during the past few years. Thus, our hopes for the

future seem excellent. Now it's up to the seafood industry to deliver the products—a truly prodigious undertaking involving technology, innovation, and entrepreneurship.

Meeting the demands of the marketplace has been difficult indeed for the seafood industry even under the most favorable of circumstances. Now the spectre of the unknown is a factor which must be understood.

Consider the importance to seafood consumers of headlines reading, "Poison Killing Caribbean Fish"—or "Oil Spill Threatens Gulf Shrimp Resource." When it's all said and done, perhaps the incident itself proved not to be destructive—as in the case of the Gulf disaster—but the harm was done at the inception because of what the consumer perceived as the problem. Yes, there were definite indications that shrimp sales were affected. Our fragile industry cannot take knocks like this.

Perhaps the only way to avoid all of the problems associated with oil drilling is to gain a better understanding of the entire subject. I am afraid from the point of view of knowledge of the sea, its environment, and its ecosystems, we are in the Dark Ages!

I would like to suggest now would be an ideal time for the industries and the governments involved to appropriate substantial research funds so that we may all know more about what is happening on the Georges Bank and, in fact, wherever oil drilling and fishing must coexist. To my knowledge, there is no reliable information available on the effect of oil spills on the eating quality of fish or seafood. How does oil affect fish flesh and its life cycle? Why shouldn't there be rigidly controlled experiments to measure the effects of various spill conditions on the actual flavor of fish?

I have a conviction that there is a need for attitudes of both government and oil interests to reinforce the need to better understand the effects of oil on our marine resources.

Secondly, I question whether the government has gone far enough in protecting the interests of the fishing industry. Although I don't pretend to understand all the regulations now in existence in this area, I am quite sure our government has no regulations comparable to those of the Norwegian government, which has many regulations to protect its fishing against the harmful consequences of petroleum activity on its Norwegian continental shelf.

The Norwegian government, in addition to heavy stringent regulations concerning drilling, pollution, and handling of wastes, has created a plan whereby the fishermen are compensated by the state for damage to gear, vessels, and lost catch. I believe that our National Marine Fisheries Service covers these contingencies through the Fisheries Contingency Fund.

In Norway, it is anticipated that there will be additional compensation for lost time fishing and bringing waste ashore.

Most important, the authorities in Norway have decided to grant thirty-five million new kroner yearly—over seven million dollars—to the fishermen's organizations as general compensation for harm the petroleum industry creates for the fishermen. The amount is not meant to be used to compensate each single fisherman, but will be used for the benefit of the fisheries as a whole.

You can see that in Norway their fishing industry is important.

I am suggesting that our marine resources and our fishing industry on the Georges Bank are important, too. I am further suggesting that the petroleum industry and the government should recognize that fact with actions of a more impressive nature.

Our nation and its industries have progressed by putting technology, research, and imagination to work. Here is an opportunity to do just that again!

The Georges Bank is a rich reserve of energy, food, and opportunity. It seems to me that there can be a great contribution made to the economy and welfare of all those interested in Georges Bank and all the lives it affects if the leaders of the oil industry, the seafood industry, and the government will sit down together for the purpose of leaving no stone unturned in protecting the marine resources of Georges Bank. This will involve using the wealth of the petroleum industry, the creativeness of both industries and the power and resources of the government to protect the future interests of consumers of both energy and seafood.

Dr. Dyer

Paul Jacobs presents in part a model of the Norwegian system, in which one might say the oil companies provide a kind of subsidy to the fishing industry, which also resembles subsidies the oil industry gives to the science industry. Paul Jacobs has implied that he would prefer a fault-free system on Georges Bank, and all costs should be directed towards providing a fault-free system. At some point, economics become an important consideration. My esteemed colleague, Morris Adelman, may shed some light on this.

Dr. Adelman

If the problem is to be the environmental impact of petroleum operations on fish life, mine is an amateur's contribution or viewpoint. I remember being told that a reservoir engineer is one who takes a limited number of facts, adds numerous assumptions, and emerges with an unlimited number of conclusions. That made me feel right at home.

But the problems faced here are often quite typical of the kinds of problems that you give to students. You figure that the exercise is good for them, and they might just possibly come up with an answer. If asked about the decline of fishing catch per boat in the Gulf of Mexico or on Georges Bank, I would respond that this is due to the high price of the product—which spurs great efforts to get everything you can from the resource. And this runs right into our old friend, diminishing returns. It takes more and more to get the same amount of fish, and more and more boats; therefore, the catch per boat goes down. Now if you asked had all other things really been equal, they plainly were not: there was large-scale oil and gas development in the fishing area. Well, that's the question you leave for the next student or the next research project. But in the real world when there is this much disagreement and there is this much room to wonder about what's actually happening, then, of course, the decision is often made on the basis of predilections that have little to do with the facts.

I find it easier to agree with Mr. Lassiter because of the 1973 MIT study group, of which I was a member. We were approached by the sponsors, who were federally funded regional groups, to do the engineering and economics of Georges Bank development. We in turn, asked to add the environmental analysis. The sponsors were reluctant. We swore that our colleagues in the life sciences were honest, upright scientists who would tell it as it is. But my private opinion is that we received the environmental grant because they could not find any other group capable of doing it.

I agree with the lecturer that experience shows there is small danger of injury to marine life because of oil and gas development. But what people fear is the very small risk of a big disaster. It is similar to the dispute over nuclear power. Three Mile Island shocked people because they be-

lieved it was a narrow escape. And they did not believe what they were told, and apparently still don't.

It may be that the small number of accidents in the North Sea might be due to the fact that for economic reasons you have a very small number of drilling platforms. Where you have great depth of water by offshore Louisiana standards, and where you have stringent, harsh environmental conditions, it's necessary to build very big platforms, and the possibility of control becomes a great deal improved. But even under the best of circumstances, we're not out of those woods, to mix metaphors a bit, because then you may have a danger, not of many small leaks, but of the big accident—small risk of a big disaster, which, of course, is very similar to the dispute over nuclear power.

Now the *Ixtoc 1* well in the Gulf of Mexico is I think an example of that. It was being operated in a professional way, but it was not really at the discretion of the people running the rig to make assumptions about the kind of pressures they would encounter, aside from possibly cutting corners. I can't be certain about that analysis, but some people have their suspicions that it was all too easy to assume that pressures offshore would be very similar to pressures onshore. The decision made turned out to be the miscalculation of the year. And it's the small probability of these big events that frightens people, at least as much as systematic dribbling of oil or other substances into the environment.

If you try to take account of these things and work up some kind of a cost calculus, you have to look at the benefits, and these are, if anything, more difficult to calculate. We've heard some estimate of what may lie underneath Georges Bank, and in my opinion, numbers like this do not deserve citation. They are a "best guess," best not used except for the one purpose for which oil companies use them: To make the decision to drill or not to drill. But to talk about 900 million barrels or 4.4 trillion cubic feet is simply to fool ourselves with this delusive precision. There may be nothing at all out there, and there may be a great deal. But we have to make up our minds that we really are working in the dark. The value to the national economy is the price or the sales value minus the cost; minus the cost of employing people like Don Kash to preserve the environment. And that, I might add, is money well spent.

The current lease bonus system is quite an efficient method of extracting the great bulk of the net value of a resource and putting it into the U.S. Treasury, an appropriate place from my point of view.

One last remark about shipping the oil, which may indeed be a bigger problem than producing it. That problem is in inverse proportion to the size of the discovery. If the discovery is big enough, then of course it pays to build a pipeline. If it is not, then you will have ocean loading as you've had in the North Sea under more stringent conditions and so far without incident. Yet we've had an accident that everybody knows about in these parts, and the question is, why? The *Argo Merchant* was perfectly well-known as a disreputable "rust bucket." What earthly business did they have being in U.S. coastal waters or indeed any kind of coastal waters? That was a predictable disaster which caught everybody by surprise. Furthermore, my impression is that even the follow-up—the analysis, the reporting—was done rather belatedly and incompletely. And that incident provides a good illustration of how to undermine confidence by not doing what can be done, using the current tools of knowledge.

Dr. Dyer

Mr. Lassiter, I have the impression the panelists have treated you kindly. None the less, you may wish to say something in response to their comments.

Mr. Lassiter

I wouldn't attempt to pass judgment on the work done by the Gulf Consortium study group because I'm not a scientist. I'm not sure, quite frankly, that an attorney like Mr. Foy is able to either. None of the studies that I used were intended to be proof positive, but were simply intended to give you some indication of how people had looked at oil and its effects on the environment. Like Dr. Kash, I can find someone in these United States who will take violent issue with any study, including the MIT report on Georges Bank. So I'll just comment on the Gulf Consortium study group. The universities involved are all well-known and reputable.

Let's address the question of boat statistics, because the comments we got were totally misleading. There are essentially two types of fishing fleets in the Gulf of Mexico, one is the shrimp fleet and the other fishes for either food fish or "trash fish." It has been estimated that there are between 2,000 and 2,500 commercial shrimp boats, and these boats only fish for shrimp—they're not outfitted or configured to do anything else. Shrimp is a high-priced product. In the last decade, the price has probably gone up on a wholesale basis from about two dollars a pound to four dollars a pound, depending on the grade. If you take that price, and convert it into a per ton basis, you begin to understand why there would be so many boats, and why they would be so small, from twenty and thirty feet long. So any set of statistics trying to compare fish catch demographics from the Gulf of Mexico to the northeast fishery (also referred to as the northwest Atlantic fishery) is misleading, unless you remove those shrimp boats from consideration. If you take the shrimp boats out, you actually find that the average catch per vessel in the Gulf is much larger than the average catch per vessel in the northeast fishery.

In fact, one of the real problems that we as a participant in that business are confronting is that we have about 950 boats in the northeast area. Of that group, fifty-seven percent, or 550 of those boats have a maximum sixty-ton carrying capacity. About 225 of those boats have a carrying capacity of 60 to 150 tons, that's another twenty-three percent, and that simply means that eighty percent of the entire fleet in the northeast has a carrying capacity of 125 tons or less. Now that may not seem significant, until you consider the

financially precarious situation the northeast fisherman finds himself in today. One of the obvious reasons is fuel, but more importantly the fish catch in the northeast, as it is in all the United States, is controlled by some form of quota system. The fisheries councils, which are essentially political bodies, set the quotas. They have established a level of catch per class of boat, per trip. Unfortunately this has the effect of reversing the economics; it has reversed the lower cost per unit effort that you would expect from bigger boats. The bigger boats simply aren't given a quota large enough to make an economic trip, so that the smaller boats are actually doing better. However, let me also point out the vast preponderance of the fish caught in the northeast last year were caught within three miles of the beach. Of the 321,000 metric tons of fish landed in the northeast last year, about 123,000 to 124,000 tons, as I recall, were caught in this nearshore region. That says, not only is there a large, healthy inshore fish resource, but the fuel costs and the quota system working together now preclude the fishermen from going to the Georges Bank. And in fact, of the 321,000 tons landed in U.S. ports, only 91,000 tons were actually caught on the Bank. I cite these statistics to point out the plight of the fishing industry, and the fact that, as Paul Jacobs mentioned, they do need help.

As far as the comment that the discoveries of crude oil on the Georges Bank would be tankered to the beach, I'd like to see the basis of that study. I think you would have to quantify such a prediction, because how the oil is transported obviously depends on the size of the reservoirs found. Clearly, pipelines are certainly preferable to tankers for transporting oil. In the North Sea, where most heavy water technology has been developed and perfected, the sea-state conditions are infinitely worse than on Georges Bank. For example, one of the big Zapata rigs worked in the North Sea for some time. One winter it actually measured a wave that was seventy feet high. The Norwegian specifications and criteria for rig design require the rig to withstand the "wave of a century," and the "wave of a century" is defined as one hundred feet. So anything we see on Georges Bank is likely to be substantially less taxing to the technology and to the experience of the industry than what we have experienced in the North Sea.

Audience Questions and Discussion

Dr. Dyer

I'd like to open the discussion to include any and all members in the auditorium.

Question

Is there regulation to deal with platforms that are no longer serviceable?

Dr. Kash

Yes. When production is finished or when a platform is no longer needed, the company must take it down below the sea floor level and move it to shore. In one form or another, every year roughly one hundred platforms, both small single wells and larger ones, are taken down in the Gulf of Mexico. It's costly, but it's easy.

Mr. Lassiter

Could I add something to that? Not only do we have to take down those used for production, but we also have to take down those that were sunk. Unfortunately, Zapata has had a few rigs go down in hurricanes. In one particular case five years ago, we lost one off Cameron, Louisiana. It went down in about 150 feet of water with part of the rig still standing on its side. We literally had to blow the rig apart and haul it off piece by piece. Those were the regulations we had to follow.

Question

To any member of the panel. What are the exact estimates of oil and gas deposits on Georges Bank? What is that dollar value, and what are the annual fish landings and their dollar value?

Mr. Foy

I can answer the question about fish, though I would have to look at some records to confirm exact numbers. At last count, Georges Bank landings were 225 million pounds of fish per year. The industry (direct fishing, not including processing) was last reckoned to be worth about 250 million or 300 million dollars a year. The New England Fishery Management Council and the National Oceanic and Atmospheric Administration (NOAA) estimate the size of that fishery can probably grow about four-fold in renewable yield, which would mean that it would yield somewhere in the range of a billion pounds of fish a year. If it were managed properly, it's estimated that annual worth would be two billion dollars.

The most probable large find from lease sale forty-two (U.S. Geological Survey estimate) was predicted to be 500 million barrels. There is also a reasonable probability that there will be nothing there. To give you a little perspective, a 500 million barrel oil field, if developed, will produce about sixty thousand barrels of oil a day. The United States currently consumes roughly twenty million barrels of oil a day. The figures you heard during the Georges Bank litigations estimating a supply four or five days consumption are fairly accurate. That means Georges Bank is a fairly insignificant field in terms of size.

Dr. Dyer

Come, come Mr. Foy, why don't you quote the fishery on a fraction of the amount of protein consumed?

Mr. Foy

Now that's an interesting question. I'm glad you raised that, though we are really going over lost ground, because we do have a lease sale on Georges Bank. There are a number of things to keep in mind about the fishery, however. It accounts for seventeen percent of the food fish in the United States annually. That's a pretty big figure. It's certainly more than the oil will account for in terms of energy consumption. It's an interesting trade-off. Mr. Jacobs suggested we might eventually conclude that food is more important than energy. I have already come to that conclusion. And in fact, I would submit that food is a primary resource, and that energy is not.

The wonderful thing about the Georges Bank fishery is that it's essentially free, in terms of production costs. It also requires very little energy investment. You don't have to fertilize, you don't have to cultivate, you don't have to do anything except take care of it, and harvest it. It is an extremely cheap form of food protein, in fact far cheaper in terms of energy consumed than any other form of agricultural production in the United States other than growing soybeans. And by orders of magnitude, cheaper than growing beef, or any other meat product. I would submit that if by numbers alone you were trying to decide which resource is worth more to the country, there is no comparison—the fish are worth a great deal more in net contribution to the economy and the needs of the country. That is not really an issue now, however; the question is, how can you have them both?

Dr. Adelman

I think I would have to take strong exception to what Mr. Foy just said about the economic value of Georges Bank. I didn't quite believe my ears, but I fear I must. Nothing is free if you have to devote effort and capital to bringing it in in such a form that it can be put to use. You can also say that oil is free because the Lord put it there for his inscrutable reasons x-million years ago. Nobody would take such an argument seriously in any other form. If, for example, the oil is there and there really are 500 million barrels, then you can put some kind of approximate dollar figure on that. You can say that the net value of all labor or capital applied to the reserves being sold today is worth roughly ten dollars a barrel. If so, the discovery, if it came about, would be worth

about five billion dollars. I could not follow the discussion on the net value of the catch, so I can't compare it with anything.

Mr. Foy

Professor Adelman, let me see if I can explain the calculation for catch value. I said it has been estimated the fishery could produce a billion pounds of fish a year, at a worth of about two billion dollars a year. If you take your twenty-year lifetime in the oil field, you get five billion dollars for oil value. If you take twenty years of fish at two billion dollars a year, what do you get?

Dr. Adelman

You get an improper comparison. The value of the oil is not of all costs, future receipts discounted to the present. The asserted value of the fish is before subtraction of the costs of catching and distribution, and furthermore it is undiscounted. There is no bases for comparison.

Mr. Foy

I get forty billion dollars which I think compares reasonably favorably to five billion dollars worth of oil. Let me respond to another point. The figure cited for food fish production from Georges Bank is supermarket value. Except for soybean protein sold over the counter in the supermarket, there is no cheaper form of protein in the United States than food fish from Georges Bank, and no protein that consumes less energy in production.

Question

In the debate on Georges Bank, there has been a great deal of discussion about oil spills and oil transport by pipeline, but there is a body of opinion that it is more likely natural gas, rather than oil, will be found. Dr. Kash or Mr. Lassiter, what is the difference in impact between oil and gas production?

Mr. Lassiter

Well, Dr. Kash is the expert, but let me simply say that in my view, the discovery of gas substantially reduces environmental problems. Generally speaking, the biggest danger in gas is simply drilling it and handling it. I think overall gas is considered to be far less dangerous and more ecologically sound to produce than crude oil.

Dr. Kash

Well, if all you produce is gas, you can't

have an oil spill, but if you are concerned about other impacts, the production processes are the same. You have to put the rigs in place and you use drill muds. Gas frequently produces, or has produced with it, liquids that if released into the environment are not risk free. There is a social judgment involved here, which requires trade-offs. I go back to emphasize the point that has been made earlier; first, there is no conclusive evidence that oil spills have had any long-term detrimental impact on fishery production. That at least is my conclusion. I am not an expert, but I have read more of these studies than most of you could tolerate, and the evidence does not show damage to fisheries.

There are two or three other things I'd like to comment on. There was a question about the worth of resources. The Geological Survey estimates a field's potential in three ways. There is a five percent chance that there is a lot of oil, there is ninety-five percent chance that there is a small amount of oil, there is a fifty percent chance that there is something in between. But it's fairly important to underline that in truth, we don't know whether there are substantial quantities of oil and gas until we drill. My colleagues repeatedly emphasize that they use a methodology and a complex set of calculations which cannot be absolutely precise to *estimate* whether there is oil. I have economic reason for raising this point. The question of how you transport oil or gas is in the end an economic question. That is, can you pay to lay a pipeline? If you have enough oil and gas, it is so much cheaper to pump it through a pipeline than it is to use ships. When one tries to do an environmental impact study in advance, I want to emphasize to you that we must use the best professional judgment we have available, underline that *professional judgment*.

For the final point I want to make, I'll put my regulator's hat back on to say that I believe in the marrow of my bones, that across the board we are making decisions in a condition of ignorance. We start by making decisions to lease when we don't know whether there's any producible oil or gas out there. This is a risk judgment. Part of being in a society is to make those judgments. In another area, we don't play probability games in the Survey. The rule, the standard, the objective, the requirement is that there not be any spills. Period. Now, the only difficulty I have is that I

honestly don't know how to get perfection out of people like you. But don't make any mistakes about it; we don't calculate for 0.9257 spills. We do the best we can with what we know to insure that there are few spills with minimal impact. My father was a small-town guy in Iowa, and he would have considered that to be common sense, and I think that is the standard that ought to be applied.

Question

I'm wondering, sir, if the environmentalists, represented today by Mr. Foy, have indeed considered the ramifications of their case in terms of overall society or whether, in fact, they are going after a gut feeling, defending a gut feeling, and then looking for data which support those feelings, and as a result getting away from any kind of scientific approach and making it a largely emotional one.

Mr. Foy

I'll try to answer your question from our point of view. You have suggested that environmental and fishing industry people have used an emotional approach that either attempts to or does, in fact, cloud the issues, and the kind of trade-offs we've got to make. I would suggest to you all, if you share his view, that you listen more carefully, and not use your stereotypical view of what environmental or fishing people, or anyone else for that matter, including the oil industry, brings to these debates. It might surprise you that the position my organization has taken from the very start of this fight, which was five years ago, is one of not opposing oil and gas activity on Georges Bank. A number of the fishing industry members probably do oppose it, and would much prefer to see the oil just go away, but the position we've taken in litigation and argued for from the start is that we are not opposed to oil and gas, we are in favor of having the oil industry coexist with others on Georges Bank. But we think you need to create a system that is workable and we believe there are extremely difficult problems that require careful, hard attention. I am discouraged and disturbed that generally people don't listen carefully to opposing arguments and instead attribute emotionalism to the dissenter.

For instance, when I questioned scientific evidence used in the GURC studies, that was not an emotional response, it was

an inquiry. What we are all asking is, how do you create a system that is workable, given the kind of risks, given the kind of problems that actually will be faced on Georges Bank, and given the value of the resource? Of course you're not going to wipe out the whole fishery in exchange for 500 million barrels of oil. That is not a feasible possibility. You may seriously damage it or you may not. The interesting kind of trade-offs that are made, though, are often simply ignored in exchange or in preference for a "let's just go ahead and we'll do it the way we've always done it."

Let me give you a few examples. There has been much said about tankering as the alternative transportation system on Georges Bank. Think about what that means. Tankering, I think everyone including Mr. Lassiter would probably agree, is not the preferred means of moving oil to the shore given the alternative of building a pipeline. It's dirtier, it's messier, it presents serious problems, particularly in the deep ocean in winter. On Georges Bank, as the field gets smaller and therefore less important as a major energy source, the potential for using tankers will rise. Therefore, the smaller the field, the greater the risks from transportation activity.

Early on in the Georges Bank debate we suggested a requirement for pipelines. The resource is too valuable as a fishery to use anything less than the best transportation technology. We said if you can't afford to build a pipeline, it's not worth developing the field. That was rejected by the government. There are a number of examples of that kind of inquiry which we felt pragmatically had to be considered before making a fundamental commitment to develop Georges Bank.

Question

Would somebody on the panel like to discuss in more general terms, the deep issue that we have—a crisis of confidence in some leadership, in some professions in this country?

Mr. Jacobs

I'll take a crack at that. I think that someone today made a statement that I'd like to build on, that is, please don't forget that both energy and food are important to us all, particularly those of us who live in New England. That is a given. We in the seafood industry have been remiss in not using many of the available technical resources

at MIT and other universities. I think that all of us who are concerned with this issue, as I stated in my prepared remarks, have been guilty of not doing enough homework. As far as the young people here today and the problem of confidence, I would look at these areas that we're discussing today as the land of opportunity. Many of us won't be around here when some of these issues are coming to the fore. And I think that marine research offers some of the greatest opportunities.

Question

Mr. Foy, I was enormously surprised to hear that the fish on Georges Bank provide the second cheapest food produced in this country. I buy fish regularly and it is very expensive. Is the final market price not part of the economics of the fish?

Mr. Foy

What do you usually buy?

Question

Whatever is there.

Mr. Foy

Right. Well, most people usually buy cod or haddock or sole, and the price of those fish is quite high. A large portion of the catch on Georges Bank includes things that most of us don't buy: squid, dogfish, ratfish, all those fish people are trying to rename. And, in fact, when you take all those together and you combine the catch, that's what the figures indicated. I didn't do the calculations, some scientists at the Marine Biological Laboratory in Woods Hole did.

Question

I work for a company that provides services to both the fishing industry and to offshore oil in Halifax, Nova Scotia. And I would like to comment. When the speakers first started, I was concerned that they seemed to take a very parochial view, limiting comparisons to the Gulf of Mexico and the Georges Bank fisheries, which have two systems in different stages of offshore development. Eventually, however, the panel was gotten to the North Sea and the Grand Banks off Newfoundland.

The North Sea, historically, is a very productive fishing ground. As such things go, there is an excellent fisheries scientific data base available for the area. It is my hope that if it is possible to do definitive analyses any place on potential long-term

effects of oil on commercial fisheries, it might be in the North Sea. However, we also know the many problems there are in interpreting effects on fisheries because they're not looking just at oil impacts. I suggest the United States also watch the Hibernia field off the Grand Banks. We are probably four to five years ahead of Georges Bank in development. Because of similarities, there will be specific instances where some questions may be answered either out of the European system or out of the Canadian one. As a final note, while pipelining will be considered as one of the alternatives in oil recovery from the Grand Banks, the chances are very good that because of the iceberg scour problem, the preferred option will be tanker transport.

Mr. Lassiter

Obviously I agree that over a time, we certainly should monitor what happens in the Grand Banks off Newfoundland as well as in the North Sea, but in the history of the offshore drilling business, there have been about thirty thousand wells drilled offshore in the world, and of those, twenty-five thousand have been drilled in the Gulf of Mexico. So between eighty and eighty-five percent of all the wells ever drilled offshore have been drilled off the U.S. coast. The rest of the world is virgin drilling territory.

Dr. Kesh

Yes, but compared to the rest of the world, the Gulf of Mexico is a very nice place, it's warm and quiet, except when hurricanes come through. It does have some slumping problems, however, as you well know, much technology is being developed in adverse environments -- deep water, the North Sea, Southeast Asia. I agree with the questioner that it is terribly important to monitor and understand as much as we can. We in the Survey have rather continuous contact with both the United Kingdom and Norway specifically, and also with the Southeast Asian nations, in a very self-conscious effort to stay abreast of what is going on.

Question

I'd like to ask Mr. Lassiter and Mr. Foy a question. The controversy surrounding oil and gas exploration on Georges Bank has certainly gone on for a number of years and I suspect that those people who feel there should not be oil development on Georges Bank will feel that way for quite a

while. I think that in the discussion today a number of panelists made clear that there is so much uncertainty surrounding the whole decision-making system and how oil and gas development might affect the Georges Bank ecosystem over the long term. Mr. Lassiter, wearing your oil industry hat, what do you feel the oil industry will bring to bear on its exploratory activities on Georges Bank? Mr. Foy, the same question, what will happen now that we will have exploration on the Georges Bank, how will the environmental community work on that issue?

Mr. Lassiter

The limits or risks of drilling on Georges Bank today are substantially less than they would have been at the time the North Sea drilling was commenced. The North Sea is quite a different body, but the turbulent winters, the abominable winds and weather conditions, have taught us an awful lot about rig stability, rig design, the handling of the pipe, barges, and all the equipment used for production. It has taken us twenty-five years to get to the current state of technology, and I suspect that ten or fifteen or twenty years from now the technology will be substantially more sophisticated than at present. But, it is still a question of designing an operation that fits a given environment. And because of the North Sea coming before, this particular environment fortunately will not demand leading-edge technology. That isn't to say that Georges Bank is not unique, clearly it is. It has got some peculiarities that have to be addressed, but I think that if anyone from a major oil company were to attempt to answer the question, all they could tell you would be they will use the best technology available.

Mr. Foy

I think the environmental and fishing communities will need to involve themselves in standards that are applied to water pollution discharge permits, to be issued for all rigs. I think that all the people in this room are really responsible for helping to develop better technologies, whether it's blowout prevention, transportation systems, or clean-up technology. Fundamentally, there has to be a careful scientific program applied to Georges Bank that will help define the extent of damage, if there is any, and will help monitor and regulate the kind of discharges that occur. That is where I see our investment of time.

Question

Dr. Kash: You mentioned, and from my reading it's very obvious, that there is a large gap in our knowledge of how the fish that we harvest get to Georges Bank. Maybe they're born there, we don't know where they come from, we don't know their full life cycle. Has the Department of the Interior made any plans to do some major funding in basic biological research? Getting this kind of data in the past has been one of the problems. National Science Foundation funds for biological research at this level have completely dried up. Are there any plans afoot anywhere in the government to fund this kind of research?

Dr. Kash

I sure hate to give a bureaucrat's response, but I haven't got any choice. You know that the federal government divides up its functions and the Department of the Interior is not the agency with responsibility nor could it get approval from the Office of Management and Budget to fund biological research. That is an activity that takes place within the Department of Commerce, within the National Marine Fisheries Service. The upshot of that is that I cannot provide you with an answer. Paul, you might know something about it, because you feel very strongly that there is a great need for additional research of that kind.

Mr. Jacobs

The National Marine Fisheries Service does know something about the fishery on Georges Bank. They know the spawning habits and seasonality of many stocks. My knowledge, however, stops there, except that I do know that there is a lot more research that needs to be done as to the effects of the co-mingling of oil and fish. I think that Doug's information on future projections is pretty sound. The Woods Hole Oceanographic Institution has assessments of the resource.

Dr. Dyer

I would like to interpolate that, in my opinion, based on observations around the world, this country for all its scientific strengths really lags far behind many other nations in better understanding the nature and habit of fish species. I wish we could do more. I think it would pay off.

Question

I would like to make a couple of general comments. I would like Mr. Lassiter to

address. I would strongly urge the MIT Sea Grant Program to put more research effort toward all the unknowns in environmental and biological research. I also believe that industry has a responsibility to support research that protects the environment. I work in the marine sciences on fish stocks and understand that while Georges Bank is a resilient entity, as the *Argo Merchant* has shown, people aren't able to really address long-term effects quantitatively. Even aside from oil, the stocks themselves are fragile. I'll give you an example of haddock on Georges Bank. In recent years the haddock stocks were resting on a one-year class. If any perturbation had occurred, it could have annihilated that species or its ability to be a productive species on Georges Bank. We need to incorporate this kind of awareness into contingency plans when we think about disturbing the ecosystem. Oil alone is not going to wipe out a haddock fishery, but together oil, extensive fishing, and other perturbations may. So we need to include an analysis of cumulative effects into a research plan.

Mr. Lassiter

On the general subject of research, let me simply point out that on this earth, the ocean is one of our very last frontiers. We still have very limited capabilities to operate in deep water. There is a practical limit now of how far or how deep we can drill. We haven't begun to look at deep water because of economics and the absence of technology. Clearly, we need all the research and development help we can get. We need it from the universities, we need it from the government, and we have to spend money ourselves to improve the state of the art. As an operating company, it's to our competitive advantage to be on the leading edge of the technology. It's clearly in our best interest to establish technical leadership and stay in the forefront. But a company of Zapata's size, in gross assets, doesn't have the capability to do all of that we'd like to do, so we're obviously dependent on the U.S. university system and on the government.

As far as fish stock research work on the Georges Bank, you may or may not know that one and two years ago Zapata invested a great deal of money in Maine with the long-term objective of building a viable fishing and fish processing operation on the Bank. We're in the second year of that plan now, and we need more biological

information about the state of the resource. For the last two or three months, one of the Zapata night-flying remote sensing aircraft has been taking photographs and videotape of fish bioluminescence in the sea. We have been looking for Georges Bank herring, which unfortunately we haven't found. We don't know whether that is a temporary or a weather-related condition, but we are actively trying to gather a data base on that resource so that ultimately we can design and build a fishing fleet that's optimum for the Bank.

Closing Remarks

Dr. Dyer

I think it appropriate at this stage to invite each of the panelists and the main speaker to make a final comment.

Dr. Adelman

The opposition to any Georges Bank development has been mistaken, but useful. The chances of serious pollution are now very much less because of the long and often acrimonious controversy over it.

On the economic value of oil and gas versus fish, let's make a rudimentary comparison. A dollar of net revenue received for twenty-five years, discounting at a low interest rate of five percent, real, i.e., independent of inflation, is worth 16.25 dollars in the present. Does the fishing industry earn as much as twenty-five cents of net profit per pound of fish? I doubt it, but let's assume that number, in order to make some allowance for the higher value of a pound of fish if some of the catch is destroyed. Then a billion pounds of fish harvested per year for twenty-five years are worth a little over four billion dollars, total, compared with the five billion I mentioned for oil. But remember how speculative is the oil or gas value. Hence, I was and am reluctant to make any such comparisons, but at least they ought not to be grossly illogical. If they are done at all they should be done right.

Mr. Foy

I gather from earlier discussions today that the MIT Sea Grant Program has focused on ocean engineering. It seems to me that whereas the debate surrounding Georges

Bank in the past four or five years focused on the kind of biological questions and resource impacts that we have been talking about, we are now going into an entirely different phase. We are entering a phase when the standards, applications and improvement of technology are becoming absolutely critical to the whole question of coexistence. There is no question in my mind that we are now at the point when MIT Sea Grant can have a significant impact on where we go from here. The kinds of resources in the Program and at MIT could be brought to bear in a very substantial and effective way on how Georges Bank and the management system evolve over the course of the next five, ten, or twenty years—through the life of that oil field. I certainly encourage you to try to come out into that public debate and be participants in the development of those technological standards.

Mr. Jacobs

I would like to say I have a deep conviction that one of the great growth industries of the next two decades, and probably the first part of the twenty-first century, is the seafood industry. I urge any young people here to look for potential careers in that area. I do think we need a lot of help. We need help from the universities, from Sea Grant programs, from anybody, including the oil industry.

Dr. Kash

I'd like to pick up a point that Doug Foy was making. I have been an observer or a partic-

important in one way or another in off-shore continental shelf oil and gas activities for about a decade now. And I really think it's important to underline that the debate on this issue has undergone a substantial evolution. Without drawing any value conclusions, it seems to me the debate in the United States and around the world is, in fact, a debate over how to develop ocean mineral resources. There are still substantial differences about the rate and requirements, how much we should know, but the major participants now are talking about how to work at sea. There is a consensus that oil and fish are, or can be made to be, compatible. That is substantial evolution over the last decade and ought to lead to one valuable conclusion: that you can be disenchanted with the processes that we have in society, but in fact we are making progress in an area where there has been a great deal of argument and uncertainty. I am in a position to comment with regard to the fishing, environmental and oil interests. The debate now is one of insuring that operations be carried out as carefully and as compatibly as possible. And, I am convinced that the process will evolve to the satisfaction of most people.

Mr. Lesalter

The theme of my lecture was compatibility. I didn't suggest it was going to be easy, and I didn't suggest it was going to be inexpensive; it's going to be neither. Nor did I suggest we had all the answers about oil exploration in the ocean of the future. We don't. I do think that it's going to take active cooperation of the people on the fishing and the environmental sides, as well as the oil and oil service industries. I feel much like Paul Jacobs: We have to keep in mind a potentially very large market for the United States that could help our balance of payments, by simply converting the total U.S. fish catch tonnage from foreign to U.S. boats. My company would not have set into motion a major project in New England, had six hundred people up in Maine working on that project, unless we sincerely believed that there were grounds for compatibility between the oil and fishing industry.

Dr. Dyer

Thank you. From my perspective, all the panel members seem to agree—this is a time to work out ways to have both food and fuel on Georges Bank. To me this is the important message. I think too, perhaps

we have called attention to a topic that may well be a good Sea Grant lecture in the future: the fishing industry, its management, growth and opportunities. With that, it's my duty to call a close to our panel discussion, thank most especially our principal speaker, and also the panelists who have participated, and each of you in the audience who have made this a lively discussion.

We of the MIT Sea Grant College Program dedicate this occasion to the identification and study of inventive approaches to major national and international opportunities in the oceans, and to all persons whose vocations or interests are served by the seas

The MIT Sea Grant College Program presents the annual Sea Grant Lecture to provide a forum for discussion of perspectives and opportunities for our current and future uses of the seas. The Lecture also explores and heightens awareness of the roles of engineering, science, and the social sciences in developing marine resources, reflecting the Institute's commitment to environmentally balanced development of the oceans and coasts

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