Texas A&M University

Department of

OCEANOGRAPHY

PROCEEDINGS: GULF OF MEXICO INFORMATION TRANSFER MEETING

held
12 - 13 May 1980
New Orleans, LA

Sponsored by
Bureau of Land Management
Outer Continental Shelf Office
New Orleans, LA

Prepared through
TAMRF-BLM
Contract AA551-CT8-35

Technical Report #80-T-11
October 1980

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Planning and Logistics Handled Through
the Texas A&M Research Foundation and
Texas A&M University,
TAMRF-BLM Contract AA551-CT8-35
Under the Direction of
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Department of Oceanography
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PREFACE

In the spring of 1980, the Outer Continental Shelf Office of the Bureau of Land Management, New Orleans, Louisiana, had an urgent requirement to obtain data and information for preparing Environmental Impact Statements and Assessment Reports. The data and information were available in the private and public sectors in the hands of various researchers or administrators. Since BLM did not have sufficient manpower to visit each of them, arrangements were made with the Texas A&M Research Foundation under BLM Contract AA551-CT8-35 for the BLM Program Office at Texas A&M University to plan a workshop bringing together these researchers and to prepare Proceedings of the workshop. The Proceedings presented here are based on a taped transcript of the workshop General Session and on written reports prepared by the chairmen of the various Special Sessions.

Over 75 industrial, educational, and governmental scientists and administrators attended the workshop. To them we offer our many thanks. We are also indebted to Mrs. Sylvia Herrig, Dr. Brent Herrig, and Dr. Benny Gallaway for their assistance in planning and supervising workshop logistics; to Dr. Rose Norman for editing these Proceedings; to Dr. Richard Rezak for providing technical assistance in editing the Proceedings; and to Mrs. Sylvia Herrig and Mrs. Judy Pate for word processing services.

Joseph U. LeBlanc
BLM Program Manager
Texas A&M University
College Station, Texas

October 10, 1980

I. GENERAL SESSION
(May 12, 1980)

Introduction

The general session was opened by Ed Wood, chief of the study staff in the New Orleans Outer Continental Shelf (OCS) office, who introduced his staff, described the function of the OCS office, and stated the purpose of the meeting. New Orleans OCS staff attending included Bob Rogers, Rick Defenbaugh, Mark Grussendorf, and Susan Bakke, as well as Doug Elvers, from the Environmental Assessment Division, and Ed Richardson, from the Operations Division. Also attending were Dave Amstutz, the Washington office representative (Assessment Division), and Tom Burke, from the Washington Environmental Studies group.

The New Orleans OCS study staff is a supporting staff. They support the leasing program directly and indirectly through the Operations Division in the New Orleans office and the support of policy decisions. In addition to the Gulf of Mexico, the office is concerned with areas off the Carolinas to Florida, in the South Atlantic Region. Wood indicated that the prime objective of the OCS office is to develop the oil and gas resources in an environmentally safe manner. This means they must concentrate on applied, rather than basic, science.

Wood explained that the purpose of the meeting was exchange of information. The goal was to provide as much up-to-the-day information as possible to support the environmental impact statements and environmental assessment reports that Doug Elvers' staff handles in support of the leasing program.

Lease Sales

Ed Richardson, BLM Operations Division, described the sales that are scheduled in the Gulf of Mexico, and a brand new proposed final OCS oil and gas lease schedule, dated March 1980. Richardson provided a chart showing the sale schedule; sales are likely to be in the last week of the indicated month. An abbreviated version of this chart shows the following schedule.

Lease Block	Month of Sale
A 62	Sep 80
62	Nov 80
A 66	Jul 81
66	Oct 81
67	Mar 82
69	Aug 82
72	Mar 83
74	Sep 83

The full list showed a five-year leasing schedule, but Richardson discussed only 1980-1983 scheduling.

He then showed a chart displaying relative industry interest in lease blocks; blocks were displayed across the entire Gulf of Mexico in a scattered pattern. Out of the 12.2 million acres nominated, approximately 4 million acres have been recommended to the Washington office. That adds up to about 760 blocks. These blocks will be broken into two individual sales. The BLM and USGS have reached mutual agreement on about 2.1 million acres.

The tracts available are scattered Gulf-wide. There is a pretty good balance between the traditional areas and the deep water areas and wildcat areas in frontier regions. The call for nominations starts about a 30-month process, which includes the tract selection, the EIS's, the sale notices, the reviews, the public hearings, and much more. It culminates in an OCS sale. In this sale, 32 companies participated, nominating around 2,060 blocks or about 11.2 million acres. Of these, there were multiple nominations on 327, which is about 16%; the remaining 1733 or 84% were single nominations. It appears that a trend is occurring where fewer companies are nominating, but they are nominating more blocks and more acreage. The nearest to shore in these nominations was 3 geographical miles and the farthest was about 150 geographical miles. Water depths range from about 10 to 3,000 m in depth, much deeper water than in the past.

Two options have been suggested to Washington. One suggestion is for blocks in a special-use area. Back in some of the Eastern Gulf of Mexico sales, there were some blocks up on the Destin Dome. There has been some interest in the Pensacola area and around the Dome itself, and then much farther out in the DeSoto Canyon area in deeper water. Prognostications are uncertain. The Washington office negotiates with the Department of Defense in this particular area of responsibility. The Dome is a pretty fair looking structure. A second option concerns about 120 blocks that are generally in the deeper water areas. These would include some in the Port Isabel and Corpus Christi areas and then into the East Breaks and Garden Banks. Some blocks at about 2400 m of water are being recommended. These deeper water blocks are for a longer lease term--8 and 10 years, respectively. So the suggestion is for a bigger chunk out there with a longer lease term. The OCS Land Act Amendments stated that if blocks can be shown to be reasonable economic production units, then tracts can be larger than the 5760 acres, and if there is deep water or other unusual circumstances, the initial lease term can be longer, up to 10 years.

There has also been interest in the South Florida area, and some blocks there will be recommended. These blocks are in the sale 66 series. There is also interest in the Mobile Bay area, where prospective formations are rather deep. There are also about 72 buffer zone tracts. These are Sect. 8(g) tracts, and they are scattered along the Gulf.

In summary, 4.1 million acres is to be divided equally between the two sales that will cover the entire Gulf of Mexico, including the Eastern, Central, and Western Gulf, and going into some of the deeper water areas.

Environmental Impact Studies: "What Is?" vs "What If?"

Doug Elvers, BLM Assessment Division, spoke on Environmental Impact Statements (EIS), environmental assessment reports, and the need for information to support them.

Elvers noted that both the field people and the Washington people in Secretarial Order (S.O.) 2974 were generally represented at the meeting. The Council on Environmental Quality requires that they gain scope. Scoping means talking with people who have information and issues to bring forth, and that was a goal of the workshop. Elvers addressed his remarks to problems in preparing Environmental Impact Statements (EIS): what to address, how to address it, and how people expect it to be addressed. Added to these questions is the controversy between studies that ask "what is?" and those that ask "what if?"

The issue boils down to money: how much money should be spent on the "what if" type issues versus how much to spend on the "what is." In the past, EIS's have almost totally dealt with "what ifs," but there is a trend toward "what is" questions. Studies inside Elver's office tend to be "what is" studies. Studies outside the office tend to be "what if" studies. That may change. It may not, but there will be problems if studies do not begin to look at what is really happening versus speculation on what might happen but can never be proven or disproven. A function of the meeting, therefore, was to outline "what if" and "what is."

Studies at the Flower Garden Banks

Biological Monitoring Studies

Speaker: Thomas J. Bright, Dept. of Oceanography, Texas A&M Univ., College Station, TX

Dr. Tom Bright provided an overview of biological monitoring studies that he and other oceanographers at Texas A&M have carried out at the Flower Garden Banks.

The Flower Garden Banks are two of possibly hundreds of outer continental shelf topographical features in the Gulf of Mexico. Oceanographers at Texas A&M have investigated, charted, mapped, and described from a biological, geological and physical standpoint about thirty of these features. The purpose of these studies was to provide BLM with information for use in formulating stipulations and regulations concerning drilling in the vicinity of these banks. Most of these banks are, presumably, potential surficial manifestations of geologic formations that contain oil or gas.

There are two Flower Garden Banks, East and West. Together they comprise possibly the most complexly developed, biologically sensitive communities on the outer continental shelf of the northwestern Gulf of Mexico. Working at the Flower Gardens since 1970, Bright has developed

a good idea of the community structure, the distribution of organisms, and the biotic zonation at the Flower Gardens.

In the shallowest water there are several zones, the most important of which is possibly the living coral reef, which is dominated by stony corals. Bright's group has identified two zones within the coral reef biotope, one a high diversity reef zone with 18 or so species of living corals, and a deeper, lower diversity zone, going down as deep as 46 to even 52 m, with only 7 or 8 species of living corals. So above about 46 or 47 m the dominant reef-building organisms or dominant substrate producers are stony corals. Down at the depths of 82 to 88 m, the communities are dominated primarily by coralline algae. These are calcium-carbonate secreting coralline algae, which are also extremely important as substratum producers.

These two groups are the ones about which Bright feels there should be most concern, environmentally. With the limited funds and limited time and logistics available, the group at Texas A&M has designed for BLM a monitoring program that uses certain stony corals and coralline algae as "indicator" organisms of processes that are critical to the biological well-being of the bank. On a continuing basis, they study for BLM the reproduction, recruitment, growth, mortality, and other processes associated with the dominant coral and coralline algae on the bank. Any substantial changes in these processes might be an indication of some impact.

To date, they have not been able to draw any cause-effect relationships between drilling operations and the health and condition of benthic communities on the banks. In fact, they have not detected any substantial change in the health and condition of biotic communities on the Flower Garden Banks during the years they have been working out there.

Some interesting things that they have determined biologically on the bank have to do with the hard substrata, the reefs and such. The structure of successional relationships between the high diversity and low diversity coral communities is unclear. The high diversity versus low diversity communities may be related to the movements of substratum versus sea surface. All of these communities are strongly correlated in their vertical distribution with depth, so the differences may have to do with light penetration: corals require certain light levels to grow. Also, the lower diversity reefs have certain species on them that are capable of surviving in a lower light intensity. But the relationship of high diversity-low diversity reefs to drowned reefs and partly drowned reefs on the bank is unclear. They have something to do with the movements, possibly of the substratum, relative to the sea surface. Some interesting basic information could be obtained that would shed some light on this problem, and would also turn out to be somewhat applied research.

On the other end, the lower end of the distribution of organisms that are actively engaged in production of substratum, controls appear to be placed upon their distribution (at the bottom of their

distribution), possibly by turbidity of water surrounding the bank and local hydrography.

In summary, the study is developing a mass of information that within the next year or two will tie together to give a good picture of what the distribution of organisms is on these banks and how the distribution of these organisms may be controlled by both physical and geological processes, as well as biological processes acting on the bank. This is good and basic, but also a good case could be made for its applied usefulness.

Geological Studies

Speaker: Richard Rezak, Texas A&M Univ., College Station, TX

Dr. Richard Rezak described the geological studies he has directed in the Gulf and at the Flower Garden Banks. Over the years that A&M oceanographers have studied offshore banks, the scope of work, geologically, has involved a characterization of the banks and the sediments around them. Doing this has required mapping the banks in detail, using precision navigation and sub-bottom profiling, side-scan sonar, and instruments of that type. So far 38 maps of offshore banks have been generated. In terms of sediment analysis, A&M scientists have been looking at the bottom sediment textures, bottom sediment mineralogy, and also suspended sediment mineralogy (which is related to the work that David McGrail discusses, below). Another important parameter as far as the sediments are concerned, particularly the sediments that are generated on the banks, is particle type. The identification of sediment particle origin is important in delineating sediment facies on and closely around the banks.

According to Rezak, the East and West Flower Garden Banks are probably the most intensively sampled banks in terms of sediments of any that he has studied. The sediment distribution map his group prepared recently is based on 140 samples. They have considerably more samples, and the density will be greater than that, but in terms of cost and time they have used just 140 to prepare the map. The map uses a color code to show (1) bank-associated sediments, and (2) terrigenous sediments, the sediments that normally occur on the shelf this far from shore.

The two different kinds of sediments cause some problems in sediment studies. Those that are derived from the continent and brought down to the shelf by streams, terrigenous sediments, have to be examined in a slightly different manner from the sediments that are generated, actually manufactured, on and around the banks. These sediments that are around the banks are mainly calcium carbonate sediments, and they are biogenic. They are produced in situ or very close to the site in which they are found.

For terrigenous sediments, the important parameters are size and mineralogy--size, mainly, because these sediments are current transported. By knowing what the sizes are, one can estimate the current velocities that transported these sediments into the site where they are found. This information doesn't help much in terms of

carbonate sediments because they are generated in situ. They are not transported by currents.

Another complication is that the boundary charted between bank-associated sediments and terrigenous sediments is artificial. On the sediment distribution map, this boundary is the limit to which the carbonate classification of sediments has been extended. Beyond that the map is based on terrigenous classification of sediments. It really does not tell much to analyze carbonate sediment in terms of size, because they are generated in place and because there are so many different organisms with different sized skeletons. For example, a large shell found in terrigenous mud has not been transported into that site by currents. It grew there and was buried, or it lies on the surface in the mud which was transported in by currents of much less force than would be required to transport that shell.

The system used for classifying the terrigenous sediments was one developed by Robert Folk at the University of Texas at Austin. Folk puts a tremendous amount of emphasis on the presence of even very small amounts of gravel. Because of this, the types of sediments shown on the map are colored to show the presence of this small amount of gravel. And the gravel, of course, is in the form of shells that are mixed with the terrigenous sediment. So in terms of sediment transport, these terrigenous sediments close to the shelf margin cannot be interpreted as gravel. Many of these are relict sediments left by a lower stand of sea level. Some of them are relatively recent, but for the most part they are older sediments that have been left since late Pleistocene or early Holocene.

The sediment distribution on the banks is much the same in terms of kinds of sediment at both the East and West Flower Garden Banks. Five zones of bank-associated sediment have been determined. First is the living coral reef, which is in the shallowest waters, and in the same location around the coral heads and running down the side of the reefs. Then, in a very narrow zone around the reefs is a zone of sediment called the Coral Debris Facies. This consists of coarse sand and gravel that have been derived by the erosion of coral and mollusks that are growing out on the reef itself. Below what Bright calls the Algal-Sponge Zone is a gravel consisting of sediment particles that range in size from a few millimeters up to several centimeters in diameter. These are algal nodules built by coralline algae that are growing in place. They are not being transported, except possibly slightly downslope due to gravity. And this zone extends out a considerable distance away from living reef. A sediment that is in slightly deeper water is called the Amphistegina Sand Facies. It consists almost up to about 50% of the skeletons of a foraminifer, Amphistegina, that is actually growing on the algal nodules in the zone above and on the corals up on the reef. This is a benthonic protozoan that has a skeleton somewhere in the sand-size range, and it is moved downslope by gravity. It probably is helped a little by currents that flow around the bank to get it started, but it moves mainly by gravity down the slope and accumulates in this zone.

The transition zone from bank-associated to terrigenous sediments is designated the Quartz-Planktonic Foraminifera Facies. It contains particles of reef rock and skeletal materials that have been derived from drowned reefs that surround the living reefs of these banks, in addition to grains of quartz sand and skeletons of planktonic foraminifera that are accumulating at the present time. The terrigenous sediments consist of: clay; mud, which is a mixture of silt and clay; sandy mud; a slightly gravelly sandy mud; silt; sands; and muddy sands. A patch just east of the West Flower Garden is a gravel consisting of shell hash.

Studies of Water and Sediment Dynamics

Speaker: David W. McGrail, Department of Oceanography, Texas A&M Univ., College Station, TX

Dr. David McGrail described his study of water and sediment dynamics at the Flower Garden Bank. A wide variety of parameters have been measured around the East Flower Garden Banks in an effort to come to some kind of understanding of what is really going on in this location. One finding is that Dr. Bright's biological distribution of species, Dr. Rezak's distribution of sediment on the bottom, and Dr. McGrail's distribution of suspended sediments all point to the same general conclusion. That is, around these banks at about 80 m Dr. McGrail observes the top of the nepheloid layer, Dr. Rezak sees the transition to principally coarser sediments instead of the clay and silt-sized material, and Dr. Bright observes faunal changes. Putting all these together makes a good picture of what is happening at the bank.

McGrail presently has two current meter arrays and one electromagnetic current meter deployed at The East Flower Garden. The electromagnetic current meter is used up on the top of the bank because in the wave dominated zone, the savonius rotor type of current meters are susceptible to pumping. He showed color slides depicting data from these and other instruments deployed at the East Flower Garden. A station taken in July of 1979 illustrated what is typical in many summertime conditions: the flow is quite baroclinic and depth dependent. Current direction changes quite considerably with respect to depth. Near the bottom, the flow is on the order of 25 cm/sec. The water column is strongly stratified; the transmissivity there picks up somewhere around 90 m. What happens is that the flow goes over the relatively fine material on the bottom there. The turbulent mixing takes place at the bottom as the energy is scrubbed from the flow. It picks up the fine sediment and puts it into suspension. It cannot be mixed very far up into the water column because of both rotational effects and stratification.

Another slide showed data taken in the same general area in April 1979, depicting the very worst condition seen or the worst possible case with respect to sediment suspension. At that time, flow was to the west, approaching 100 cm/sec--from top to bottom--relatively depth independent flow. There was very little stratification out there except in the uppermost portion of the water column. Sediment was

being actively resuspended, and there was a lot of stirring going on near the bottom, mixing this material up into the water column. But even under this worst possible condition (very high flow and weak stratification) the mixing up from the bottom was finite; that is, it did not mix up through the whole water column. It just did not have that much energy. And that is to be expected in a rotational flow of this type: the boundary layer should be limited, and the data show that it is. This same kind of condition was seen over a two-day period and so it is quite clear that the boundary layer had reached its maximum thickness and that this is the maximum one might reasonably expect.

Internal waves propagate through this area, particularly at the tidal frequency. During the fall and summer, it looks like a lot of the energy in the tide occurs as a baroclinic wave. Observations from the submersible show that the sediment was resuspended almost as a front as the wave propagated through that region. The displacement of these waves is on the order of about 9 m and so the material could not be moved very far up in the water column above bottom. The waves supply a big pulse of energy and resuspend the sediment. One might ask if internal waves are common in the case of currents in a stratified rotating fluid. The answer is yes. They are seen out there. At the East Flower Garden it appears that the energy of the internal waves is minimal at frequencies higher than semi-diurnal. The only substantial internal waves observed there are those with tidal frequencies. There are a lot of reversals of the currents, due to this kind of feature; that is, the temperature fluctuations and current fluctuations are very well correlated.

Current meter records (July-September 1979) show very strong correlation between the temperature oscillations and those of the currents. Analysis of variance shows that the general trend of variances is parallel to the isobaths along the shelf; that is to say they are trending approximately northwest-southeast just north of the bank there. Records from a current meter that is only 2 m off the bottom show the current aligned parallel to the isobaths. The major axis of variance is parallel to this trend and has approximately 300 cm^2/sec^2 variance in that orientation. Across isobath variance is on the order of 5 cm^2/sec^2, which is to say that topographic forcing is extreme here. There are no cross isobath transports to speak of or any oscillation that has been taking place in the cross isobath direction. Offshore flow is very strong in this region. What is happening is that as flow impinges on the bank it is forced by the topography into a parallel flow there, and it is also accelerated.

The low-pass filtered record for this same period (July-September 1979) shows very exact correlation between the currents and the temperature oscillations. The bottom flow was accelerated and also turned as the bottom was approached, being forced to flow parallel to the isobaths. The flow was very strongly polarized and had enormous strength, even in the low-frequency end of the spectrum. For instance, the mean speed of one current was about 10 cm/sec in the offshore direction. This shows, then, the very strong oscillations of the flow capable of resuspending the fine sediment. But on the western side of

the bank where there is coarse carbonate sediment, the nepheloid layer is much thinner, and it occurs less frequently. The reason is that there is less sediment locally to resuspend. The same record shows that on the east side of the bank, there is still a lot of energy and a lot of the fine sediment is picked up around the bank. Over on that side, the nepheloid layer is much more persistent, containing a lot more suspended sediment, and this is reflected in sediment distribution. But these currents are quite strong, sometimes approaching 60 cm/sec even in this record, and they are hardly steady.

Putting these pictures together--the currents, the suspended sediments, and the biota--creates a coherent picture of what's going on at the Flower Gardens.

Geological Background

Speaker: Henry Berryhill, USGS, Corpus Christi, TX

Dr. Henry Berryhill first described the general regional structure of which the Flower Gardens are a part. The geologic setting of each Flower Garden Bank is not unique. The East and West Flower Garden Banks sit on two of a large number of large diapiric structures that continue on to the east and west. Berryhill used bathymetric maps done from the acoustical properties as revealed by high-resolution seismic profile. Through the area a 3 x 3 mile spacing grid, supplemented by 1-1/2 x 1 mile spacing was used, supplemented by the profiles that Dr. Rezak referred to. Shown also on the map are all of the faults or the lines that indicate the movement of the seafloor.

With that background, Berryhill described the regional sediment pattern and geomorphology at the approximate edge of the shelf. A stream system fed this area during the Wisconsin fall of sea level. The system apparently shifted back and forth. An earlier system of a delta outbuilding is seen east of the Flower Gardens. The system switched and built a delta system to the west of the West Flower Garden, truncating Coffee Lump Bank to the north and beveling it down to sea level. So material was flowing in. It flowed at times around both sides of that diapir, coming in at one time around the east, filling a subsidiary channel lying between West Flower Garden and the structure south of the East Flower Garden. It then flowed to the West of the West Flower Garden, building a delta to the shelf edge.

During the Wisconsin low fall, a rather large volume of sediment was pouring in around the two diapirs that formed the foundation for the building of the reefs on the East and West Flower Garden, which are of interest because they have living communities. However, presumably dead reefs continue on to the east and sit on many other diapirs on to the east.

Several things are of interest to those who are wrestling with the problem of the Marine Sanctuary aspect. One of the discussions is resolved around a position of the 100 m isobath. Actually it does not

circle either one of the reefs. It swings around the east side of East Flower Garden and then just goes out across the shelf and continues on its way out to the west. Again this is nothing more than the bathymetry. The reefs lie on piercement domes and the diapiric material is cut by faulting. There are marine terraces on the reefs that are offset. We have not studied these in detail, but they are offset. They are not any longer at the same level, so the implication is a rather recent movement.

In summary, during the Wisconsin low stand, sediments flowed in building two large deltas. There are terraces that have been offset by fairly recent faulting. In geology we say that the past is the key to the present. Here the past is the key to the future. At the next low stand of sea level, the East and West Flower Garden will probably be truncated to base level just as their near neighbor was. So slumbering down here at a greater depth are another diapir or two waiting for fame to be thrust upon them, and receive the weight of BLM problems.

Proposed Marine Sanctuary

Introduction

Doug Elvers brought up the situation of the proposed Marine Sanctuary at the Flower Gardens. BLM supports the Sanctuary and believes that some valuable additions to the area around the proposed Sanctuary can be made, both in protection and in reef building. These additions are platforms. Elvers invited responses from NOAA and EPA representatives.

NOAA

Rick Podgorny, Marine Sanctuary Office, Washington, DC, responded for NOAA, describing the background of the proposed marine sanctuary and the current status of the proposal. The East and West Flower Garden Banks were nominated for sanctuary status in September 1977 by Texas State Senator Schwartz in conjunction with the Texas Folklore Marine Council. The banks are biologically unique and important. They contain the northwesternmost living coral reefs on the Gulf of Mexico's outer continental shelf, and they are the only truly tropical coral reefs in the northwestern Gulf. The live reef contains at least 18 coral species, more than 100 species of Caribbean reef fish, and more than 200 invertebrate species.

In December 1977 a public meeting was held in Houston, and in June 1978, about six months later, NOAA issued a white paper for public comment on the Sanctuary proposal. The nature of the nomination was basically the issues at large, and NOAA solicited comments to determine whether or not they should go forward with the draft environmental impact statement. As a result of those comments and discussions with public interest groups, industry, and other federal agencies, NOAA then did decide to prepare a draft environmental impact statement (DEIS). NOAA published the DEIS on April 13, 1979, and public hearings in Lake Charles, LA, and Galveston, TX, were held on May 17 and May 18, 1979,

respectively. The commentary on the draft environmental impact statement closed August 10, 1979.

NOAA, together with the Department of the Interior, the Environmental Protection Agency, and Department of Energy, as cooperating agencies, are in the process now of reviewing the comments received, and are preparing a final environmental impact statement which should be released sometime this summer. Some have asked if NOAA is going ahead and preparing to propose a designated sanctuary. The answer is yes. NOAA is proposing to designate a marine sanctuary in the waters in the Gulf of Mexico and the waters overlying the Flower Garden Banks. After designation, which requires presidential approval, NOAA must promulgate necessary and reasonable regulations governing activities within the sanctuary.

Podgorny then described the present review process and NOAA's plans for regulations at the Flower Garden Marine Sanctuary. NOAA is in the process of reproposing regulations for the Flower Garden Banks Marine Sanctuary. They are revising their proposed alternatives and DEIS on the basis of comments from the cooperating agencies (Department of Interior and all its agencies, EPA, and the Department of Energy). When this step is completed, a notice will be published describing the revised regulations. When the final notice comes out, comments and rebuttals are encouraged; the commentary will be legally open, again on revised issues. Podgorny stressed that comments received within 30 days of the announcement in the Federal Register can be reflected in the FEIS before it is printed. However, even comments received after that 30-day period will be responded to in a final rule-making document that his office will prepare.

NOAA proposes to revise the regulations in two specific ways. First, the 5-year moratorium on hydrocarbon activities under the new lease has been eliminated. Secondly, the proposed absolute prohibition of bulk discharges of drilling mud has been changed to allow bulk discharges if approved by the Sanctuary task force. In addition to those particular changes, NOAA proposes the required shunting of drill muds and cuttings to 10 m rather than 6 m from the bottom, and the proposed monitoring requirements have been revised to allow for more case-by-case flexibility on the Sanctuary task force. The revised proposal emphasizes now the use of existing regulatory activities as the first line of defense for the bank.

Last month, NOAA received a revised BLM chart on recent surveys at the Flower Garden Banks. The chart shows that the 100 m isobath does not float--it does not completely surround the East Flower Garden Bank. However, BLM maps do show that the West Flower Garden does close at 100 m. Since a number of proposed regulations in the Sanctuary use the 100 m isobath as the boundary, a closing line will need to be established. That closing line will approximate the 100 m isobath as it appeared in the DEIS issued last April 1979.

Another issue that came out of negotiations since the closing of the commentary last August is that NOAA and the Environmental

Protection Agency have agreed that there is no reason to maintain their principles of agreement in the future. The designation document will be NOAA's change from the draft except for the corrections of two errors: (1) the department that prepared the line referring to defense activities (Article 5, Section 2) is taking out the flaws in reference to war, hostility, and emergency; (2) the size was incorrectly stated in the DEIS and will be corrected to 257 square nautical miles.

The "no activities" remain the same as originally proposed in the DEIS. The proposed regulations from the DEIS remain unchanged except for the following:

1. The general prohibition against the collection and removal of coral, etc., invertebrates and bottom structures will be strengthened by eliminating the specific exceptions in the original proposal, which allowed the collection of dead shells. As it turns out nothing will be allowed to be collected at the bank, including the dead shells. As previously stated, the moratorium provision is deleted.

2. Shunting to 6 m is deleted, but retained is the requirement for shunting to 10 m in the whole sanctuary, an area as large as that now covered by the BLM stipulation. BLM covers about a 3-mile area.

3. Total prohibition of both discharges is eliminated, but the assistant administrator of the Office of Coastal Zone Management will review and certify discharges on a case-by-case basis after a recommendation by the sanctuary task force.

4. The prohibited simultaneous discharge with drum fluids or muds from more than one well from a single rig on platform is clarified to apply only to exploratory wells.

5. The revised proposal that will be in the Federal Register eliminates the regulation which would have tied monitoring of the effects of drill cuttings and effluents to the NPDES probe, under certain conditions. It provides that the assistant administrator must certify any permit allowing discharge of drilling fluid, muds and cuttings, and produced waters after recommendations from the sanctuary task force, which will review data from the Flower Garden Banks interagency monitoring committee. The certification will be necessary only to those provisions of permanent concern to monitoring.

Podgorny also provided a brief description of the Sanctuary task force mentioned above. Basically, the Sanctuary task force is proposed as a mechanism for gaining interagency recommendations, advice, consultation, and coordination on all issues relating to conditions and activities in the Sanctuary and for assuring that the assistant administrator of the Office of Coastal Management can easily communicate with the representative from each major federal agency which has jurisdictional interests in the Sanctuary. The task force will be composed of representatives from the agencies having principal regulatory authority in the Sanctuary. Those agencies would be the

National Marine Fisheries Service, the United States Geological Service, the Bureau of Land Management, the Fish and Wildlife Service, the Environmental Protection Agency, the Department of the Interior, and the Department of Energy.

Another committee involved in this but not directly tied to the Sanctuary task force is the Flower Garden unit interagency monitoring committee. This is an existing committee with membership from the Department of Interior, EPA, and NOAA. The committee's purpose is interagency coordination of research and monitoring in the Flower Gardens Area, and its proposed activities include, to mention some, (1) formulating a research and monitoring program for the Flower Gardens on the basis of the regulatory needs of participating agencies, for correlating on-going and planned research in monitoring programs; (2) identifying major research and monitoring gaps, and seeking ways to fill these gaps by the activities of individual agencies or other means, for coordinating research and monitoring activities to help get them appropriate zero base budget ranking and other funding; and (3) acting as an interagency information center for research and monitoring activities in the Flower Gardens Bank area.

NOAA presently plans to have a Sanctuary designation sometime during 1980, with a final environmental impact statement out sometime during the summer of 1980.

EPA

Bob Vickery, EPA Region 6, provided information on the background and status of permits proposed in October 1979 by three leaseholders at the East and West Flower Garden Banks. On Oct 13, 1979, EPA proposed three NPDES permits under section 402 of the Public Water Act for oil and gas facilities operating in the East and West Flower Garden Banks. Hearings were held in Galveston on January 29, 1980. Several people at the present meeting testified at those hearings. EPA has not yet made a final determination on the three permits.

The next step that EPA would take, and this will happen May 17, concerns the proposal for nine more permit fees in the East and West Flower Garden Banks area. This will conclude EPA actions on a proposed basis for all the lease holders in the proposed sanctuary area. They again will use the nautical mile from the 100 m isobath as a description of the area. On May 17 they will propose nine more permits. Those permits won't be any different from the ones that have already been proposed. The action that will key any interested party to refute what they have done will be a decision on the first three permits proposed.

The next step is to make a determination on those first three permits, from Mobil, Union, and American Natural Gas. When that is done, any interested party has thirty days to request what is called an evidentiary hearing. Those people who participated in the public hearing will receive notice of this determination (it will not be in the Federal Register).

During that 30-day period, EPA will receive requests for evidentiary hearing, and there will have to be a determination made whether or not to have one. Discussions are presently going on in EPA, among other federal agencies, companies, and environmental groups. Unable to predict an outcome, Vickery did project that any evidentiary hearing held (which is an agency review here) would consolidate all twelve permitees in one hearing process. Such a hearing would probably happen sometime in the fall. These companies, of course, are moving on their leases now and they are under very serious time constraint. To further complicate matters, EPA is coming out with consolidated regulations which these companies may apply. At this particular point, EPA is not sure of how some of the regulations can be fit into the process. It certainly isn't an easy situation.

II. SPECIAL SESSIONS
(May 12-13, 1980)

Geology

Participants

The geology sessions were attended by the following:

John Antoine	Decca Survey Systems, Bryan, TX
Henry Berryhill	USGS, Marine Geology, Corpus Christi, TX
Arnold Bouma	USGS, Marine Geology, Corpus Christi, TX
Bill Bryant	Texas A&M University, College Station, TX
Burt Carlson	Shell Oil Company, Houston, TX
Jim Coleman	Coastal Studies Institute, LSU, Baton Rouge, LA
Barney Congdon	BLM, New Orleans OCS Office, LA
Jim Hauser	Odum Offshore Surveys, Baton Rouge, LA
Jack Hill	Oceanonics, Houston, TX
Bob Hoff	Decca Survey Systems, Houston, TX
Jesse Hunt	BLM, New Orleans OCS Office, LA
Bob Kuzela	USGS, CD, Metairie, LA
Dave Prior	Coastal Studies Institute, LSU, Baton Rouge, LA
Jack Rebman	BLM, New Orleans OCS Office, LA
Dick Rezak	Texas A&M University, College Station, TX
Jim Sides	John Chance and Associates, Lafayette, LA
Bill Sweet	USGS, CD, Metairie, LA
John Wolfe	Conoco, Houston, TX
Tokuo Yamamoto	RSMAS, University of Miami, Miami, FL

Geology of the Pleistocene Trend Area

Speaker: Henry Berryhill, USGS, Corpus Christi, TX

Dr. Henry Berryhill opened the geology session with a report on his study of the geology of the Pleistocene trend area along the shelf edge of High Island and the West Cameron area. It is a complete study of the shallow geology, including salt diapirism, as interpreted from high resolution geophysical profiles. The emphasis is on seafloor stability. They are looking for the effects of the fall in sea level, its impacts on the sedimentary regime, and the additional impacts of diapirism on the entire system. The work is being done cognizant of the needs of BLM and GS-CD, and maps are at the compatible work scale of 1" = 4000'. It will also be compiled into a 1:250,000 atlas series. The tangible results are a series of nine maps.

Map 1 shows basic structure, which includes faults which reach within five milliseconds of the seafloor, salt diapirs, and the outer limit of deformed sediments around the diapirs. Many of the diapirs on the shelf were truncated during lower stands of sea level, and some off the edge of the shelf have terraces cut into them. Certain patterns of faults can be seen around the diapirs.

Map 2 shows Wisconsin Sediment Patterns. During the low stand when sea level was approximately -130 m, the first sediments to reach the edge of the shelf arrived in two main channels. The East and West Flower Garden Banks, and several others around them, acted as bulkheads to the channels and deflected the sediment around them.

Map 3 shows terraces in the area. As sea level rose from -130 m, there was apparently a still stand at -80 to -85 m, which cut a very prominent terrace in the shelf edge to the east of the Flower Garden Banks, and which apparently extends eastward to the vicinity of the Mississippi Canyon. Average depth to the bottom of the terrace is -120 m, and sediments are still being deposited on it. Some diapirs and faults offset the terrace, indicating Recent movement, and some reefs grew along it. The terrace appears to be tilted downward some 30 m on the eastward side. This terrace exactly matches the one on the South Texas OCS.

Map 4 shows the Holocene sediment fill, and it matches the terrace very well. The zero sediment line coincides exactly with the scarp of the terrace. Sediments on the terrace thicken toward the Mississippi Canyon. The unconformity at the terrace is easily discernible from well logs, since the Holocene sediments are quite shelly and below the terrace surface there are no shells.

Map 5 depicts gasified sediments within 25 milliseconds of the seafloor. The gasified sediment concentrations correlate well with the deltaic wedges mapped in the Wisconsin sedimentary regime. There is a distinctive lack of gasified sediment on the terrace. Where the deltaic wedges are found is where the gasified sediments are found. Therefore, the gas appears to be biogenic in origin.

Map 6 depicts gas at greater depth. Most of this gas appears to be coming from depths of 250 milliseconds or greater and some of it seems to conform to fault patterns. It, therefore, appears to be petrogenic in nature.

Map 7 shows gas seeps. Some 450 have been mapped, of which some are associated with mud mounds and others show gas in the water column going all the way to the surface.

Map 8 is of six deformation types which occur at the seafloor and to a depth of 200-300 m. The most prominent deformation type is slides. The extent of buried slumped material is also shown. The deformation pattern changes abruptly at the shelf edge.

Map 9 classifies seafloor hardness based on acoustic properties. Classification I is soft seafloor showing no evidence of a bottom multiple on seismic profiles; Classification II has one strong multiple and a second recognizable; and Classification III shows three strong bottom multiples. The old deltas fall under Classification III.

Gulf of Mexico Upper Slope Investigations

Speakers: Arnold Bouma, USGS, Corpus Christi, TX
Dave Prior, Coastal Studies Institute, Louisiana State Univ., Baton Rouge, LA

Lou Garrison was unable to attend, so his presentation on Gulf of Mexico Upper Slope Investigations was made by Dr. Arnold Bouma and Dr. Dave Prior. Bouma discussed several different methods of formation of basins on the slope. Canyons often have sedimentary fans or are "dammed up" by diapirs. Diapirs also can uplift around an area of seafloor, forming a basin. Such depressions are of interest to the oil industry because that is where the sands occur and trap hydrocarbons in the sedimentary column. To properly study such basins, first we need accurate bathymetry along with something like the GLORIA system to establish morphology. Sediment geotechnical properties are very important to know, especially in fine-grained sediments. The final most important things to know are the sediment stability characteristics, i.e., slumping, faulting and folding (related to creep). USGS, along with the Coastal Studies Institute at LSU, are also studying the slope around the Mississippi Delta. Prior gave brief results of the Delta Project studies regarding the mudslides and overlapping mud lobes.

Physical Properties of Mississippi Delta Sediments

Speaker: William Bryant, Dept. of Oceanography, Texas A&M Univ., College Station, TX

Dr. William Bryant addressed the physical properties of Mississippi Delta sediments. The importance of the study of physical properties was emphasized by the South Pass 70 failure during Hurricane Camille in 1969, resulting in the loss of two structures. Generally, the delta clays have very low permeability and, therefore, won't consolidate very rapidly. As a result, excess pore pressures are very common in the delta area.

Several years back, Bryant participated in a project known as SEASWAB, which involved placing peizometers in South Pass 28 to measure pore pressures. They placed two in a collapse depression, one outside of it, and also installed wave riders and accelerometers. The measurements indicated negative stress, which means the pore pressures were in excess of geostatic and hydrostatic pressures! They have only analyzed about 5% of the data collected. The bottom line of these studies is that the bottom in the Mississippi Delta area absorbs a tremendous amount of wave energy. By moving up and down with the waves, it dissipates wave energy and greatly reduces size of waves as they move into shallower water.

Bryant also briefly mentioned research underway on the pressurized core barrel. When a core is taken, it is sealed at depth, then is transferred at the surface to a transportation chamber which is pressurized to the same depth. Back at the lab, the core is then placed in a hyperbaric chamber and the engineering properties are determined before and after the pressure is released and the sediment

degasses. They have found that the sediment loses 30% to 40% of its shear strength due to degassing. They are also studying the effects of gas in the sediments on seismic velocity. Less than 1% gas in the sediment can cause tremendous seismic velocity reductions.

Modeling of Sediment Instability

Speaker: Tokuo Yomamoto, University of Miami, Miami, FL

Tokuo Yomamoto closed the first day session with a talk about mathematical modeling of sediment instability. The stability is dependent on effective stress, not total stress. For modeling purposes, the soil is assumed to behave as a visco-elastic material. As an experiment, wave and pore pressures of both fine and coarse sands were measured in a wave channel. They found some phase change (a lag) between the water wave pressure curve and sediment pore pressure curve. Stress concentration is under the wave crest.

Hazards of Salt Domes

Speaker: Richard Rezak, Dept. of Oceanography, Texas A&M Univ., College Station, TX

Dr. Richard Rezak opened the May 13 session with a discussion of salt domes. Classification of salt domes is possible and there are certain hazards associated with each classification. Block faulting at the crest of salt domes is common and is an ongoing process. There is good evidence that it may be catastrophic in nature. His conclusions are based on findings at several Gulf of Mexico banks.

At Alderdice Bank Rezak found a large vertical ledge which goes from 225-foot depth up to 180-foot depth, and is 12 to 15 feet wide at the base and 4 to 5 feet wide at the top. They took some rock samples and it turned out to be a late Cretaceous basalt. It had to have been exposed only recently because it was almost free of encrusting organisms.

Fishnet Bank has a relatively small surface expression. In subsurface expression there is evidence of block faulting with an associated sag in the Recent surface sediments.

On Diaphus Bank they found a large south-facing fault scarp with a moat which is probably erosional. The fault cuts the dome in half and appears to be regional. On Rezak-Sidner Bank, faults cut the north and south sides and appear to be part of a large complex of faults. There is also other evidence for catastrophic movement on the crests of salt domes.

Findings at these four banks provide background for studies at the East Flower Garden Bank. There they found a brine lake 30 m in diameter and about 0.1 m deep, fed by a brine seep. Salinity of the brine is about 200 o/oo as opposed to 34 o/oo of the surrounding seawater. Calculation of the velocity and volume of the outflow show that the brine in the lake is completely renewed four times a day, which amounts to 864 cubic meters of brine per day. This means that

24,200 cubic meters of solid salt is being dissolved and removed from the dome each year. Therefore, it is possible that only the cap rock and reef are holding the top of East Flower Garden Bank up and that it could collapse at any time. This may have happened on a number of other domes since collapse calderas have been observed.

Conoco's Tension Leg Platform
Speaker: John Wolfe, Conoco, Houston, TX

John Wolfe gave a presentation on Conoco's Tension Leg Platform (TLP) planned for the Hutton field in the North Sea. This will be the first TLP installed as a production facility. Set up in 485 feet of water, it will be a 6-leg design somewhat similar to a semisubmersible, and will be a floating structure. Three to four tension members will be attached vertically to each corner and some 12,000 tons of tension will be applied (about 1,000 tons per member). The tension members themselves will be 9-inch diameter pipe, with a 3-inch hole in the middle. The design will allow no vertical motion; only yaw, sway, and surge. They figure that 99% of the time the horizontal displacement will be less than 10 feet with a 5-foot wave surge. Under worst conditions, the maximum horizontal displacement would be 33 feet with a 46-foot wave surge (total of 79 feet off-site) in 80-foot waves. The structure will be 256 feet by 243 feet and a total of 212 feet tall (above baseline). The deck load design at present is for 56,970 tons. At operating depth, the TLP will extend some 100 feet below sea level. The design is such that the tension members can be retracted (one at a time) into the legs for maintenance under normal weather conditions. The subsea portions are divided into chambers and any two chambers can be damaged and flooded without reducing buoyancy to a dangerous level. The TLP will have slots for 32 wells, a number of which will be injection wells. In order to reduce wave loading, they plan to use 9 5/8-inch risers to the surface instead of larger standard conductors. Abandonment costs are lower, and there's a very short time between installation and production. After it is installed, production will go to shore via pipeline.

Deep Water Technology
Speaker: Burt Carlson, Shell Oil, Houston, TX

Deep water technology was the topic of the talk by Burt Carlson. He divided it into three parts: Exploratory Drilling, Development Drilling and Production, and Transportation and Storage.

Currently, thirteen rigs are capable of drilling in 3,000+ feet of water, and four are capable of drilling in depths greater than 6,000 feet. To date, 17 wells have been drilled in more than 3,000 feet of water, the deepest of which was in 4,876 feet of water off Newfoundland.

Conventional exploratory drilling systems (with semisubs or drillships) use catenary anchor systems, guidelines, hydraulic blowout preventer contacts, and risers with no buoyancy attached. The four technological achievements which allow deep water drilling are:

(1) dynamic positioning; (2) guidelineless systems using wellhead sonar/TV; (3) electric (electrohydraulic) blow-out preventer controls allowing fast response times; and (4) marine riser systems using buoyancy modules and tensioners.

For development drilling and production to date, the standard has been the fixed leg platform. The 50,000+ ton Cognac platform, in 1,025 feet of water, is the largest of this type structure. It was built and installed in three parts. The size of the Cognac platform approaches the economic limit of this type structure for the Gulf of Mexico. Limits involve land area of fabrication yards, lift capacity of cranes, and size of waterways for float-out.

Alternatives to the fixed leg platform are the Tension Leg Platform (previously discussed), and the guyed tower. Both of these designs are compliant structures (can move slightly with the waves) and require much less steel for construction. With these structures, as well as the fixed leg platform, risers are brought to the cellar deck and the well heads are mounted at that level.

Another method of producing hydrocarbons is through the use of subsea completions. Since the first one, in 1960, 275 subsea completions have been made worldwide in marine waters. Two basic designs have been used. The first is known as a "wet tree" and consists of a well head on the seafloor and exposed to the water. This system uses remote controlled valves, diverless flowline installation, and through-the-flowline service. Most of the subsea completions are of this type. The second type is called a "dry tree," and consists of the well head enclosed in a one atmosphere chamber. This design allows technicians to service the well in a shirtsleeve environment. The deepest subsea completion to date is of this type, located in the Garoupa field of Rio de Janeiro, Brazil.

Exxon has tested a submerged production system which consists of a template through which all the wells are drilled. Maintenance is accomplished using a robot manipulator on a track. The advantage of this system is that no flowlines are required around the manifold. Shell has developed a similar system which is called the deepwater production system, and has chambers around the wells with covers over the chambers for protection from dropped objects.

Actual deep water production lags far behind the drilling capability mainly because no fields have been found which would be economically feasible to develop.

The third part of Carlson's talk was on methods of transportation and storage capabilities in deep water. The conventional method involves welding on the barge. Conventional pipelaying equipment is limited by the amount of tension that can be maintained on the pipe to reduce stress in the pipe (bending moment) as it leaves. Another method of laying pipe is the reel barge method. Here the pipe is welded on shore, wound onto a reel, and then unrolled at the site. Using the reel barge methods, 12" diameter pipe has been laid in 1,000

feet of water in the Gulf of Mexico. Up to 16" diameter pipe can be laid in up to 3,000 feet of water. Another concept in pipelaying is the inclined ramp method. The CASTORO SEI semisubmersible lay barge has installed pipe in up to 2,000 feet of water in the Mediterranean Sea.

In summary, Mr. Carlson stated that: (1) industry has historically developed the technology needed to produce hydrocarbons regardless of the environmental constraints; (2) concern that production technology doesn't exist for deep water is unfounded based on this history; and (3) economics, and not technology, has limited deep water development. The exorbitant costs of operating in deep water require that very large and productive fields be found to justify development, and, to date, none have been found.

Deep Water Surveying

Speaker: Jim Coleman, Coastal Studies Institute, Louisiana State Univ., Baton Rouge, LA

Jim Coleman's presentation on deep water surveying completed the geology session. After briefly going back over some of the results of the Mississippi Delta project survey, he went on to the work underway in the Mississippi Canyon area. Existing geophysical data are being tied back into cores, and this work is still ongoing. Three borings from the walls of the canyon and two from within the canyon have been looked at. It was previously thought that an old channel shoreward of the Mississippi Canyon in the Grand Isle Area tied into the head of the canyon. They found that it does not. On seismic profiles, a very prominent reflector can be seen which extends beneath the canyon and has been traced back to the Mississippi Delta area, where dates from bore holes show that it is 100,000 years before present. Another reflector dated at 30,000 years B.P. is cut by the canyon. In side-scan records, they have determined that the canyon walls to around -250 feet are capped with a reef which is probably drowned. No diapirs were seen along the walls. In the subsurface, the canyon is benched along the sides and in some areas shear planes bound the benches, indicating slumping. The side-scan sonar worked well to 1,800-foot water depths, but deeper than that may be a problem, partially due to cost.

After Coleman's talk, the geology session adjourned and joined archaeology for a joint panel discussion.

Archaeology

Participants

The archaeology sessions were attended by the following:

Barto Arnold	State of Texas Antiquities Committee, Austin, TX
Henry Berryhill	USGS, Marine Geology, Corpus Christi, TX
Arnold Bouma	USGS, Marine Geology, Corpus Christi, TX
Gordon Burton	USGS, Reston, VA
Donna Byrne	BLM, New Orleans OCS Office, LA
W.A. Cockrell	State of Florida, Department of State, Division of Archives, History and Records Management, Tallahassee, FL
Jim Coleman	Louisiana State University, Baton Rouge, LA
Robert Floyd	John Chance and Associates, Inc., Lafayette, LA
Ed Friedman	USGS, Reston, VA
Sherwood Gagliano	Coastal Environments Inc., Baton Rouge, LA
Jim Hauser	Odom Offshore, Baton Rouge, LA
Jack Hill	Oceanonics, Houston, TX
Bob Hoff	Decca, Houston, TX
Lori Hughston	ARCO Oil and Gas, Houston, Tx
Dana Larson	Exxon, Houston, TX
Murice Rinkel	State of Florida OCS Representative, St. Petersburg, FL
Reynold Ruppe	Arizona State University, Tempe, AZ
Jim Sides	John Chance and Associates, Inc., Lafayette, LA
Brent Smith	USGS, Metairie, LA
Melanie Stright	BLM, New Orleans OCS Office, LA

Introduction

The Archaeology session on May 12 was opened by Melanie Stright of the New Orleans OCS Office. She indicated that the overall purpose of the meeting was to obtain feedback for the EIS process. The four basic questions to be addressed were:

(1) What is the legal and regulatory basis for the cultural resources program on the OCS?

(2) What are the potential impacts to significant cultural resources from oil and gas development?

(3) Which impacts are the most significant?

(4) What changes should be made in the cultural resources program to improve it?

Three major concerns with the current cultural resources program on the OCS are:

(1) Shipwreck Archaeology--is the magnetometer effective in locating and/or avoiding historically significant shipwrecks with present line spacing?

(2) Prehistoric Archaeology--what are the capabilities for site identification and information retrieval using current coring techniques (penetration, core analysis, spacing, and configuration)?

(3) What is the overall cost/benefit ratio of the cultural resources program on the OCS?

Ms. Stright stated that in her opinion an initial change in the program which would be beneficial to both industry and archaeology would be to reduce the broad high probability area where archaeological surveys are currently being required by using existing geophysical data to outline areas of increasingly lower probabilities for site occurrence, locatability, and recoverability.

Evaluation of the Current Cultural Resources Program

Speaker: Reynold Ruppé, Arizona State Univ., Tempe, AZ

Dr. Reynold Ruppé talked on the results of his study conducted during a six month IPA appointment with BLM. This study was designed to evaluate the effectiveness of the current cultural resources program on the OCS in meeting the intent of the law. It involved assessment of the quality of the marine survey archaeological reports over the last six years. Dr. Ruppé brought up the following major problems with the current program:

(1) There are basic conflicts between federal agencies, particularly USGS and BLM, regarding their specific responsibilities and authorities under the current program.

(2) Report quality is not assured because there is no "peer review" of the marine survey archaeologists' reports. The result is that in the reports reviewed by Dr. Ruppé, neither the geophysicists nor the marine survey archaeologists are doing adequate assessment. A related problem is that most survey jobs and archaeological assessments are contracted to the "low bidder." Two possible solutions to problems with quality assessments were offered: (a) send examples of what are thought to be inadequate reports to the Society of Professional Archaeologists (SOPA) grievance committee for review; and (b) have BLM and USGS require that the reports be published.

(3) The ultimate legality of the program is in question: (a) the Antiquities Act of 1906 was ruled inapplicable to the OCS as per the 1978 "Atocha decision," and (b) the question has been raised as to the applicability of the National Historic Preservation Act of 1966 to the OCS. Dana Larson of Exxon made the point that the OCS Lands Act, as amended,

specifically states that "Exploration will not . . . disturb any site, structure, or object of historical or archaeological significance."

(4) Responsibility for further investigations is in question. Should the federal government or the lessee have this responsibility?

(5) Adequacy of the program cannot be assessed without ground truthing of selected anomalies.

Dr. Ruppé's presentation was interrupted by numerous comments and discussion. After the question of the legality of the program was discussed at length, it was mutually agreed by all present that to proceed with any meaningful discussion of the cultural resources program, the legality of the program would be assumed.

As the result of Dr. Ruppé's presentation, and the extensive discussions it produced, four major concerns were raised:

(1) After six years and over 1,000 marine survey reports, no real archaeological information has been collected in the Gulf of Mexico as a result of the present program.

(2) Are the archaeological surveys currently being required in the Gulf of Mexico effective in identifying and/or avoiding significant cultural resources in terms of technology, assessment quality, and the amount and type of further investigations being conducted?

(3) Use and transfer of data being gathered are inadequate. There is very little sharing of data, and there is no central storehouse for the data.

(4) There is no professional review of marine survey archaeologists' work outside the federal agencies.

The Predictive Model for Prehistoric Site Occurrence

Speakers: Sherwood Gagliano, Coastal Environments, Inc., Baton Rouge, LA
Robert J. Floyd, John Chance and Associates, Inc., Lafayette, LA

After the general discussion session, Dr. Sherwood Gagliano gave a short presentation on the predictive model for prehistoric site occurrence presented in his 1977 cultural resources baseline study for the northern Gulf of Mexico. He also spoke briefly on the progress and preliminary findings of a study he is currently doing under contract with HCRS entitled "Sedimentological Studies of Archaeological Deposits."

The basic tenets and findings of Dr. Gagliano's studies indicate that areas of high probability for the occurrence of drowned

prehistoric archaeological sites may be located on sub-bottom profiler records by using the terrestrial analogue of site association with specific features of coastal geomorphology. These areas of high probability can then be investigated further through core analysis. The preliminary findings of his sedimentological studies indicate that certain sedimentological parameters may be identified which can distinguish a cultural deposit from a naturally occurring deposit.

Robert J. Floyd presented additional evidence supporting Dr. Gagliano's position by showing specific sub-bottom profiler records of well defined relict geomorphology which, using the terrestrial analogue of Avery Island, Louisiana, would indicate areas of high probability for prehistoric site occurrence.

Alternative Courses of Action

As a result of Monday's discussions, the following four courses of action for the OCS cultural resources program surfaced:

(1) Status Quo--continue the OCS cultural resources program in its present form (requiring surveys within the high probability area at 150 m line spacing).

(2) Eliminate the requirement for an archaeological survey at 150 m line spacing. Work more closely with the oil industry and use the geophysical data being gathered at 300 m line spacing as the basis for "in-house" archaeological assessments by USGS and BLM, calling in consulting archaeologists when the need arises. Geophysical data would also be used to identify areas for further archaeological studies, which would be jointly funded by the government and industry.

(3) Continue the archaeological survey requirements at 150 m line spacing, but eliminate the contract archaeologist by routinely requiring that all magnetic anomalies, side-scan sonar contacts, and certain relict geomorphology be avoided by oil and gas activities.

(4) Continue the archaeological survey requirements at 150 m line spacing, but eliminate many areas from the archaeological survey requirements by using existing geophysical data to outline areas of increasingly lower probability for site occurrence, locatability and recoverability, within the currently broad high probability area.

On Tuesday, May 13, the opening session was geared to this fourth alternative. Reports were given on two recent geological studies in the Gulf of Mexico and the applicability of the results of these studies towards the deletion of large areas from the archaeological survey requirement.

Subaqueous Sediment Instabilities in the Offshore Mississippi Delta
Speaker: Jim Coleman, Louisiana State Univ., Baton Rouge, LA

Dr. Jim Coleman reported on the results of a recent BLM study entitled "Subaqueous Sediment Instabilities in the Offshore Mississippi Delta." Side-scan sonar and seismic data compiled for the active delta region indicate that the current Mississippi Delta area is covered by a thick sequence of Recent sediments, and that faulting, slumping, and mass sediment movement are widespread. Recent disturbed sediments within the survey area ranged from zero to more than 200 feet thick. Dr. Coleman stated that the depth of sediments deposited in the survey area over the last 100 years alone averages about 40 feet thick.

Mr. Robert Floyd, in commenting on the archaeological implications of this information, combined with his own diving experience in the active delta, stated that he felt further archaeological investigations, even for historic shipwrecks, in the active Mississippi Delta are not feasible. J. Barto Arnold III, State Underwater Archaeologist for Texas, took exception to Mr. Floyd's assessment. Arnold stated that the Mississippi Delta area is an extremely high probability area for the occurrence of historic shipwrecks, and that it therefore should not be deleted from the archaeological survey requirements. He further stated that even though further investigations may not be feasible, ferromagnetic remains of wrecks could still be located and avoided by oil and gas activities.

Dr. Coleman's response to this argument was that the mass sediment movement throughout the historic period would probably have completely destroyed and scattered any ships which might have gone down in the area. Dr. Gagliano commented that should Mr. Floyd's suggestion be adopted, the near-shore submerged historic sites off the mouth of the Mississippi should not be "written off." These sites, however, lie in waters under the jurisdiction of the State of Louisiana, and management decisions made on the OCS would not affect such sites.

No final consensus was reached on the recommendation by Robert Floyd to delete from the archaeological survey requirement the blocks covered by Dr. Coleman's data.

BLM's Geological Mapping Program in the Gulf of Mexico
Speaker: Henry Berryhill, USGS, Corpus Christi, TX

Dr. Henry Berryhill reported on his ongoing geologic mapping program for the BLM in the Gulf of Mexico. His work involves constructing a series of regional geologic base maps from existing USGS preleasing shallow seismic data at 1.5 mile line spacing and collecting new seismic data on a three-mile grid to tie in existing data. It was Dr. Berryhill's position that maps produced by the study would be useful in redefining high probability areas for the occurrence, locatability, and preservation of archaeological sites.

Maps on the series which may provide useful information for this purpose include:

(1) Water Circulation--Rates of Sedimentation
(2) Paleogeography and Depositional Environments, Late Pleistocene and Holocene
(3) Post Wisconsin Sedimentation Patterns and Tectonism
(4) Structure of the Continental Terrace--Salt Diapirs

Dr. Gagliano qualified the usefulness of these maps by stating that both the geomorphology detailed on the maps and the time intervals covered by the maps are of too gross a scale for direct application to archaeological problems. Dr. Gagliano expressed a desire to work directly with the original data to compile maps more useful for the archaeological problems at hand.

Procedures and Problems in Archaeological Remote Sensing Surveys
Panel Discussion: Joint Session, Geophysicists and Archaeologists

The second session on May 13 was a joint session of geophysicists and archaeologists to discuss the procedures and problems involved in the archaeological remote sensing surveys. Discussion focused on the capabilities of the current surveys at 150 m line spacing for locating historic shipwrecks and prehistoric archaeological sights. As a result of the panel discussion, the following major points were brought out:

(1) The technology and methodology exist to locate historically significant shipwrecks; however, the general survey mode of the present surveys probably will not locate all historically significant wrecks.

(2) The present surveys at 150 m line spacing were designed as sampling surveys. The concept was to avoid all evidence which may indicate the presence of a shipwreck (all unidentified magnetic anomalies and side-scan contacts) by the distance to the next survey line (150 m).

(3) Designing archaeological surveys with a search mode and 100% magnetometer coverage would not be economically feasible on a routine basis.

(4) All present agreed that some ground truthing of magnetic anomalies is absolutely necessary to further evaluate the effectiveness of the current survey methodology. Barto Arnold indicated that one-third of all promising magnetic anomalies in state waters without any side-scan sonar confirmation, when investigated, have been related to shipwrecks. However, he also stated that this correlation on the OCS would probably be much lower.

(5) Dr. Berryhill asked whether any evidence of shipwrecks might be observed on sub-bottom profiler records. After some discussion, the general consensus was that no such evidence would be observed due to the interference in the shallow returns of seismic signals.

(6) Evidence of relict geomorphology, which would indicate areas of high probability for prehistoric site occurrence, is observable on sub-bottom profiler records; however, evidence of specific sites generally is not observable, due to the relatively small size of most prehistoric sites.

(7) It would be possible to improve survey methodology to actually locate evidence of extremely large cultural deposits; however, once again this was thought to be not economically feasible.

Opinions on the effectiveness of the existing archaeological surveys ranged from the feeling that they are absolutely useless to the opinion that they are gathering useful information for future studies and that as a result of the surveys, numerous archaeological sites both historic and prehistoric, are probably being avoided by oil and gas activities.

It was Dr. Berryhill's suggestion that technological capabilities and economic feasibility be the main factors considered in determining our survey requirements and methodology. Dr. Berryhill strongly supported the option of using available information to refine high probability areas where archaeological surveys are required down to areas of "highest probability," where more intensive surveys, further investigations, and future study efforts should concentrate.

At the end of this session Barto Arnold offered the following resolution for adoption by the group:

Given that:

(1) neither industry nor the archaeological community are satisfied with the current OCS cultural resources survey requirements;
(2) both industry and the archaeological community wish to avoid disturbing objects causing magnetic anomalies and to avoid certain sub-bottom geological features which may be high probability locations for prehistoric sites and hazardous to rig stability; and
(3) analysis and synthesis of existing data are inadequate and basic field research under-funded.

Be it resolved that:

(1) means be developed to accomplish the avoidance mentioned in #2 above in a more reasonable, mutually satisfactory manner; and
(2) BLM and industry fund more basic research and synthesis on OCS cultural resources on a high priority basis.

This resolution was seconded by Dr. Gagliano. No opposition to the resolution was expressed.

As a result of the meeting, two specific proposals for future studies were offered:

(1) A study to ground truth selected magnetic anomalies in order to determine what types of ferromagnetic objects produce what types of signatures, and what types of objects are being located and avoided as a result of surveys. Thousands of anomalies have been located and simply avoided by oil and gas operations, with no further confirmation or investigation, and therefore no further archaeological information on the Gulf.

(2) A study to run intensive surveys and do extensive data collection and testing of a specific high probability area for prehistoric site occurrence in order to actually locate prehistoric sites on the OCS and to help establish characteristic site signatures.

Recreation-Tourism

Participants

The following is a complete listing of those attending some or all of the recreation-tourism session:

James Barkuloo	U.S. Fish & Wildlife, Panama City, FL
T. J. Ciaffone	USGS, Metairie, LA
Barney Congdon	BLM, New Orleans, LA
Bob Ditton	Texas A&M University, College Station, TX
Carolyn French	U.S. Fish & Wildlife, Slidell, LA
Benny Gallaway	LGL Ecological Research Associates, Bryan, TX
Mark Grussendorf	BLM, New Orleans, LA
Tommy Hill	Louisiana Geological Survey, Baton Rouge, LA
Bonnie LaBorde	USGS, Metairie, LA
Dana Larson	Exxon, Houston, TX
Bethlyn McCloskey	Gulf of Mexico FMC, Metairie, LA
Gail Rainey	BLM, New Orleans, LA
Villere Reggio	BLM, New Orleans, LA
G. Ed Richardson	BLM, New Orleans, LA
Ron Schmied	Recreational Development Services, NMFS, St. Petersburg, FL

Introduction

Mr. Villere Reggio, Workshop Chairman, structured and focused the session agenda so as to divulge and share information on recreational fishing in the offshore environment, with particular emphasis on the inter-relationship between offshore oil and gas structures and marine recreational endeavors. Reggio prefaced the workshop session by noting that the BLM OCS leasing program has contributed in large measure to the more than 3500 oil and gas structures in the Gulf of Mexico, and stated that it was his firm belief that these artificial structures have had and will continue to have a profound influence on fish and fishing. Invited participants included key individuals from government, industry, and academia responsible for and knowledgable about the recreational fishery associated with the Gulf of Mexico. The formal presentations are summarized below.

Marine Recreational Fishery Studies in the Southeast

Speaker: Ronald L. Schmied, Chief, Recreational Development Services Branch, NMFS, St. Petersburg, FL

Ron Schmied, who is the NMFS principal contact for recreational fishery matters relating to the Gulf, South Atlantic, and Caribbean, set the stage by characterizing the goals and problems associated with the rapidly developing southeastern marine recreational fishery. He began by emphasizing the need to understand data collection problems when assessing recreational fishery studies. One problem he identified as "fisherman's bias" dealt with assessing the uncertainty of a fisherman's "fish story," and with the serious problem of locating and quantifying recreational fishermen in the southeastern United States.

The NMFS has employed a new survey methodology which utilizes both telephone and intercept modes, developed by Human Sciences Research, Inc. Interested parties (states, localities) can buy into the survey, which will continue for 3-5 years and will offer catch/effort/ participation data. Unfortunately, the results of the 1979 marine recreational fishery survey for the Gulf were not available in time for the workshop.

Through the use of some startling statistics gathered from former regional and national surveys (Tables I-IV), Schmied demonstrated that marine recreational fishing in the southeast United States is an area of growing popularity, economic significance, and consequence to the region. In the years following World War II, increases in affluence, discretionary income, leisure time, and mobility of the American population, along with increased technology and population shifts to the coasts, were instrumental parameters affecting the increase in outdoor water-based recreation. Between 1955 and 1975, participation in salt water sport fishing in the United States increased 3.5 times and related expenditures grew sevenfold. In contrast to the South Atlantic, most recreational fishing in the Gulf of Mexico in 1970 occurred in bays, sounds, and rivers, probably due to the accessible coastline. Only 38% of marine recreational fishing occurred offshore in the eastern Gulf of Mexico. Although undocumented, increases in offshore recreational fishing in the last ten years have been attributed to the establishment of offshore drilling platforms.

Schmied sees energy-related impacts to be most significant in future changes of recreational fisheries. The NMFS plans to initiate a socioeconomic survey to understand future impacts, to continue their National Survey to better identify salt water fishing and target species, and to develop a salt water vessel enumeration system to aid in better documentation of fishing vessels.

The full text of Schmied's remarks is included in a paper he is preparing entitled "Development of Marine Recreational Fisheries in the Southeastern U.S.: Problems and Solutions." Copies of the final document will be made available on request to his office.

Biological Aspects of Oil and Gas Structures as Artificial Reefs

Speaker: Benny J. Gallaway, President, LGL Ecological Research Associates, Bryan, TX

Dr. Benny Gallaway, who has over ten years of experience studying Gulf of Mexico reefs and reef associated organisms, was asked to describe for the workshop the biological aspects of oil and gas structures as artificial reefs. He was a principal investigator on BLM and NMFS studies of the encrusting organisms and fish associated with oil and gas structures in the Gulf of Mexico off Louisiana and Texas.

Dr. Gallaway noted that oil and gas structures in the Gulf of Mexico are rapidly colonized by epiferric organisms, also known as biofouling organisms, and thus serve as artificial reefs. Reef

TABLE I - PARTICIPATION AND EXPENDITURES FOR SALTWATER SPORT FISHING IN THE UNITED STATES*

CRITERIA	YEAR 1955 Thousands	1960 Thousands	1965 Thousands	1970 Thousands	1975 Thousan
A. Number of Saltwater Sport Fishermen	4,557	6,292	8,305	9,460	16,40
B. Number of Recreation Days Saltwater Sport Fishing	58,621	80,602	95,837	113,694	207,2
C. Expenditures of Saltwater Sport Fishermen	$488,939	$626,191	$799,656	$1,224,705	$3,450,0

*Data from 1970 and 1975 National Survey of Fishing and Hunting and Wildlife Associated Recreation. U.S. Department of the Interior, Washington, D.C.

TABLE 11— ESTIMATED NUMBER OF SALT-WATER ANGLERS AND THEIR CATCHES IN THE UNITED STATES IN 1960, 1965, and 1970, by SURVEY REGION *

	REGION	Number of anglers			Number of fish caught			Weight of fish caught		
		1960	1965	1970	1960	1965	1970	1960	1965	1970
		Thousands			Thousands			Metric Tons		
I.	North Atlantic (New England and New York)	1,160	1,530	1,666	97,383	172,660	117,014	83,518	143,800	121,569
II.	Middle Atlantic (New Jersey to Cape Hatteras)	1,344	1,375	1,767	114,502	92,126	168,209	80,909	58,313	111,939
III.	South Atlantic (Cape Hatteras to Florida keys)	1,024	1,720	1,808	156,942	190,802	184,177	168,233	178,106	183,597
	Gulf of Mexico 1/	1,412	--	--	184,582	--	--	186,868	--	--
IV.	East Gulf of Mexico (Florida West Coast to Mississippi River)	--	1,234	1,478	--	104,551	188,888	--	85,435	151,873
V.	West Gulf of Mexico (Mississippi River to Texas)	--	738	872	--	89,550	97,708	--	85,281	68,913
VI.	South Pacific (Pt. Conception South)	687	978	894	50,064	48,542	37,221	70,055	80,376	42,834
VII.	North Pacific (Pt. Conception North)	714	999	1,311	29,399	38,508	24,100	37,827	38,850	36,014
ALL REGIONS		6,198 2/	8,236 2/	9,392 2/	632.872	736,739	817,317	629,410	670,161	716,739

* This table is taken from the 1970 Salt-Water Angling Survey published by The National Marine Fisheries Service, 1973, Page 9.

1/ The Gulf of Mexico was not separated into East and West sampling regions for the 1960 Angling Survey.

2/ These figures are less than the sum of anglers for the individual regions because some anglers fished in more than one region.

TABLE III - CHARACTERIZATION OF MARINE RECREATIONAL FISHING IN THE SOUTH ATLANTIC AND GULF OF MEXICO

Characteristic	South Atlantic	East Gulf***	West Gulf***
(1) Estimated Total No. Anglers (1970)*	1.8 million	1.5 million	.9 million
(2) Estimated Total No. Fish Caught (1970)	184.2 million	188.9 million	97.7 million
(3) Estimated Total Weight of Catch (1970)	183.597 metric tons	151,873 metric tons	68,913 metric tons
(4) Percent Fishing in Bays, Sounds, Rivers (1970)	38%	62%	55%
(5) Percent Fishing in Ocean (1970)	62%	38%	45%
(6) Percent Fishing by Method of Fishing (1970)			
a. Private or rented boat	25.2%	37.7%	32.6%
b. Bridge, pier or jetty	28.1%	25.7%	33.1%
c. Bench or Bank	24.3%	16.5%	22.7%
d. Charter or headboat	22.4%	20.1%	11.6%
(7) Percent Fish Caught in Bays, Sounds, Rivers (1970)	39%	78%	52%
(8) Percent Fish Caught in Ocean (1970)	61%	22%	48%
(9) Percent Total Fish Weight Caught in Bays, Sounds, Rivers (1970)	29%	67%	57%
(10) Percent Total Fish Weight Caught in Ocean (1970)	71%	33%	43%
(11) Percent Fish Caught by Method of Fishing (1970)			
a. Private or rented boat	40%	46%	58%
b. Bridge, pier or jetty	26%	22%	23.8%
c. Beach or Bank	23%	21%	13.7%
d. Charter or headboat	11%	11%	4.5%
(12) Percent Total Fish Weight Caught by Method of Fishing (1970)			
a. Private or rented boat	56%	50%	57%
b. Bridge, pier or jetty	17%	23%	22%
c. Beach or bank	13%	21%	16%
d. Charter or headboat	14%	6%	4.5%
(13) Economic Impacts (1975)**			
a. Sales	$289 million	$424 million	$219 million
b. Value added	$108 million	$164 million	$ 83 million
c. Wages and salaries	$ 52 million	$ 81 million	$ 41 million
d. Employment (person-years)	8,090	11,560	5,970
e. Annual Capital Expenditures	$8.8 million	$11.5 million	$5.8 million

* Data from: 1970 Saltwater Angling Survey, National Marine Fisheries Service, Washington, D.C. April 1973.

** Data from: Economic Activity Associated with Marine Recreational Fishing, Centaur Management Consultants, Inc., Washington, D.C., June 1977.

*** A line extending south from the Mississippi River divides the Gulf into Eastern and Western subareas.

TABLE IV - NUMBER AND WEIGHT OF FISH CAUGHT BY UNITED STATES SALTWATER ANGLERS IN THE SOUTHEAST IN 1970. *

SPECIES GROUP	NUMBER			NUMBER		
	South Atlantic	East Gulf	West Gulf	South Atlantic	East Gulf	West Gulf
	Thousands			Metric Tons		
1. Barracudas	325	4	-	1,703	50.9	-
2. Black sea basses	7,218	1,248	12	5,627.7	800.9	10.9
3. Billfishes	214	8	-	5,676.8	250.5	
4. Bluefish	12,851	86	477	8,759.5	159.5	594.5
5. Bonitos	323	282	12	1,043	1,343.2	16.8
6. Catfishes	11,207	27,300	15,390	7,531.8	14,540.4	8,090.9
7. Cobia	26	8	85	352.3	37.3	19.5
8. Croakers	8,521	36,033	13,893	2,703.2	21,841.4	6,701.4
9. Dolphins	2,166	268	-	12,639.1	969.5	-
10. Black drum	5,195	4,402	5,087	5,510.5	7,316.4	5,910.9
11. Red drum	4,883	7,273	5,911	6,071.8	12,511.4	11,600
12. American eel	162	76	17	55.5	34.5	8.6
13. Summer flounder	3,724	4,421	2,176	4,062.7	3,655.5	1,356.8
14. Groupers	4,198	3,138	438	10,964.1	7,242.7	419.1
15. Grunts	21,800	8,820	11,825	11,800.9	3,233.6	1,961.8
16. Jacks	7,254	1,146	145	15,067.7	1,531.4	555.9
17. Kingfishes	15,035	11,959	3,243	6,605.9	5,762.7	1,412.2
18. Ladyfish	547	1,607	-	868.2	870.9	-
19. King macherel	4,165	2,813	259	15,882.7	11,127.7	1,353.6
20. Spanish mackerel	4,967	2,314	479	6,646.8	3,272.7	0.3
21. Mullets	461	3,565	257	155	838.6	43.2
22. Perches	389	769	688	102.7	367.7	265.4
23. Yellow perch		158			50.4	
24. Pompanos	143	546	135	69.5	357.7	81.4
25. Porgies	16,230	13,234	1,968	10,935.9	9,690.9	2,579.5
26. Puffers	9,102	208	25	2,018.2	45	3.6
27. Searobins	4	34	4	1.8	4.5	0.5
28. Sand Seatrout	47	21,818	8,189	10.5	9,601.8	4,247.7
29. Spotted Seatrout	13,992	28,481	24,298	11,381.8	18,576.8	18,403.2
30. Sharks	20	137	68	304	6,283.2	530.5
31. Sharks, dogfish	67	220	58	97.3	285.9	24.5
32. Skates & rays	105	163	271	213.6	542.3	728.6
33. Snappers	613	126	1,215	334	40.9	1,160.9
34. Red Snappers	1,797	3,557	119	2,582.7	5,163.6	126.4
35. Yellowtail Snappers	10,843	581	-	9,165	370	-
36. Snook	2,529	401	-	8,162.3	1,585	-
37. Atlantic Spadefish	56	1,042	190	23.2	815	128.6
38. Spot	12,110	-	-	4,472.7	-	-
39. Striped bass	71	-	-	85.9	-	-
40. Tunas	354	12	-	2,701.4	375.9	-
41. Wahoo	82	-	-	714.1	-	-
42. Miscellaneous	381	630	774	491.8	324.1	299.1
TOTALS	184,177	188,888	97,708	183,596.6	151,872.4	68,636.3

* Table taken from 1970 Salt-Water Angling Survey, National Marine Fisheries Service, Washington, D. C. 1973 pp. 11-13 and pp. 17-19.

assemblages characteristic of these platforms differ as a function of distance offshore and latitude. Community composition and structure on a given reef vary with depth, and biomass ranges up to 38 kg/m. Fish populations around these reefs are large and diverse, and include several game and commercial species. Some species are seasonal residents, whereas others reside at the platforms year round.

Red snapper populations are heavily exploited at platforms accessible to sport fishermen. The implications of this harvest are little documented, but one hypothesized scenario suggests that management actions are in order for the protection of the fishery.

A series of excellent underwater slides was used to illustrate his salient points and model demonstrations. The full text of Dr. Gallaway's research findings is included in a draft report to BLM, Volume II: "Artificial Reef Studies in Ecological Investigations of Petroleum Production Platforms in the Central Gulf of Mexico" (BLM Contract No. AA551-CT8-17). The final report will be made available through NTIS.

Fisherman Reaction to and Public Benefits of Artificial Reefs

Speaker: Robert B. Ditton, Dept. of Recreation and Parks, Texas A&M Univ., College Station, TX

Over the past seven years, Dr. Robert Ditton has focused investigations into fishermen reaction and public benefits associated with the various artificial reefs developed in the Gulf of Mexico. His research has demonstrated that collateral recreational use associated with oil and gas structures is highly significant, and, he believes, should be officially recognized.

Ditton highlighted the results of a 1977 study report on sport fishing participation patterns by the Houston-Galveston boating population. Offshore fishermen were reached through the state boat registration files. He is currently refining a survey sampling procedure which combines telephone interviews with mailouts, producing a phenomenal 90% response rate.

His 1977 survey initially determined that only one-third of the boating population in the Houston-Galveston area were salt water fishermen and 5% of those boats fished offshore. Oil and gas structures attracted more fishing than any other type of feature, natural or artificial: 87% of the boats that fished offshore and 50% of all offshore recreational fishing effort are directly associated with these platforms. The kingfish, snapper, and ling proved to be the most sought after offshore sport fishes. Ditton projected several figures on the overhead projector, identifying the study area and graphically depicting his findings (see Figures 1-3).

Examining boat length categories in relation to distance traveled offshore, he identified one of the determining factors in assessing offshore fishing activity. Fishing within 10 miles of shore was normally practiced by boats less than 19 feet long, with few larger

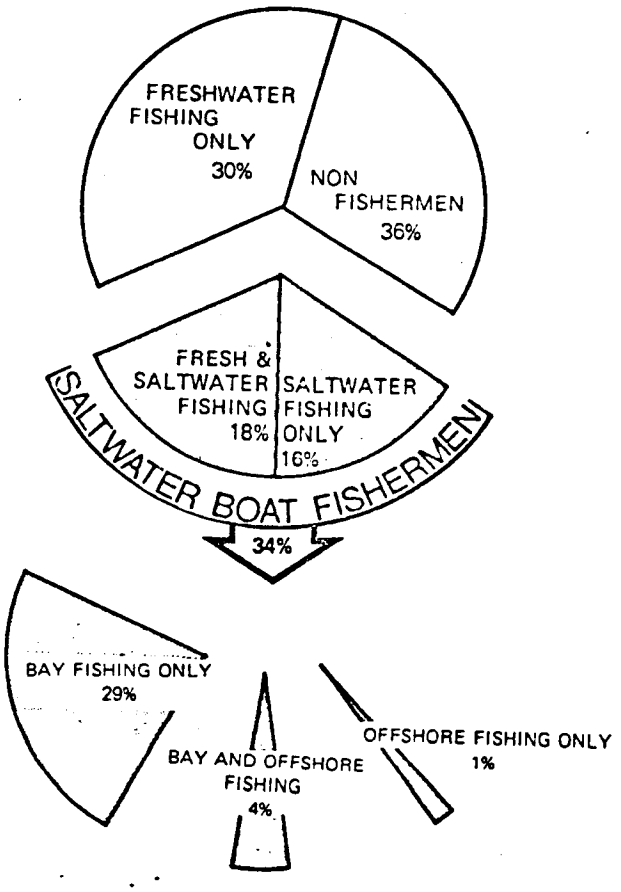

Figure 1: Distribution of the Population of Boat Owners, By Type of Boat Fishing Activity

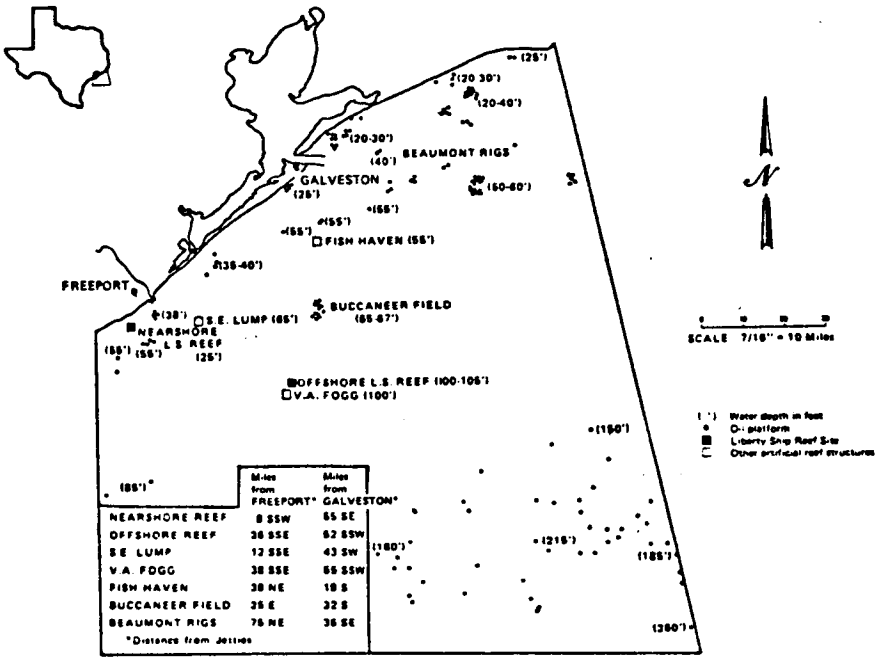

Figure 2: Map of the Offshore Area Adjacent to the Galveston Bay System

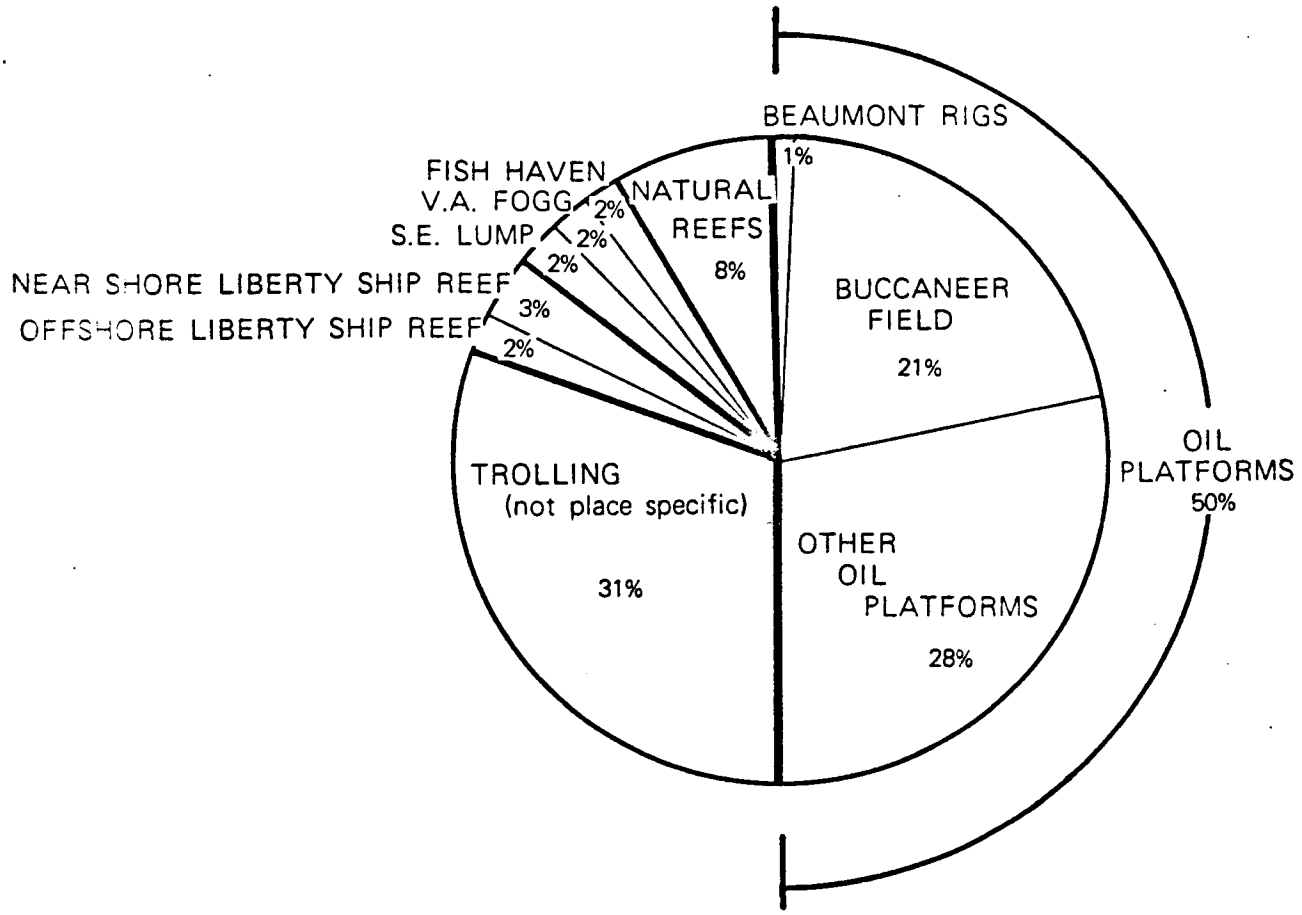

Figure 3. Offshore Fishing Trips

boats fishing at this close range. The 11-20 mile distance range offshore attracted the broadest and the largest constituency and was concluded to be the optimum range for artificial reef usage in the study area.

Ditton has also examined the spending patterns of offshore fishermen. Of the $80/day/fishing party spent, $53 was energy-related. He estimated that offshore fishermen pumped over five million dollars into the Houston-Galveston coastal economy during 1977. Although having less of an economic impact in the coastal zone than bay fishermen, which are a much larger group, offshore fishermen are bigger individual spenders and are more likely to do most of their spending in the shorefront access community.

In conclusion, Bob Ditton proposed that both the public and private sectors should interact in order to enable the perpetuation of platform benefits after oil production has ceased.

The following referenced material includes extensive discussion related to Dr. Ditton's presentation:

Ditton, Robert B. and Alan R. Graefe, 1978. Recreational Fishing Use of Artificial Reefs on the Texas Coast. Contract Report. Prepared for the Texas Coastal and Marine Council, Austin, 155 pp.

Ditton, Robert B. and James Falk, 1979. Obsolete Petroleum Platforms as Artificial Reef Material. Paper presented at the Regional Conference on Artificial Reefs, coordinated by Florida Sea Grant College, Daytona Beach, September 13-15, 1979.

Fishery Management Plans

Speaker: Bethlyn McCloskey, Member, Gulf of Mexico Fishery Management Council, Metairie, LA

Bethlyn McCloskey stressed the lack of data bases, especially concrete knowledge on which the Council can develop fishery management plans. The Council's "recognition of important parameters that need to be monitored, and of socioeconomic indicators that have not been assessed" is paramount. She gave a brief overview of the Council, which was formed in 1976. Before fishery management plans can be made, the Council must: (1) follow a scoping process; (2) deliberate the plan both in management meetings and in Council meetings; and (3) put forth the plan at public hearings.

McCloskey acknowledged that the Council is aware that oil and gas structures have a major influence on certain recreational fish and fishing and lamented the fact that so little documentation exists in this regard. This need might be infused into the Council's planning process and reflected in its individual management plans.

Offshore Structures and the Oil Industry

Speaker: Dana W. Larson, Exploration Dept., Exxon, Houston, TX

Dana Larson prefaced his remarks by stating that he was not a spokesman for the industry but would be pleased to make some observations of interest to the workshop. He reminded the group of the dramatic changes in the energy supply and demand situation of the 1970's and speculated that 40% of our energy supply in ten years will not come from today's sources. He believes our current problem does not stem from a lack of technology but is one of processing. He sees the "what-if?" question to be what if there is not enough energy. At present 5% of the total GNP is directed towards domestic energy development, and imports are frozen. Restrictions on industry do not encourage the promotion or expansion of business. Exxon's production is declining. Larson offered no solutions to his dismal "what-if?" of the energy crisis.

At present the oil industry is mandated by regulation to remove platforms once production has ceased. Cost of removing major structures runs into millions of dollars. As the cost of structure removal and dismantling increases, relocation of some structures may become more feasible. Exxon has successfully negotiated with the state of Florida to donate one of its obsolete structures as an artificial reef. The underlying conclusion presented was that disposal of obsolete offshore structures is a costly problem for industry and that there is every reason to believe industry will cooperate with responsible proposals to perpetuate collateral public value in these structures offshore, thus saving them money and enhancing their public image.

Recreational Implications of Offshore Oil and Gas Structures

Open Discussion

The remainder of the workshop involved open discussion on the recreational implications of offshore oil and gas structures.

Villere Reggio informed the group of BLM's effort to increase the data base on the scope of recreational use associated with oil and gas development. In this regard, BLM is attempting to buy in on the NMFS 1980-1981 marine recreational fishing survey for the Gulf of Mexico to learn the effort, catch, and participation of private boats and charter boats associated with oil and gas structures. In addition, with the cooperation of 30 offshore operators, BLM is collecting data on the fishing activity associated with more than 125 structures off the coast of Louisiana. These data will enable them to learn many facets of the recreational fishery directly associated with oil and gas structures, unavailable through the NMFS survey.

Tommy Hill of the Louisiana Geological Survey requested that future environmental statements indicate the number of obsolete structures being removed from the OCS along with a discussion of their ultimate disposition.

Paul Leach, a headquarters representative of NMFS, presented a draft concept paper he has prepared addressing the potential for continued use of obsolete oil and gas structures as artificial reefs. The specific objectives of his draft proposal are to examine the feasibility for utilizing oil and gas structures for artificial reefs, including but not limited to: (1) developing a national policy which recognizes the artificial reef benefits of oil and gas structures; (2) promoting the preparation of an artificial reef plan for the Gulf of Mexico; (3) establishing a standard procedure to ensure and facilitate timely conversion of obsolete structures to artificial reefs; (4) identifying research and studies necessary to optimize use of obsolete oil and gas structures as reefs; (5) identifying legal restrictions that may prevent use of obsolete oil and gas structures as artificial reefs, and prescribing means for overcoming them.

The workshop group endorsed the objectives of the concept paper and encouraged him to carry forward in obtaining the official commitment of the NMFS and others to these five objectives. Leach distributed copies to the workshop attendees and solicited comments after the workshop. Additional copies may be requested from him or from Villere Reggio.

Villere Reggio informed the group of another BLM-NMFS cooperative initiative aimed at fostering the development of a prototype fisherman's map in an area of extensive impact from oil and gas development. The map would be useful to both commercial and recreational fishermen. More details on this project initiative are available from him or from Paul Leach.

This workshop has unequivocally demonstrated that oil and gas structures in the Gulf of Mexico are significantly affecting primary target, sport, and food fish under the water, which have had a major influence on fishing patterns and fishermen habits above the water. Considering the temporary nature of production platforms and likely expansion of oil and gas exploration and development throughout the Gulf of Mexico, as well as other areas, it is recommended:

(1) That a continued, and as feasible, expanded biological, social, and economic data base be generated and analyzed which will apprise decision makers in government and industry of the full ramifications of oil and gas production platforms on the Gulf of Mexico recreational fishery.

(2) That the conclusions derived from this data analysis and synthesis be widely promulgated for a broader understanding of the determinable consequences of offshore oil and gas development on fish and fishing.

(3) That government take the lead in facilitating and perpetuating the serendipitous public enjoyment and benefit derived from offshore oil and gas development.

Nearshore Biology

Participants

The nearshore biology group was attended by the following;

Richard Bennett	USGS, Metairie, LA
David Blanc	State of Louisiana, NSTL, Bay St. Louis, MS
Michael Brim	FWS, Panama City, FL
Carolyn French	FWS, Slidell, LA
Thomas Fritts	FWS, Belle Chasse, LA
James Johnston	FWS, Slidell, LA
Jacob Lehman	BLM, New Orleans, LA
Ronald Magee	NOAA, NSTL, Bay St. Louis, MS
Larry Shanks	FWS, Slidell, LA
Ted Stechmann	USGS, Metairie, LA
John Steen	NOAA, Ocean Springs, MS
Mike Windham	La. Dept. of Wildlife & Fisheries, New Orleans, LA

Introduction

The following topics were discussed in the nearshore biology group: ecological characterization studies, a marine bird study, and an endangered species study.

Ecological Characterization Studies

Speaker: James Johnson, FWS, Slidell, LA

The Gulf of Mexico Coastal Ecological Characterization Program currently consists of five separate studies: Chenier Plain (southwestern Louisiana and southeastern Texas) completed 1979; Mississippi Deltaic Plain Region (southeastern Louisiana and Mississippi) to be completed fall 1981; Texas Barrier Islands Region to be completed winter 1981; Northeastern Gulf of Mexico Coast (Alabama and panhandle of Florida) to be completed fall 1983; and Southwestern Florida, including the Keys, to be completed fall 1983. The major purpose of an ecological characterization is to compile existing information about coastal ecosystems from biological, physical, and social sciences. Specifically, the objectives of the ecological characterization are to:

(1) Assemble, review, and integrate existing biological, physical and socioeconomic information to establish a sound information base for decision-making purposes.

(2) Identify and describe various components (subsystems-drainage basins and watershed units, habitats, communities, and key populations and species in coastal ecosystems).

(3) Identify and describe major physical, biological, and socioeconomic processes and interactions that are related to the components of the various ecosystems.

(4) Relate known and potential ecosystems' responses to natural and man-induced changes, emphasizing OCS oil and gas activities.

(5) Identify major information deficiencies, as an aid to determining research priorities in the study area.

The products of the characterization studies will be:

(1) An ecological atlas consisting of maps and diagrams with supporting narrative and tabular data that depict biological resources, coastal processes, socioeconomic activities, coastal studies locations, physical features, and hydrological information. Map scales vary from 1:24,000 to 1:100,000, depending upon the topic portrayed.

(2) Conceptual ecosystem models which define and delineate physical processes, biological resources, socioeconomic features, the functional relationships among them, and the forces that influence them.

(3) A narrative report explaining cause and effect relationship of human activities and natural changes and controlling influences upon the study area.

Marine Bird Study

Speaker: Larry Shanks, FWS, Slidell, LA

The marine bird study will synthesize and analyze information about marine birds occurring in the Gulf of Mexico OCS region as follows:

(1) Distribution, abundance, seasonality, and movements of selected marine birds occurring in the study area.

(2) Food habitats of these marine birds.

(3) Relation of species distribution and abundance in the study area to total distribution and abundance.

(4) Review, assessment, and evaluation of the impact of OCS oil/gas activities on marine bird species in the study area.

(5) Identification, description, and evaluation techniques to minimize or eliminate marine bird exposure to catastrophic and chronic perturbations, disturbances, displacements, and hazards associated with OCS oil/gas activities.

The products of the marine bird study will be species counts for approximately 130 marine bird species and maps with winter and breeding distributions. The study should be available about August 1980.

The final report for the marine mammal, bird, and turtle study in the Gulf of Mexico will be available about August 1980. The objectives

of the study are to collect and analyze field data on the distribution of marine mammals, birds, and turtles; to synthesize available data; to identify and describe areas of biological significance to these species; and to develop a comprehensive study plan for future studies of these species.

Endangered Species Study

Speaker: Thomas Fritts, FWS, Belle Chasse, LA

A continuing study for endangered and threatened species in the Gulf of Mexico and South Atlantic, similar to the above pilot study, has received FY 80 funding. There will be four subunits for this study: Meritt Island, FL; Charlotte Harbor, FL; Marsh Island, LA; and Brownsville, TX areas. Results will be published in early 1982 as three reports: literature synthesis; Manatee studies in peninsular Florida; and aerial survey work for marine mammals (birds and turtles) in the four study areas.

Chemistry

Participants

The chemistry session was attended by the following persons:

Ken Adams	FWS, Slidell, LA
Elliot Atlas	Texas A&M University, College Station, TX
Richard Defenbaugh (Chairman)	BLM, New Orleans OCS Office, LA
Terry Hight	USGS, Bay St. Louis, MS
Don E. Johnson	Southwest Research Institute, San Antonio, TX
Tom Kraemer	USGS, Bay St. Louis, MS
Patrick L. Parker	University of Texas, Port Aransas, TX
David F. Reid	Naval Ocean Research & Development Activity, NSTL Station, MS
William Sackett	University of South Florida, St. Petersburg, FL

Radionuclides in Formation Water from Petroleum Production Facilities

Speaker: David F. Reid, Naval Ocean Research and Development Activity, NSTL Station, MS

Dr. David Reid presented and discussed data on radionuclides in formation water produced and/or discharged from petroleum production facilities in the central Gulf region. These proved not to be a hazard for the offshore environment, even though values may be four levels of magnitude higher in formation water than in open sea water.

Values range from approximately 40 to 1000 pCi/l. Geothermal brines range from approximately 40 to 1000 pCi/l for radium-226 and 40 to 500 for radium-228. In contrast, salt dome brines produced by the Strategic Petroleum Reserve Project are very low in radium-226, ranging from 0.4 to 3.1 pCi/l in samples analyzed. The sources of radionuclides in formation waters are naturally occurring minerals in shales and sandstones. Radium in fresh water sources is typically bound to suspended particles, but desorbs into solution when exposed to salt water as the fresh water enters estuaries or bays.

Despite the higher levels in formation water as compared to open sea water, there seems to be no apparent human health or environmental contamination problem, because of the rapid dilution of these formation waters when discharged offshore. On land, formation waters are typically reinjected or disposed of down disposal wells. There are some instances of discharges into coastal marshes, however, which might allow accumulation of these materials in sediments or biota. The only problem apparent at present is one of regulation; proposed EPA regulations would classify normal formation waters as a "hazardous waste" because of the levels of radionuclides which occur naturally, and would prohibit their release into the environment. Resolution of this bureaucratic problem was beyond the scope of the workshop.

Low Molecular Weight Hydrocarbons Released to the Marine Environment

Speakers: William Sackett, University of South Florida, St. Petersburg, FL

Dr. William Sackett discussed low molecular weight hydrocarbons released to the marine environment, and noted that about ten times as much of these hydrocarbons is introduced by underwater venting, as compared to discharge of produced formation waters. Dr. Sackett and his students have conducted numerous studies on occurrences, distributions, concentrations, and effects of these hydrocarbons in and on the marine environment of the northern Gulf of Mexico. Laboratory tests indicate a high toxicity of some compounds, especially the volatile aromatics, especially to phytoplankton. However, the "GUFEX" field study examined the effects of underwater venting and could find no apparent impact on phytoplankton in the vicinity of the vents. Dr. Sackett suggested that above-water flaring (with flame) is environmentally more desirable than underwater venting, but is probably more dangerous in terms of engineering design and facility safety considerations. No consensus was reached on whether underwater venting is a problem, because no adverse effects have been documented.

South Texas Studies and Ixtoc-1

Speaker: Patrick Parker, University of Texas, Port Aransas, TX

Dr. Patrick Parker briefly discussed levels of hydrocarbons in the South Texas area and related study needs. He indicated that prior to the Ixtoc-1 oil spill, levels of hydrocarbons in the area were "background," and of no environmental concern. Samples of sediments exposed to Ixtoc oil had not been analyzed, but water samples indicated an increase by 2 to 3 orders of magnitude of dissolved hydrocarbons in the water column. Dr. Parker stressed the need for more knowledge of details of biological phenomena in time and space with major biological events. Examples he gave included a lack of definitive information on spawning sites of redfish, and knowledge of where in the water column gravid shrimp release their eggs. Lack of these and similar bits of information precluded sound decisions on mitigatory actions for the Ixtoc-1 oil as environmental impact due to the spill.

Central Gulf of Mexico Platform Study

Speaker: Don E. Johnson, Southwest Research Institute, San Antonio, TX

Dr. Don Johnson briefly discussed findings from the Central Gulf of Mexico Platform Study, and indicated that the area exhibits generally elevated levels of hydrocarbons, including aromatic compounds. These aromatic compounds are predominantly petroleum constituents, not pyrogenic contaminants. Aromatic compounds were generally absent from samples analyzed in the South Texas and MAFLA study areas. The concentrations of hydrocarbons in the Central Gulf are higher than

those in the less developed western and eastern Gulf regions, but are lower than those found in bays (Corpus Christi, Galveston, and Chesapeake Bays were mentioned) or in a charcoal-broiled steak.

The group as a whole discussed information needs and strongly endorsed suggestions for field process studies, especially those addressing ecosystem processes and physical oceanographic circulation processes in the Gulf.

Physical Oceanography

Participants

The physical oceanography section was attended by the following:

David Amstutz	BLM, Washington, DC
Floyd Bryan	USGS, Metairie, LA
Wen-Ssn Chuang	CSI/LSU, Baton Rouge, LA
Don Day	NOAA/OMPA, Bay St. Louis, MS
Johnny Dickey	USGS, Metairie, LA
Peter Duncan	Lawrence Berkeley Lab., Berkeley, CA
Ya (Phil) Hsueh	Florida State Univ., Tallahasse, FL
Norden E. Huang	NASA/WFC, Wallops Island, VA
Harley Hurlburt	NORDA, Bay St. Louis, MO
Andy Johnson	NOAA Data Buoy Office, Miami, FL
Clifford D. Leitao	NASA/WFC, Wallops Island, VA
David McGrail	Texas A&M Univ., College Station, TX
William Merrell	Science Applications Inc., Bryan, TX
Steve A. Piacsek	NORDA, Bay St. Louis, MO
William Schroeder	University of Alabama, Marine Science Program, Mobile, AL
Dong-Ping Wang	Argonne National Lab., Argonne, IL
William J. Wiseman,Jr.	CSI/LSU, Baton Rouge, LA
Ed Wood	BLM, New Orleans OCS Office, LA
Kurt Zimmerman	NOAA Data Buoy Office, NSTL Station, MS

After a review of past and projected leasing activity, the workshop members introduced themselves and described their areas of interest. These are summarized below.

Circulation Pattern Around the East Flower Garden

Speaker: David W. McGrail, Dept. of Oceanography, Texas A&M Univ., College Station, TX

Dr. Dave McGrail expanded on an earlier presentation, discussing the circulation patterns found around a topographic feature (the East Flower Garden Bank). In his study, a combination of physical, geological and biological evidence showed that the water near the base of the feature flowed around and not over the structure.

The circulation actually formed a mote-like feature around the bank with prominent sand waves (on the order of h = 1 m, L = 10 m) normal to the bathymetric contours. The highest extent of the nepheloid layer was to a depth of about 85 m. Examination of the current meter records indicated occurrences of internal waves and tidal frequencies, as well as 3-5 day episodic phenomena and some significant energy at 48 hours. There are daily surges in the currents sufficient to resuspend the sediments.

General Circulation of the Gulf of Mexico

Speaker: William Merrell, Science Applications, Inc., Bryan, TX

Dr. William Merrell discussed the general circulation of the Gulf of Mexico. The Gulf of Mexico is a closed basin except for an inlet through the Yucatan Strait, and an outlet through the system is about 30×10^6 $m^3 \cdot s^{-1}$.

The eastern Gulf is dominated by the Loop Current, which forms intermittently from the northward flow through the Yucatan Strait. Temperature data in the form of 20°C isotherm surface topography was used to hypothesize ring formation. The northern extension of the Loop Current separates from the main flow forming an eddy or warm ring (anti-cyclonic) and subsequently migrates into the western Gulf. Data were presented indicating that as many as three eddies may have formed in one year.

The western Gulf circulation is influenced by the movement of eddies and effects of wind and tides. The eddies tend to move westward about 2.1 $km \cdot d^{-1}$. The eddies eventually lose energy when they impinge upon the shelf in the northwestern Gulf. Eddies are believed to lose energy through friction, heat loss, and dispersion into the lower levels. The cold (cyclonic) features have been observed in the western Gulf to extend down to about 1500 m. A nearly permanent wind-driven "low" or cyclonic eddy exists in the Gulf of Campeche. Other lows, in the form of eddies and troughs, are associated with the westward migrating eddies.

Predicting Eddy Formation from the Loop Current

Speaker: Steve Piacsik, NORDA, Bay St. Louis, MA

Steve Piacsek discussed the results of a two-layer model (separated by 200 m) which predicts eddy formation from the Loop Current on the average of 320 days. By changing several parameters, it has been determined that the depth distribution of the inflow controls whether or not the Loop Current will form. If the transport is near the surface, the Loop Current will extend far up into the eastern Gulf of Mexico. However, if the flow is deep enough to interact with the topography, the flow turns to the right around Cuba and into the Straits of Florida. An eastward flow in the central Gulf will also retard intensification of the Loop Current.

It is interesting to note that the Gulf Stream follows its present flow in the model even if the Florida Peninsula is removed. It may be that Florida is where it is because of the Gulf Stream and not the reverse. Another interesting result of parameter testing is that mean monthly Gulf winds have less influence on the Gulf circulations than the wind curl over the Atlantic (affecting circulation through the Yucatan Strait flow). Dr. Piacsek presented a film strip of the model results showing eddy formation in the eastern Gulf, a southwestward migration to the western shelf edge, then northward movement until the eddy dies out in the northwest Gulf of Mexico.

Three-Dimensional Time Dependent Model

Speakers: Dong-Ping Wang, Argonne National Lab, Argonne, IL

Dong-Ping Wang discussed the three-dimensional time dependent model funded by DoE's Ocean Thermal Energy Conversion program (OTEC). The model has been applied to the Gulf, a data base assembled, and several test runs made. Some problems have been experienced with the sigma coordinate system. Work is continuing on this model. [BLM is interested in the DoE model (Princeton of Dynalysis) for its own use and plans to support the collection of transport data.]

DoE Work and OTEC Sites

Speaker: Peter Duncan, Lawrence Berkeley Lab, Berkeley, CA

Peter Duncan addressed related DoE work especially as it pertains to OTEC sites on the eastern Gulf of Mexico shelf slope. A site at Key West is under consideration; however, the Gulf Stream is often most intense on the Cuban side of the Straits.

Loop Current position and structure have been studied by a number of investigators: Robert Molinarie, George Maul, Peter Niiler, and Fred Vukovich. Within 370 km of the coast, OTEC facilities require a 20°C temperature differential between the surface and 1000 m. The distance from shore limitation could be relaxed through the use of facilities standing on or anchored to the shelf edge or free floating facilities. DoE is interested in circulation affecting sourcewater (Loop Current) and shelf circulation as it affects the transport of OTEC related contaminants to shallow biologically sensitive areas.

High Frequency Wind Patterns and Shelf Circulation

Speaker: Phil Hsueh, Florida State Univ., Tallahassee, FL

Phil Hsueh presented calculations and data indicating that high frequency wind patterns are not effective in setting up shelf circulation. The energy instead goes into surface and internal waves. Sea level responds to Ekman wind "pile-up." A wind of 5 $m \cdot s^{-1}$ corresponds to a set-up (or set-down) of about 20 cm. Medium (several days) to low (about 10 days) frequency winds are needed to obtain significant barotropic shelf circulation. Tidal circulation tends to be long-shelf diurnually and of lower amplitude cross-shelf semidiurnually.

Norden Huang pointed out that wind stress is very effective in causing surface drift. Most measurements give ambient or residual current and do not give surface drift. He recommends more work on measuring surface winds and surface currents.

Hydrographic Data from the Florida Middle Ground

Speaker: William Schroeder, University of Alabama, Marine Science Program, Mobile, AL

Will Schroeder presented data from current meters and salinographs located in the Florida Middle Ground. He also discussed circulation

off the Mississippi-Alabama coast. His current meters were out during several storms. The data were still being analyzed; however, storm patterns were clearly evident. Preliminary salinograph data indicate the presence of significant amounts of low salinity water. These are believed to be from fresh water springs. Coastal circulation tends to be from south to north on the west Florida shelf and from east to west across the northern Gulf. This flow causes a significant migration of the barrier islands along the Mississippi-Alabama coast. Fresh water outflows have a major effect on circulation in the nearshore region.

Research at the Mouth of the Mississippi River

Speaker: William Wiseman, CSI/LSU, Baton Rouge, LA

Bill Wiseman covered research carried out around the mouth of the Mississippi River. The flow is to the west along the Louisiana coastline with the Mississippi River flow hugging the shore. The plume is often quite thin (about 1-2 m). The shelf water is characterized by a 5-20 m turbid, low salinity lense from Mobile to Texas in all seasons. There are occasional intrusions of high salinity low oxygen water. Comined with high oxygen demand, the oxygen level can decrease to the point of killing fish. While the system is strongly stratified, "northers" can cause inversions. Warm water from the west Florida shelf moves westward on the mid to outer shelf causing strong shear currents off the mouth of the Mississippi River.

Bill Merrell agreed that the coastal circulation along the eastern central Texas coast is from east to west but with a west to east flow further offshore. The coastal currents along the south Texas are wind-driven and tend to be southward during the winter and northward in the summer. Circulation in the northwest Gulf of Mexico tends to be complex at times when eddies are impinging on the shelf and coastal circulations are opposed. There is evidence for an offshore flow around 27° N latitude.

Use of Circulation Data in OSRAM

Speaker: David Amstutz, BLM, Washington, DC

Dave Amstutz talked about the use of circulation data in the DOI Oil Spill Risk Analysis Model (OSRAM). He pointed out that transport at all levels is important to cover all types of spills. The Campeche spill pointed out the need for subsurface transport to cover blowouts or pipeline breaks. The model is presently only able to give probabilities of surface-borne oil striking a particular area.

Summary

The group generally agreed that more research is needed on the behavior of the Loop Current and the mechanism which forms the warm eddies. Coastal circulation is also important, especially where anthropogenic activities have either a positive or a negative effect on the marine environment. The Gulf needs to be studied as a system to be fully appreciated since activities in one part affect those in another and international implications are involved.

Combined Session: Biological and Chemical Oceanography

Participants

Biological Oceanography and Chemistry sections met jointly on the afternoon of 12 May 1980. Attending were:

Rob Abbott	Conoco Inc., Houston, TX
Ken Adams	U.S. Fish & Wildlife, NCET, Slidell, LA
Elliot Atlas	Dept. of Chemistry, Texas A&M Univ., College Station, TX
Lee A. Barclay	U.S. Fish & Wildlife, Charleston, SC
Jim Barkuloo	U.S. Fish & Wildlife, Region 4, Panama City, FL
Don Boesch	Virginia Institute of Marine Science Gloucester Point, VA
Dee Chamberlain	Atlantic Richfield Co., Los Angeles, CA
Rezneat Darnell	Dept. of Oceanography, Texas A&M Univ., College Station, TX
Les Dauterive	USGS, Metairie, LA
Richard Defenbaugh	BLM, New Orleans, LA
Warren Flint	University of Texas Marine Science Institute, Port Aransas, TX
David Gettleson	Continental Shelf Associates, Tequesta, FL
Charles Guice	USGS, Metairie, LA
Terry Hight	USGS, Metairie, LA
Charles Hill	BLM, New Orleans, LA
Donald E. Johnson	Southwest Research Institute, San Antonio, TX
Tom Kraemer	USGS, NSTL Station, MS
Donald S. Marszalek	RSMAS, Univ. of Miami, Miami, FL
Brian O'Sullivan	Center for Natural Areas, Washington, DC
Russell Peterson	U.S. Fish & Wildlife, Galveston, TX
Rick Podgorny	NOAA/Sanctuary Programs Office, Washington, DC
Jon Proni	AOML, Miami, FL
Larry Pugh	NOAA/R&D, Rockville, MD
David F. Reid	NORDA, Code 334, NSTL Station, MS
Bob Rogers	BLM, New Orleans, LA
Bill Sackett	University of South Florida, St. Petersburg, FL
John Steen	Gulf Coast Res. Lab., Ocean Springs, MS
Bob Vickery	EPA Region 6, Dallas, TX

Drilling Muds and Cuttings

The first session was on "Drilling Muds and Cuttings." Dr. David Gettleson led off with a discussion of the stipulations and the monitoring studies carried out by the industry in response to the stipulations. He noted that none of these industry-funded studies, nor any of the BLM-funded studies, have shown a detrimental impact to the biota of nearby banks due to oil and gas drilling activities, and that indications are that most of the muds settle to the bottom within about

1000 m of the discharge point, especially for shunted operations. Two problems of such monitoring were discussed: (1) because of operating conditions, it is very difficult to get an estimate of what is actually being discharged; and (2) water column measurements are difficult to make because of currents, dilution, dispersion, etc., so benthic measurements are preferred.

In the ensuing discussion it was pointed out that currents and shunting may lead one to believe that muds present no threat to biological systems, when the reason for noticing no effect was that shunting works and/or the currents took the muds in a direction other than towards the bank. Stipulation-required monitoring studies are just that, not research projects, and broad and definite conclusions cannot be drawn from this type of study. Production monitoring has been accomplished in the goverment-funded Buccaneer Field Study. Dr. Rezneat Darnell pointed out that there is a lack of protocol regarding monitoring of oil and gas activities and recommended that one be developed which would include laboratory studies, field studies, identification of sensitive species, and a method of incorporating field experience. Dr. Don Boesch noted that the most serious threat apparently lies in the particle-borne toxicants, not in the dissolved fraction.

Mr. Bob Vickery noted the research cooperation that is present between Dr. Tom Bright of Texas A&M and EPA's Gulf Breeze Laboratory. He stated that the NPDES process for permits at the Flowers Gardens is reaching a conclusion. He discussed some approaches to potentially toxic wastes, particularly (1) use of less toxic substitutes if possible, and (2) the development of black (prohibited), gray (use under certain permitted conditions), and white (unrestricted use) lists. He stated that a manual on solid waste disposal has been developed in cooperation with the National Wildlife Federation (NWF). The manual requires analysis of a reference sediment and the proposed dump material. If there is a difference of 10% or more (presumably of toxic materials, but perhaps also of sediment size, etc.), the material would be unacceptable to dump. He noted that agreement had been reached with NWF on the procedures of the manual and wondered if similar agreement can be reached on procedures for handling muds and cuttings. He went on to note that even characterization of the muds is a continuing problem. Mr. Larry Pugh indicated that NOAA is commencing a three year program at the Flower Gardens in cooperation with EPA.

Dr. Jon Proni discussed some of his acoustical work, which might prove useful in tracking mud plumes in the vicinity of the Flower Gardens. His methods can detect particle concentrations as low as .4 mg/1 at 120 m from sensor; up to 30 mg/1 can be resuspended by bottom waves. He has noted a phenomenon he calls "spires," which appear as straight vertical traces from the top of the boundary layer (thermocline) to the surface. He interprets these spires as particulate matter and suggests that they may be manifestations of a mechanism for vertical transport of particulates. This would be a mechanism for introduction of nepheloid suspended material up onto the bank and then up into the water column. In answer to a question, he

stated that the spires were not gas seeps since they were not seen below the thermocline, while gas seeps are.

Dr. Rob Abbott stated industry's position that protection of valuable sensitive areas is a must, but that regulations must be reasonable in providing that protection. We can't go to zero risk and we can't keep asking "what if?". If industry, in well-designed monitoring studies in areas of sensitivity, shows no impact, industry's obligations are fulfilled.

Oil Spill Impacts: Targets of Assessments

The second session was on "Oil Spill Impacts: Targets of Assessments." Presentations and discussions in this session are summarized below.

Dr. Rezneat Darnell briefly discussed his summer project to be performed for the BLM under an IPA appointment. This includes locating data bases pertaining to collections of offshore fauna, accessing and synthesizing this information, and developing a map and accompanying text describing biological communities of the northern Gulf. It is hoped that this information will allow conclusions to be drawn on locations of areas which are biologically sensitive due to migratory, spawning or wintering activities, or because of the uniqueness of the biological assemblages.

Dr. Warren Flint described studies or study ideas in mind to assess impact of the Ixtoc-1 oil spill on Texas shores. His primary interest seemed to be in studies of community structural changes and the ecological implications of these changes. He stressed that occurrence of changes in species composition is not adequate evidence to determine functional ecological impact, and that unrelated environmental phenomena may confuse study results. He suggested that increased freshwater flows to the bays will cause an increase in shrimp for the shrimping industry in the next few years Investigators not aware of these increased freshwater flows and of historic correlations between such flows and shrimp production will thus conclude that the Ixtoc-I spill was actually beneficial to the shrimp fishery. Following a discussion of sampling problems associated with benthic populations varability, Dr. Flint indicated that this problem could be resolved through prudent sampling design.

Dr. Elliot Atlas suggested that key words in oil spill impact studies are "transfer," "fate," and "effect," and that of these, transfer processes have been the least studied. He suggested a need for additional studies on effects of oil spills on microorganisms, especially those capable of degrading hydrocarbons. Dr. Donald Johnson briefly described pilot studies in progress by Southwest Research Institute to assess distribution of oil in the sediments and selected biota of the South Texas area. Analytical results were not available at time of presentation, however.

Mr. Bob Vickery read the following prepared statement outlining EPA's areas of interest in offshore oil spills:

"Response to an offshore oil spill, such as would occur from an operating oil production platform or an underwater petroleum pipeline, is primarily the responsibility of the U.S. Coast Guard. This response is centered around removing the free floating oil and containing/diverting oil around or away from economically and/or environmentally sensitive areas. However, EPA has a definite role to play in an offshore response and because of this role, EPA maintains a prime position on the Regional Response Team. This role can be expressed simply as 'protecting the environment.' However, it encompasses a wide range of disciplines and areas.

"EPA is lead agency in the areas of dispersant usage. Annex X to the National Contingency Plan identifies EPA as the decision agency in two of three circumstances under which dispersants can be used: i.e., to protect wildlife and to reduce the overall environmental impact from the discharge.

"In addition, EPA provides input into the cleanup scenarios with a view to physically removing the oil while at the same time creating the lowest environmental impact. Such impact might include proper use of containment equipment to reduce entrainment of oil in the water column. EPA has a prime responsibility to protect shorelines and other environmentally sensitive areas such as coral reefs and estuarine areas. Equipment selection and use plays an important role in how well this job is done and EPA is active in recommending recovery actions in these sensitive areas.

"Finally, EPA is involved in determining the extent to which a cleanup action continues. This is the question of "How clean is clean?" Different environments are able to recover from oil impacts at different rates. The decision as to when the impact of the cleanup operation itself balances against the impact of the remaining oil belongs primarily to EPA. This decision will also include determining the extent of contamination, both biologically and chemically."

Mr. Ken Adams noted that the Fish and Wildlife Service is involved in a study of behaviors of migratory birds, relative to the Ixtoc oil spill.

Dr. Dee Chamberlain briefly discussed a planned study of the Ixtoc oil spill to be performed by the Gulf Universities Research Consortium, which includes the University of Mexico. This study would be performed with cooperation from the Mexican Government and from Petroleos Mexicanos (PEMEX), and would include three phases of effort. The first phase is assembly of information pertaining to the normal environmental conditions in the area (i.e., establishment of baseline conditions), to be followed by a delineation of sensitive areas possibly affected, and

then by development of study protocols. The first phase will be initiated in the near future if funding is secured.

Dr. William Sackett mentioned that he is presently monitoring occurrences of floating tar balls off the west coast of Florida, including screening of these tarballs to determine whether or not they were formed from spilled Ixtoc-1 oil.

The final session of the day was to have been a discussion of EPA's approach to the NPDES, but since no one from the Atlanta Region office nor the Washington office was present and Mr. Vickery of the Dallas Region office had already discussed the process at the opening joint meeting, and since it was late, the session adjourned for the day.

Biological Oceanography

Participants

On 13 May 1980 the biologists met alone. In attendance were:

Jim Barkuloo	U.S. Fish & Wildlife, Panama City, FL
Don Boesch	Virginia Institute of Marine Science, Gloucester Point, VA
Mike Brim	U.S. Fish & Wildlife, Panama City, FL
Dee Chamberlain	Atlantic Richfield Co., Los Angeles, CA
Les Dauterive	USGS, Metairie, LA
Warren Flint	Univ. of Texas Marine Science Institute, Port Aransas, TX
B. J. Gallaway	LGL Ecological Research Associates, Bryan, TX
David Gettleson	Continental Shelf Associates, Tequesta, FL
Charles Hill	BLM, New Orleans, LA
James B. Johnston	U.S. Fish & Wildlife, National Coastal Ecosystems Team, Slidell, LA
Don Marszalek	RSMAS, University of Miami, Miami, FL
Russell Peterson	U.S. Fish & Wildlife, Galveston, TX
Rick Podgorny	NOAA/Sanctuary Programs, Washington, DC
Larry Pugh	NOAA/R&D, Rockville, MD
G. Ed Richardson	BLM, New Orleans, LA
Bob Vickery	EPA Region 6, Dallas, TX

Topographic Features and Live Bottom Areas

The first session concerned the significance of topographic features and live bottom areas other than the Flower Gardens. Mr. Russell Peterson discussed Dr. Tom Bright's "prioritization" of the banks and the stipulations which have been designed to protect their biota. He went on to state that banks which crest deeper than 85 m may require some protection if there is no nepheloid layer. Dr. David Gettleson noted that his firm will be making TV transects at two deep water banks as part of an existing BLM contract. Dr. Rezneat Darnell noted that in regard to ecosystems the less management the better. He suggested two analyses of merit: (1) Determine values--is the living resource of concern unique or rare, and if either, is it protectable? (2) Conduct an activity risk analysis. It was noted that in the case of live bottom areas, the uniqueness criterion may not apply as such areas seem to be widespread on the Florida Shelf. Mr. Peterson noted that shunting at high relief banks seems to work, but (1) what about the spires Dr. Jon Proni sees in his acoustical records? and (2) how much relief is needed? Mr. Jim Barkuloo stated that platforms seem to enhance marine life and that there are positive as well as negative impacts. Dr. Darnell suggested the need to summarize existing monitoring results, both from a scientific and an applied point of view, including transport and ultimate fate of muds.

Fishery Problems Related to Oil and Gas Activities

Discussion then turned to fishery problems related to oil and gas activities. (Since Mrs. Melissa Smith is no longer with BLM, and could not attend, and Dr. Charles Caillouet of NMFS was unable to attend, the published agenda was not followed to the letter.)

Dr. Benny Gallaway reported on the Buccaneer Field Study. The field is in shallow water, and fish populations are not platform-dependent. Hydrocarbons in the sediments below platforms are relatively high. In summer, spadefish appear healthy, but in winter they congregate near the bottom of platforms and are infected with Vibrio, an oil degrading bacterium and fish pathogen. This pathogenicity is not seen at nearby liberty ship reefs. These findings are preliminary and will need to be followed up with, among other things, population dynamics studies to determine the impact of platforms.

Dr. David Gettleson discussed the reef fish study just started. He noted that small inshore banks may have large populations of snappers.

Mr. Jim Barkuloo questioned whether unburied pipelines are really problems to fishermen; there are few documented cases of trawl hangs on pipelines. Dr. Dee Chamberlain noted that change does not necessarily equal damage and urged identification of sensitive areas and a prioritization of protective measures.

Dr. Don Boesch made the following points:

(1) Current studies show a lack of specificity, such as addressing change vs. damage and long term vs. short term.

(2) "So what?" questions require imaginative studies.

(3) Functional studies are not carried out.

(4) Can we affort to answer some (all) questions?

(5) The Gulf should be able to provide guidance on long term effects.

(6) BLM has reacted to criticisms of benchmark studies by going to applied studies, but may now be too myopic and political--i.e., now highest rated studies involve endangered species.

(7) We need long term and functional studies.

(8) Uncertainty and risk--what is the probability that there is an effect, but we don't see it? For instance, Dr. Tom Bright sees no impact, Dr. David McGrail (also of Texas A&M) has evidence that shunted material cannot be

transported up onto the bank, but what about Dr. Jon Proni's "spire" evidence? We need to evaluate whether we're looking at the right thing.

Dr. Rezneat Darnell made the following comments:

(1) While BLM has management responsibilities, academia needs to have input and maintain communications.

(2) We need to design actions in advance rather than simply respond to crises.

(3) In order to do this, we need to know the biology of species of concern (basics) as well as long term effects. BLM has not concerned itself with these aspects in the past.

(4) Once we know this, then we can tackle the "so what?" questions.

(5) Analysis must include an appropriate mix of methods.

(6) The bottom line is to preserve genetic diversity.

Summary

Although no firm conclusions nor recommendations were drawn from the biologists' two days of meetings, the meetings were exceedingly useful in getting people together and hearing a variety of viewpoints and perspectives, as well as being brought up to date on the status of a variety of research projects.

A BIBLIOGRAPHY OF LITERATURE ON THE FLOWER GARDENS

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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.