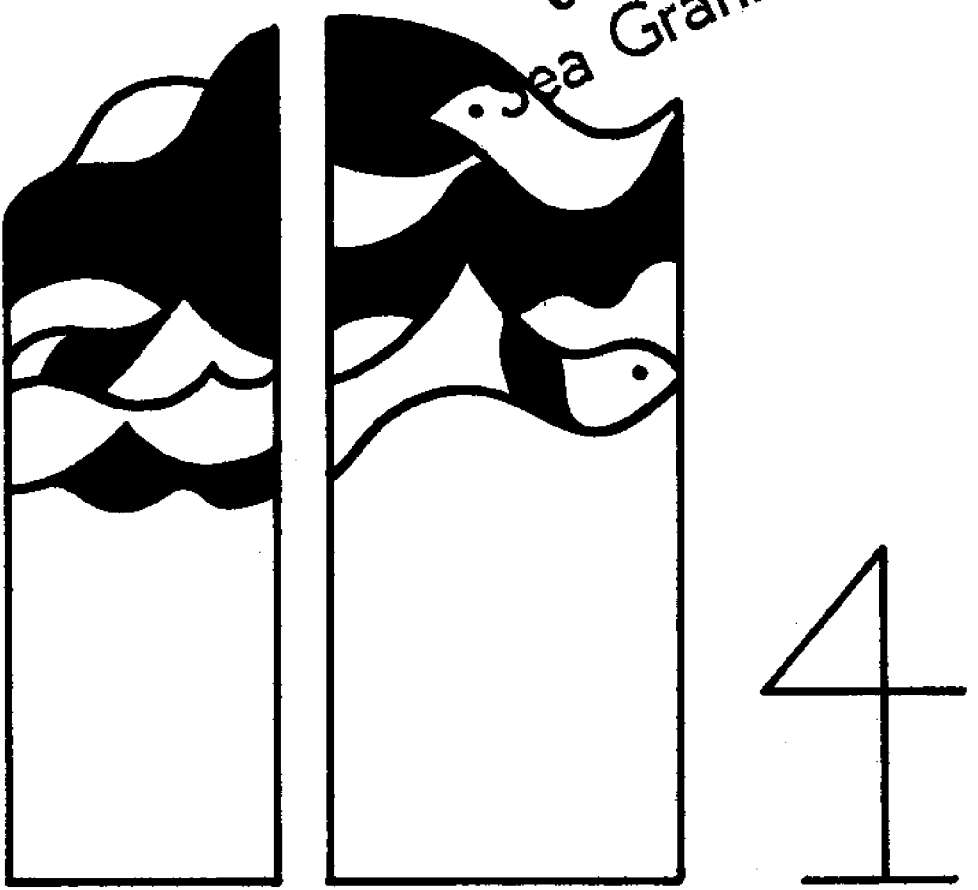
Proceedings: Fourth National Sea Grant Conference

University of Wisconsin



Madison, Wisconsin

October 12-13, ~~1972~~ 1971

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Foreword

The precedent of national meetings of Sea Grant institutions was set in 1965 at Newport, Rhode Island. The second conference in Rhode Island (1968) and the third in Oregon (1970) established the pattern of meetings where institutions with Sea Grant support (or an interest in the Sea Grant Program) could discuss matters of common interest. At the third conference, institutional representatives voted to establish an Association of Sea Grant Program Institutions to carry on these national meetings and to take charge of other appropriate matters.

The University of Wisconsin invited the newly formed association to hold the Fourth Sea Grant Conference in Madison in October, 1971. In November, 1970 the Board of Directors accepted the invitation and recommended some of the subjects for the conference. After discussion with institutional coordinators, a program was proposed to and approved by the Board, and the session chairmen were selected to structure the meeting.

This volume records some of the material presented at the conference. The coverage of sessions differs because session purposes differed. The Ocean Engineering Session, for example, was designed as a working conference to allow various spokesmen to propose and discuss ideas without the constraints of detailed reporting. The results are summarized in Professor John Duffie's report. Other sessions are recorded in more or less detail, as the chairmen requested.

The Association officers and Board and the host institution wish to thank the speakers and the following session chairmen for their help in planning and conducting the conference: Jack A. Davidson; John A. Duffie; William Gaither; Joel M. Goodman; Water Gray; Theodore Green, III; H. Gary Knight; Nelson Marshall; and John S. Steinhart.

Special appreciation is also expressed to the guest speakers: the Honorable Patrick Lucey, Governor of Wisconsin; the Honorable Ernest F. Hollings, U.S. Senator from South Carolina; Robert White, Administrator, National Oceanic and Atmospheric Administration; Richard Balzhiser, Assistant Director, Office of Science and Technology; and David Potter, Chief Engineer, Delco Electronics Milwaukee Division, G.M.C. and former member of the Sea Grant Panel.

John A. Knauss
President of the Association
1970-1971

Gregory D. Hedden
General Chairman of the
Conference

FOURTH NATIONAL SEA GRANT CONFERENCE

Hosts:	Patrick Lucey, Governor State of Wisconsin
	John C. Weaver, President University of Wisconsin
	Robert A. Ragotzkie, Coordinator University of Wisconsin Sea Grant Program
Association President:	John A. Knauss, Provost for Marine Affairs University of Rhode Island
General Conference Chairman:	Gregory D. Hedden University of Wisconsin-Extension
Proceedings Editors:	Linda Weimer Thomas Burroughs Jeanine Katzel
Artist:	Christine Kohler

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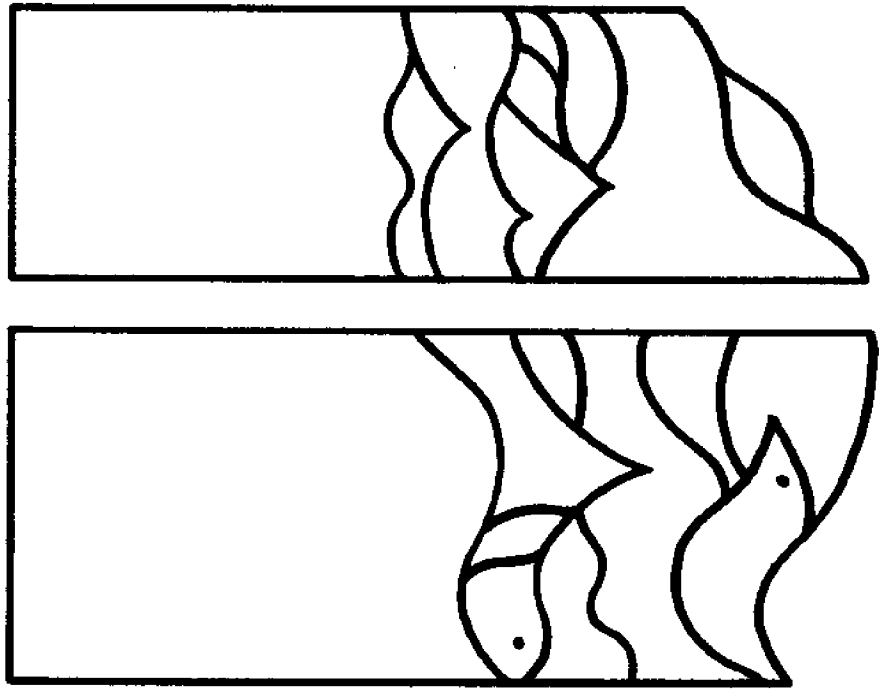


SPECIAL ADDRESSES

Sea Grant in Wisconsin

Welcoming Address

Honorable Patrick Lucey
Governor, State of Wisconsin

I am pleased to address the Fourth National Sea Grant Conference and welcome all of you to the State of Wisconsin. I am glad that you can spend these two days on this campus and I wish you had additional time to visit the rest of our beautiful state and the other campuses in our university system.

After earlier conferences on the east and west coast, it is particularly fitting that you should meet in the Great Lakes Region--the location of our nation's great inland coast. The 3,500 miles of shoreline on the Great Lakes is equivalent to the area from Maine to Texas. The Lakes have long served the people of two nations as an important avenue of commerce and as a recreational resource.

It is also appropriate that a Sea Grant Program is located at the University of Wisconsin. Indeed, we expect soon to have a Sea Grant College here. We look upon Sea Grant as a logical extension of the Land Grant Concept and of the famed "Wisconsin Idea", a partnership between government and university in the service of the people of the state. The Sea Grant Program is concerned with research, education and advisory services dealing with the problems and opportunities of marine and Great Lakes resources.

As most of you are aware, univeristies have been and are still in the midst of difficult times. Internal strife, dwindling public confidences and a lagging economy have caused major problems. Yet the people of our state still support a Sea Grant program. My own budget, which of necessity was austere, provided new money for this program. I have noted with approval that the Sea Grant program has pooled the resources of the various campuses in a cooperative adventure. A prime reason for the forthcoming merger of our two university systems is to promote cooperation of this sort, rather than the often wasteful and duplicative rivalry of earlier years.

I have also noted that the Sea Grant program is dealing directly with the problems of this state. In my budget message this year, I suggested that the university reallocate

a portion of its research monies to areas of critical state needs, such as urban problems, health sciences and environmental areas. It is clear that the people of this state, indeed the people of all your states, are going to demand greater accountability from the universities and greater concern with pressing public problems. The Federal Government is moving in the same direction, with the establishment of RANN, or Research Applied to National Needs, a division of the National Science Foundation, as well as the research programs of the Environmental Protection Agency and the Sea Grant program.

I do not wish to spend much time on matters that many of you are familiar with, but I would like to touch briefly on several areas that are of interest to this state and university, and which have national and international implications. I have noticed that these matters will be covvered in greater detail later on in this conference.

We have all heard that the power demands of this country are doubling every 7 to 10 years. This development is of particular interest to the Great Lakes states, for the Lakes are expected to provide the cooling water for the new plants that will be needed to meet projected energy demands. Lake Michigan, in particular, has been designated for the massive development of both nuclear and conventional plants. The effects of such development on our shorelines and our landscape are obvious. But of more immediate pressing interest is the increased heat load on the lake. It has been estimated that the waste heat load discharged to Lake Michigan by the year 2000 will be at least 10 times the present rate. The effects of this level of heat discharge must be carefully analyzed. I realize that all the research has not been completed. I further realize that we may have to make some hard choices long before such research is available. The recent court decision in the Calvert Cliffs, Chesapeake Bay case has substantially increased the pressure for environmental impact statements. I hope that many of you will continue to address yourselves to this important problem area. We need better insights not only to environmental problems, but also into such matters as actual energy demands, social costs, public policy alternatives and their probable consequences, cooling towers and cooling ponds, changes in rate structures, and possible site locations.

A second area of compelling interest for this region is that of water quality. The Great Lakes comprise the largest fresh water resource in the world. This resource is vital to our region for drinking water, recreation, much of our economy and many of the aesthetic values which enhance the quality of our lives. The preservation of this resource is fundamental to our existence. To date we have been fortunate. With the exception of Lake Erie and parts of Lake Ontario and Michigan,

the water quality of the region is remarkably high, a level which Wisconsin intends to maintain. However, there are threats from nutrient enrichment, heavy metals, pesticides and other man-made chemicals such as PCB's. Already our fisheries have received several serious setbacks and we are anxious for information and policy alternatives to help stave off additional harm.

Finally, we are concerned about our coastal zone. We are watching the development of a vast megalopolis in the midwest which may include as one of its main components a corridor from Detroit to Chicago up through Milwaukee and a considerable part of this state. Typically the majority of this growth is being funneled into the coastal area. One wonders whether qualities which make this coastal area so attractive may not in the end lead to its destruction. How much of a load can such a fragile area bear?

In the the near future, every state is going to have to make fundamental decisions about its coastal areas. We shall have to move to protect uniquely valuable resources such as estuaries and marshes. We shall have to arrive at programs which allow for both economic and environmental health. We shall have to decide how to make recreational assets such as our own Door County, available to the public for maximun use, without creating fatal overloading. We hope to have the aid of the legislation which your speaker, Senator Hollings, and many of you in the audience have been promoting. In addition we shall need the competent aid of our universities and the wisdom of an informed citizenry.

I have touched upon our local programs and problems because they are most familiar to me. I am aware, however, of the work which many of you have been engaged in, your work with fisheries, shrimp production, aquaculture , coastal zone modeling, and the all important advisory services. I trust that this important work will continue, and that the National Sea Grant Program will prosper in the years to come.

All of the speakers here will provide you with charges for the conference and for your own individual programs. I urge you to continue to build upon the good work you have already done. I would also like to make a plea from my position as Governor of a state. In recent decades, state government has been under continuing attack. Frequently this attack has been that the states have had the problems and the responsibility, but someone else has had the power and the resources. We are beginning to see signs of positive change in this situation. I hope that all of you will double your efforts to provide your states and local communities with the resources they need to effectively deal with the increasingly complex problems which confront them, a myriad of problems for which there are no easy answers. I hope that both as teachers and citizens you

will strive to create an atmosphere of reason which will allow us to approach these problems with wisdom, rather than emotion or narrow self-interest. Thank you.

Can America Keep Pace in the Oceans Race?

Luncheon Address, October 12

Honorable Ernest F. Hollings
U.S. Senator, South Carolina

I welcome this opportunity to be with you here today. And I appreciate the company of this dedicated group of professionals. I feel like the little fellow in school who walks into his first Latin class and finds himself confronted with all that erudition. It's an eye-opening experience. So I'm not going to make an effort to speak of the latest scientific developments, or to describe the technological innovations which are helping unlock the secrets of the oceans.

Quite frankly, my friends, I think we have all got to start taking a little different tack if we are going to get a sound oceans program. The trouble so far is that too few Americans are alive to the great promise of the oceans. Too few understand how closely intertwined is the fate of the human species and the fate of the oceans.

I've been in politics a good long while now, and I've seen programs come and programs go. The only programs that stay around are those that have strong popular support behind them. Without that support, we might just as well throw in the towel right now. We can have all the best plans, all the detailed blueprints, all the future technology on the drawing board--but unless Mr. and Mrs. Average American are behind us, we can forget about success. There simply will be no sound oceans program unless you in the sciences and we on the political end join forces to mobilize the vast power of public opinion. A bill gets lost in Congress mighty easily unless there is a constituency outside keeping an eye on committee and legislative development.

For many years now, important problems confronting American society have gone unmet. For many years, the problems of the city and the ghetto have been compounding. Crime abounds. The narcotics problem has reached epidemic proportions. There are problems across the whole gamut of American life. Each of these problems has a priority and each deserves attention. So when we talk about developing an oceans program, let's realize that we are competing for

attention with some other very real and very urgent problems. The overlooked needs and unsolved problems of many decades cry out for attention.

Now you know and I know that the development of the sound oceans program deserves a high priority. You know and I know that a comprehensive and well-funded program is an urgent necessity for the United States. Such a program would respond to both the immediate needs and the long-range goals of the country. In a time of soaring joblessness, it offers work. In a time of rapidly disappearing technological superiority for the United States, it offers the prospect of innovation and renewal. In a time of national drift, it holds out challenge and opportunity. In a time when the future of the species is by no means guaranteed, it offers the hope of survival.

Within your profession, all this is the conventional wisdom. You accept it as truth, and you go about the task of developing a far-reaching program. Unfortunately, a majority of Americans do not share in your awareness of what the oceans mean. They need to be convinced. And once convinced--then we will have the clout needed to pass a well-rounded and amply-funded plan for the maximum utilization and efficient management of the oceans.

It is popular nowadays among our newspaper analysts and broadcast commentators to talk about how Americans no longer respond to challenge in the way they once did. How much of the old vitality and the pioneer spirit has gone by the way. Well, I submit that insofar as the challenge of the ocean goes, Americans do not yet know the challenge exists. So let's not spend our time running down the people for not responding until they know why they should respond. And that is a job for you as the experts in the field, and for those of us in public life who have an interest in the oceans.

The challenge to America on the oceans is not difficult to see. It is military, but it is also economic. It is political but it also goes to the roots of future survival. Other nations are responding to the challenge of the seas. They are acting to transform potential into reality. We in this country are, to put it bluntly, behind.

Admiral Mahan said that he who rules the sea rules the world. Mahan spoke in the 1890's. But even today, in the age of rocketry and space, he is right. Sea power affects our transportation, our national security, our way of life--each day--every day. Are we just going to sit by while the Russians, and the Japanese too, launch well-conceived, well-planned and lavishly-financed oceans programs that spread their military and economic influence? If so, the future will belong not to America, but to others.

Look at what the Russians are doing. Within the past year the Soviet force of nuclear-powered submarines has increased by 10, growing from 75 to 85. During that same period, the American nuclear sub force increased by only 4, from 87 to 91. This year the Russians will without question pass us by, and by 1975 they will have a nuclear sub fleet of over 150 while ours will total only 109. And these figures don't include the 235 diesel submarines the Russians can put up against less than 50 for us.

With their growing armada, the Russians are flexing their naval muscles all around the globe. In the Mediterranean and in the Indian Ocean, they are making their presence felt, and the balance of power is tottering under the weight of Soviet Sea power in these vital areas. The British have withdrawn from the Indian Ocean. The United States has a small base at the middle of the Indian Ocean for surveillance purposes but with no effective military or naval presence. As a result, the Russians have threatened the movement of oil not only to Western Europe, but also to Japan and everywhere else in the world. An oil pipeline across Israel will not help the situation. The Russians have a fleet in the Mediterranean that could easily interrupt the flow of oil by tanker to the Mediterranean and Western European ports.

Mahan's dictum applies not only to fleets of the Navy. It also applies to fishing, it applies to merchant fleets, it applies to ocean research. The Russian fishing fleets, and some of you have probably seen their ships off the coast, are highly organized and range the world. During the 1960's the Russians not only drew abreast of the catch that American fishing fleets were bringing in annually, but they shot ahead--and now catch more than three times what we catch. The Russians are doing better in fishing off our coast than our own American fishermen are. Their fishing fleet -- largest tonnage in the world -- has over 4000 ships with a total gross tonnage of six million. What do we have? Thirteen thousand ships totaling 500,000 tons! In effect we are fishing with row boats while the Russians roam the seas in up-to-date vessels and equipment.

The American merchant fleet shriveled to approximately 135 usable ships last year. National security has been needlessly jeopardized. We have sacrificed our once preeminent ability to move equipment and ordnance to American armed forces around the world. Yet in recent years, the growth of the Societ merchant fleet has been nothing less than spectacular. In 1950, it ranked 21st in tonnage among the world's merchant fleets; in 1958, it ranked 12th; and in 1968--5th. Compared to our merchant fleet of 135 vessels, the Soviet fleet today exceeds 1766 ships. The growth in numbers of their tanker fleet has been faster than that of any other nation. So here we have a threat not only to national security, but also to America's commercial prosperity. And few of our leaders even pause to give

a second thought to the problem!

These matters of defense and trade involve the safety and national security of the nation. They are serious matters, and we had better wake up to that fact and wake up to it soon. Let's tell it like it is to the American public. They can appreciate the needs for national security. And if their concern for national security can be joined to the intelligent utilization of the oceans, so much better for us all.

America is also being challenged in the area of research involving the future development of the world's oceans. Last year, although we commissioned the RESEARCHER to perform both oceanic and atmospheric studies, we laid up several ocean research vessels. And on top of that, the Administration refused to build those for which money had already been appropriated by Congress. While we refuse to fund laboratories, the Soviets are quietly expanding their own ocean research fleet and establishing new maritime research programs.

Look also at the Japanese. They are leading the way in opening up the oceans to the needs of the future. The Japanese are assembling an enormous ocean engineering capability to harvest the resources of the Pacific--and they are aiming at the Atlantic, too. Their projects have the strong and enthusiastic backing of the government. Their scientific and technological research capacity is unquestioned. They have unique backing from the Bank of Japan. They have the commitment, the will and the determination to act. And they are acting.

This is the country that many people feel will be the most economically powerful country in the world by the year 2000. Yet it is a country with a poverty of national resources. Its lack of the essential ingredients of modern industrialism contrasts sharply with the storehouse of natural abundance that has always been America's. Their poverty of resources has not discouraged the Japanese--it is instead encouraging them. They must go into the oceans, and they are going with a full-fledged and well-planned development program.

Twenty-five percent of the total Japanese output of coal is mined off-shore. They are now searching the Pacific Ocean floor for manganese nodules--they are interested in the nickel, cobalt, copper, and manganese content. They are searching for oil offshore because now they are forced to import more than 99% of the fuel they consume. Soon they will be offshore for power plant siting. They are well ahead in developing the technology and know-how for constructing huge, floating platforms. These "floating

islands" can be used as deepwater harbors and offshore terminals; they can be turned into nuclear power plants, airports, and industrial centers.

Last year, the Japanese regained the number one spot in world fisheries. Its shipbuilding industry has led the world for years, growing from 2.2 million tons in 1963 to 8.2 million tons in 1968. Its two largest shipbuilding companies each produce annually more ships than the entire output of West Germany. The Japanese have 26 major shipbuilders and 52 shipyards. By comparison, the United States has 17 major builders and 39 yards, not all of which are building yards.

When the Japanese want to move they can move fast and bring enormous leverage to bear. It's just as Taylor Pryor of Hawaii told our subcommittee last year: "We can all relax or at least just continue spinning our wheels, for soon the Japanese will have accomplished everything we ever dreamed of in the oceans."

Science and technology is the name of the game in the oceans, just as it is in space. We still have the potential of regaining our number one spot in technology. As of today, however, the American monopoly holds only in computers and aircraft. If we are to regain our preeminence, we will have to expand our research and development and make a genuine national commitment for the oceans.

Let's face facts. Other nations have already seen the light, and are well on the way to opening up the vast treasures of the seven seas. It is only a matter of time until we must do the same thing. We can either do it now--rationally, comprehensively--or we can wait until we are pushed in by necessity and then we can imitate others and play the game of following rather than leading. The time is here to decide. It is not a question of can or cannot. It is a question of will or will not.

If we move ahead now, we will not only be planning for the future--we will also be improving the present. A national commitment to a sound oceans program would pay both long-term and short-term dividends. Today 6.1% of the American labor force is out of work. The unemployment rolls include an armada of scientists, researchers, engineers and technicians. People whose special talents could be harnassed to meet the challenge of the present are instead being sacrificed to the shopworn economic dogmas of the past.

Fourteen months ago, I criticized the Nixon Administration for not taking the lead in oceans development. I urged that the President create an independent National Oceanic and Atmospheric Agency. History shows that an independent NOAA was not created. The Administration compromised for a smaller NOAA housed in the Department of Commerce. I have

not lost interest in an independent NOAA. If anything, recent experience points up the need for just such an agency.

The Administration just is not leading. It is going to have to be pushed into assuming an activist role. You and I can meet at professional gatherings to cuss them out and pour balm on one another's wounds. But until the public joins us in an awareness of the challenges and problems of ocean development, we'll sputter along without an all-out program.

Not that we are without successes. We have the Sea Grant program. And right here at the University of Wisconsin important research is being done concerning the exploitation of mineral deposits in the water; the problems of electrical power production in the Great Lakes; and the extension of the season in the St. Lawrence Seaway. Universities the country over are engaged in similarly important research. And I am happy to report that in the conference committee this year, we managed to increase the Sea Grant appropriation by over 2.5 million dollars.

Due to changing priorities within the Administration and to jurisdictional disputes in Congress, progress on a Coastal Zone Management Bill has been slower. Without going into all the details, I can say that it looks like we will be able to bring the Coastal Zone Management Bill to the floor of the Senate before the end of this session.

In addition, prospects look favorable for an ocean dumping bill getting out of committee and to the floor this session.

All of these are important first steps. But while we win some of these initial victories, we should be using the time to gather our ammunition and organize for the larger battles ahead.

What can you do? Well, looking at the professional organizations in the oceans field, there are many different groups working for an oceans program--but not always working together. I think it would be desirable for the Marine Technology Society, the National Oceanography Association, the Association of Sea Grant Program Institutions, the American Society of Oceanography and other groups to better organize their efforts to have an impact on Capitol Hill. There should be one focal point in Washington through which the organizations can gather and disseminate the information they desire. And a focal point to which Congress can reach for information and support.

Secondly, you can help in the area of public relations. You can help convey the substance and the excitement of the oceans to Mr. and Mrs. Average American. You can talk about what the oceans mean--food--jobs--recreation--and ultimately--survival.

So important do I deem this educational role, that I am convening in Washington next week, October 18, the International Conference on the Oceans. We will try to mobilize public interest--to present the challenge of the oceans as it really is--and the promise of the oceans as they affect the everyday well-being of our citizens. Jacques Cousteau will be there. Scott Carpenter will be there. In a second session next month, Thor Heyerdahl will be there. Representatives from the major industrial countries will be in attendance, as well as members of our own scientific, professional, and--importantly-- public media professions. I look forward to seeing some of you there--to help us enlist public support for the substance of the superb programs you have helped to formulate.

I am excited at the prospect. The program I have introduced and hope to see enacted holds before us the opportunity of the future--the chance not only for survival, but renewed greatness. We are adventurers to be envied--for in our hands--yours and mine--is the challenge of enlisting our fellow Americans to the call of the real new frontier. We can afford to do everything that needs to be done. The question is, are we up to the challenge?

Earlier this year, I introduced a bill, the National Oceanic Act of 1971. It is a short bill, but one which I believe can get the job done. It would amend the Marine Resources and Engineering Development Act of 1966 to authorize sufficient money for marine science, technology, resource development and management, and other related programs. It would authorize $24.9 billion over the present base during the next five years to take advantage of the promise of the oceans, and to rectify some of the awful abuse that man has been wreaking upon the sea.

My proposal calls for the immediate infusion of $1 billion over the President's Fiscal Year 1972 requests. This will prime the pump. And it will give immediate support to vital areas where new money is urgently needed. It will also permit the agencies to plan well for the sharp growth I hope for in the next five years.

I am not proposing just a program in ocean science. It is a program that covers the broad range of oceanic concern. Its federal spending would be spread through nine departments and agencies. The four-fold increase which would come in government spending per year in the next five years would go a long way toward the assertion of American leadership in ocean development. We are talking about an assault on marine pollution. We are talking about new applications of marine science. We are talking about new growth in industry, in universities, in fisheries, in re-

source management. We are talking about a coastal zone management program so that the 80% of our people who will live within 50 miles of the ocean and the Great Lakes by the turn of the century will have a habitable environment. We are talking about farming the ocean floor for food and fuel and minerals. And we are talking about utilizing our most precious resource, more precious even than the bounty of the seas--Man.

Jobs will come in areas like Burbank, Seattle, Long Island, Charleston and many others. We ought to be planning the constrution of a "floating island" in an area such as Seattle--it could be used as an airport, or to develop the food and energy resources of the sea. And over the long pull, jobs will be provided in cities and towns throughout the nations.

In the final analysis, of course, the ultimate challenge to man concerns not the pocketbook but the motivation of the human spirit. The program I hope to see enacted holds before us the opportunity of the future--the chance for renewed greatness. In the oceans is the challenge of knowledge--man must go where he has never been; man must do what he has never done; man must dream what his father never dreamed. Can we afford this program? We can afford nothing less if we are true to the spirit of the American past.

Programmatic Research at Universities - Lessons from Sea Grant

Dinner Address

David Potter, Chief Engineer
Delco Electronics, General Motors Corporation

I know I'm supposed totalk about the oceans and their unique and inexhaustible untapped resources which will save the world; the Great Lakes and the immense challenge to man's ingenuity in striving for solutions to the environmental problems which they evidence. But I'm not going to do it. That's a speech, which with variations, has been given ad nauseam by me and by many of you in the audience.

But, as some of you know, I have been relegated to the role of "bystander" in the sea business for the last few years, and now that my term on the Sea Grant panel has expired, I am dropping my last activity directly connected with the ocean use and resource problem. I would like to use this opportunity to talk about what has become, for me at least, the central issue in our Sea Grant activities. I have been impressed by the fact that technical problems have generally been worked with skill and enthusiasm and a considerable degree of success. The fact of the importance of the technical problem to some larger goal, though, has not always been well established. Some of the social ramifications of our business have received attention, and there are a few lawyers willing to examine the small grain issues bothering communities trying to stave off pollution or develop a resource body of water with many small jurisdictions along its shores.

In short, the human resources available in this country and especially on the university campuses seem very capable of generating workable solutions to most of the problems which come under the Sea Grant banner. The "central issue" which I spoke of earlier is the great difficulty we have had in trying to "put it all together." The long squabble in the federal government on where even to put an ocean program is just one example. Every university now participating in Sea Grant is in itself a further example of how difficult it is to attack a multi-disciplinary program in any of our educational institutions. In the short term, the general principles of management which are evolving, and the con-

tinued pressure to produce further advances, seem more important in a national sense than any of the individual technical contributions. It is this facet of Sea Grant which I wish to talk about. I propose to do this in part by giving you my quite biased view of what has happened over the past five to ten years and relate this quasi history to the needs as I see them. Since I have no firm solution, you'll be spared the hard sell at the end.

It is particularly appropriate to address this subject here at Madison because it was on this campus some years ago that I received my first rude awakening to the magnitude of the management problem which confronted the Sea Grant people. That was the occasion of first meeting Chuck Engman, an association we've enjoyed ever since (which only shows that time and age can overcome an unruly tongue). Since then my colleagues and I have spent hundreds of hours debating this theme, and I am sure that many thousands of hours have been spent by various university faculty groups on precisely the same subject--"how to manage programmatic research at universities."

This is a subset of the more general issue of how the nation should handle the programs arising from concerns about environmental quality, urban problems, and poverty. For example, without adversely affecting some of the ongoing effort in matters of transportation, the utilization of our ocean and our lake resources, and the like. It's a subject worth a little exploration because it often develops that the federal problems come through with far greater clarity than the equivalent university problems and thus serve to illuminate them.

In order to prosecute new large-scale programs and to give them adequate visibility, the federal government has found it necessary to modify and add to the executive administration apparatus. We have seen the addition of agencies, sometimes independent, and sometimes imbedded within a departmental framework; the creation of new cabinet-level departments, and the modification of existing departments to accomodate the "new thrusts." These new programs seem to be characterized by a high initial urgency followed by several years of great activity which should, in principle, diminish in later years as the initial goals and requirements are met.

There is a distinct possiblity that after the current period of confusion and change, some of these areas will be perceived as having received the wrong kind of response. For the federal government, the drastic changes within the bureaucracy may prove to have been inappropriate to the longer range and continuing requirements.

In simple terms it should not be necessary to carve out an entity like the Coast Guard from one department of government and transplant it to another in order to underscore a change in emphasis in our national objectives; then worse, in a few short years, seriously contemplate uprooting it once again because our national priorities have changed. Please understand, my quarrel is only mildly with the men who have advocated these moves; they are realists and are trying to get a job done. We have a system which forces such a response, and I guess we aren't fighting it hard enough!

My first contact with the governmental problem was at the state level when the late Benny Schaefer, who was first chairman of the California Governor's Commission on Ocean Resources, coerced me into seeking a solution to the California problem of focusing state attention on ocean resources--all this when the state governmental apparatus seemed far more concerned with the fresh water sports fishery, with saving the condors, and doing something about the unemployment problem. This was about two crises back in the long saga of "boom or bust" in the California aerospace industry; Mr. Brown was governor, and I was still on speaking terms with some of my old academic cronies which places all this a few years back.

Benny asked Wib Chapman to follow along and make sure that I had the benefit of mature guidance (which was tantamount to a direct conclusion) in trying to unravel the organizational properties of California state government. At that time it had something approaching 300 commissions, councils, and other advisory groups and was just as tangled as the federal government.

Wib, as many of you know, was a great proponent of a "Department of the Ocean" at the Federal level and for a while we tried to reconfigure the state into such a pattern, but when the cash crops are oranges, wine and Hollywood, it's mighty hard to retain any real enthusiasm for anchovies. The upshot of all of this was a compromise affair with what became known as the interagency council on ocean resources and a new legislative charter.

To show my naivete, I bought the drinks, and Wib, Benny, and I sang a few verses of "Bow Down to Washington." The long term effect was about as significant as Crazy Horse's victory at the Battle of Little Big Horn, and the Pale Face bureaucrats went laughing all the way back to Sacramento.

Incidentally, it was one of the joys of our association that we managed to rotate the chairmanship of the California Commission among the three of us, all loyal graduates of the University of Washington. With a couple of drinks, we could,

with such clarity, recall the green forested hills, the white capped mountains, and the blue water of the fjords up the inside passage of our native state while basking in the delightful sunshine of California.

The great message to me out of that experience was that the federal and state governments had to develop a new management technique to accomodate the pursuit of constantly changing,relatively short-term objectives without having to perform major organizational surgery.

The leap to the notion of utilizing the developing program management techniques of the aerospace and military electronic industries to this problem was in reality a mighty small step taken by a number of people almost simultaneously. Unfortunately, these ideas came along much too late to have a real impact on the governmental organization necessary to push ahead with our legitimate concerns in the development of our ocean and Great Lake resources.

Instead, we have witnessed such things as the great battle between those who need a marine arm for purposes of collecting duties and preventing smuggling versus those whose mission is to mark navigable waters, maintain lighthouses, and generally promote trade; versus those interested in rescuing Sunday sailors on their return from Catalina or Green Bay; and, finally, those interested in research and development programs to ameliorate the impact of oil spills, mine for manganese and diamonds, and otherwise promote the utilization of ocean resources. One could only wish that the programmatic arms of these several groups could be their sole concern instead of finding that the chore of buying and maintaining a diverse fleet of vessels, building and running the shore facilities, training the personnel, deciding who will make Admiral, and running an academy for providing the operations and management team of this activity will devolve upon the happy winner of the current bureaucratic lottery, a lottery in which coup is counted by those who own the most, not those who do the job the best.

The goals and objectives of those who run functional organizations are different from those concerned with getting on with a particular program, and legitimately so. If I were a program manager responsible for developing some means of handling oil spills at sea, I would have little interest in the sea arm carrying out my experimental work other than it would be proficient and efficient. The vessel overhaul schedules, recruitment of personnel, their training and upgrading, would have interest for me only if

there were an adverse impact on my program. I would also be quite unconcerned about the continuing existence of this sea arm beyond my period of immediate need.

This, incidentally, is one of the organizational problems which has forced program management in the more volatile defense industries. A program manager who also runs a functional group will inevitably reconfigure his whole program and bend goals and schedules to keep his functional group alive. The only way I have been successful in forcing a program manager to use the right mix of functional resources and to cut back as the job nears completion, is to take all such resources away from him and put them in the hands of functional managers. He can now be pretty dry-eyed about assessing his resource requirements.

This same problem of program management faces the universities. Unlike the federal government, the universities have adequate time to adjust to the new demands. There is time to modify administrative concepts so as to pursue with effectiveness the ocean programs which are our primary interest in the face of sometimes more urgent problems of the environment, urban renewal, mass transportation, or any other "new thrusts" which come along.

Historically, the federal government has turned to the universities for help in illuminating the theoretical aspects of these "new thrusts" problems and for the pursuit of research and development projects leading towards their solution. In the past ten to fifteen years, the class problem faced by the federal government has changed from a well-structured set, suitable for individual faculty members, or at most, small groups, to a more amorphous and multidisciplinary set of problems not readily attacked by a single contributor and, hence, not satisfactorily directed by a university with its strong disciplinary orientation. According to the way I scored the game, the establishment of the National Sea Grant College Program required the creation of a new administrative apparatus in each of the universities who chose to participate in the early years. In only two of these universities was the initial management concept found to be acceptable; in all other cases the management concept and staffing required considerable strengthening and modification after its initial inception. All of these universities who applied for initial grants had a long-term commitment to ocean or Great Lake research, had capable faculty members pursuing their individual discipline-oriented research programs, and yet in no case had the university administration found it either necessary or desirable to offer guidance or a management framework for focusing the research towards the needs of the community or state. Such a focusing was left to individual contributors or in some cases departments who often did surprisingly well, but in no sense could they draw on the total relevant resources of the university.

These university managements probably do not even now consider that the lack of such guidance in any way represents a shortcoming of the university. Up to this point in time university administrations have considered their objectives to be the teaching and training of students and the pursuit of desirable research by their faculty members. The desirable research has, as an experimental fact, become narrowly defined--this narrow definition being enforced by the editorial policies of the preferred professional journals within a discipline, or the pedantic requirements of the textbook. Professional credit and advancement come as a result of the pursuit of these narrow objectives.

It has long been noted that the traditional notion of a university as a community of scholors has given way to the hardened compartmentalization of academic departments. In fact it is hard to imagine cooperative multi-disciplinary programs when one recognizes that mathematicians would not only choose not to cooperate with physicists but consider their own research all the more desirable if it cannot be used by the physicist; and, similarly, that the physics faculty member takes great glee in pursuing research which in his judgement cannot possibly be useful to the engineer. Unfortunately, these are not overstatements but can be heard on any campus today. In those institutions which have attempted multi-disciplinary research programs, it has usually been the fate of the resulting institute or program management office to find that it and its employees are regarded as second-class academic citizens.

The federal government has a need for university participation in the new social and environmental programs. In certain specific cases this need has been expressed by the Congress and by the various state legislatures.

In the case of the Sea Grant Program, the Congress has very specifically expressed itself as desiring a total program yielding results measurable in crass economic terms and having an impact on society at large.

I would like to turn back the pages of Sea Grant history now to quickly review a few points which are important to the conceptual development of the program. Athelstan Spilhaus is generally conceded to be the inventor of the catchy notion of "Sea Grant", and as far as I know, it's true. Spilly and his cronies worked very hard to get this idea pushed forward, and with the help of many, and a meeting sponsored by the Rhode Island contingent--Johnny Knauss, Senator Pell et. al.--they got something going. The West Coast folk got tired of fighting among themselves on whether to go for a million ton anchovy catch versus a two million

ton allotment (incidentally, it took three more years to get 75,000 tons) and came back to testify before Congress that Spilly had a great idea.

The primary issues as I recall them were:

(1) Should there be a requirement of matching funds, and
(2) The multiple choice question of what agency should sponsor Sea Grant--
  (A) The National Science Foundation
  (B) The Smithsonian Institute
  (C) The Department of the Interior
  (D) None of the Above

As I remember, Bill Nierenberg came back and testified that the idea was great--it was even bigger than Scripps and only the West Coast management should be centered at LaJolla.

The only testimony that I preserved was my own--so unfortunately I must quote it to illustrate the fact that even at that time the concern for program management was evident and although the basic idea was right, as usual I had lodged the problem in the wrong place.

"Two points that I wish to mention have to do with the administration of the program by the National Science Foundation and also the need for funding of institutions as distinct from funding for specific projects. There seems to be some reservation on the part of the NSF for accepting this responsibility which is certainly understandable. Historically the foundation has maintained the point of view that they should fund worthwhile projects conducted by men of stature and demonstrated competence primarily in basic science.

"Further, the foundation has preferred to take a passive role in the development of the field by choosing from among programs presented to them rather than the active role of giving direction by soliciting proposals in particular areas.

"This last point I don't think has been mentioned before and may be the most serious objection to the foundation. It is clear that the administration of the Sea Grant college program requires significant departure from the present National Science Foundation philosophy in order to be successful."

You will note that I imagined the NSF, or at least the host activity, would be the logical program developer. As it later developed, the far more Machiavellian approach was adopted by Bob Abel and company which passed the responsibility for creating the complete program down to the universities. I wish I could claim that I thought of the idea, but

then that's much too devious for people like me.

That Bill S.2439 was passed is an historic fact. Bob Abel found that his luck had run out, and he transferred to NSF to run the show. He collected a few of his old drinking buddies who owned white shirts and dark suits and formed a panel meant to give guidance and respectability to the enterprise.

The first year was a shambles. The site visits were a disaster. First-rate nationally known and respected research people were paraded in front of the visiting committees to talk about their projects. After all, fifty such projects at $20,000 a crack made up a million dollar program. It seemed to me to be demeaning to place these able men in such a defensive position, and for my part, I felt dirty in having to participate in the resulting inquisition.

The initial results were so bad that there was a serious debate among the panel members as to whether first rate academic instituions should have a role in Sea Grant; we were concerned that it might not be in the instituions', and hence, the nation's, best interest.

I recall during a luncheon address at Newport, publicly expressing the doubt that universities were the correct instrument for programmatic endeavors, and privately I felt we should look elsewhere because it was more a certainty than a doubt.

Well, universities are resilient and adaptive institutions. Program managers, institute directors, and so on were named, the new vocabulary was readily mastered and by the third year you had to know the institution to know you were getting a snow job.

It would appear that I am leading up to a proclamation of success--I am not. Step one has been taken, but that is all. The changes in the university approach are all readily reversible and without continuing pressure will reverse. There are few results which would satisfy a congressman's requirements for an economic return or for an important impact on the community at large. I get enough reports from my old stamping grounds up and down the West Coast to assess the impact there, and I've been in New England recently enough to gauge the success on that coast. I have taken a good look at the Great Lakes region where I now live and the situation is similar there.

To have expected anything but a negative result this

early was sheer foolishness on my part, yet I think that five years ago many of us expected to be that far along. None of us correctly anticipated the managerial problems which are now so evident. A number of you in this audience have been key figures in the establishment of bona fide Sea Grant Programs at your respective institutions; you have labored long, you have learned a new vocabulary, and as you have privately communicated, you have learned to be effective in spite of second-class academic citizenship. You will not have succeeded, however, until there are other institutions and programs in other fields enjoying first class citizenship, and, in fact, enjoying premium prestige and reward in your institutions as do your industrial counterparts.

I choose not to make concrete recommendations to you because certainly I have no magic formula or "right way" for accomplishing these objectives, Further, I suspect that there is no "right way." The format found to be effective will certainly be conditioned by the institutional history and its own internal institutional culture. Such things as what departments had fights over the last twenty years and the particular organization of departments into schools and colleges will make a world of difference. There are, however, some general principles which will underlie successful programs. There are two that I would put right at the top of the list.

The first is the acceptance by the university administration, by department heads, and by the involved faculty that some form of program management is necessary and desirable; that capable, creative faculty members are urged to move in and out of the institutions or program offices as their interests and the needs of the program dictate. In effect, this is a reorientation of at least a part of the scholorship, research, consulting, and teaching activities of traditional departments directed toward collaboration designed to undertake meaningful and substantial efforts in national problem areas. These commitments and collaborations can be temporary and shifting and certainly leave the possibility for desirable simultaneous attention to the more classic commitments of these departments necessary to provide flexibility and strength for future adaptations.

This first point is then that the university administration and the university culture permit such commitments to problem-oriented research and collaboration across the lines of traditional disciplines, to see to it that these arrangements are encouraged, are respected, and are facilitated by staff selections. The insurance of commitments must extend all the way from providing the necessary physical facilities to adjusting the criteria for reward, and must be made real, specific, and visible.

The second key point is that the institutes or program offices should not staff the job themselves and, in fact, should bend over backwards to make as infrequent use of full time staff as possible. Instead, they should make full utilization of the existing departments where the goals of technical strength and education can insure the success of a program and its later dissemination through the education process to the ultimate users in government or in industry. Most institutions seem to be moving in a direction which would achieve these goals.

There are many lesser "do's and don'ts" which one can worry about, but it is certainly not my purpose to write a cook book of my conception of program management. I feel it is much more important for each of you who are responsible at the various universities to write your own.

In summary, where do I think we now stand? Wib Chapman used to talk about a group he called the "Sea People." Some of you may remember that he expounded on this theme at his acceptance speech at Rhode Island on the occasion of being named the first recipient of the Sea Grant Award. His thesis was that those who work in the sea, who accept the privations and discomforts and misery have to love the sea. Such people are different from landsmen and are bouyed up in moments of trial by an emotional response to the sea. Many of you here are sea people just as I have considered myself to be one during the technical working years of my life. Yet, in spite of a strong emotional attachment to the sea and to all things that pertain to the sea, I would have to judge that <u>if stopped today</u>, the Sea Grant Program would be shown to have fallen short. Your institutions would revert to their former ways, and very little could be claimed as a benefit from the resources thus far expanded. The payout in the sense of the congressional expectations can only come with time; a time much longer that I visualized a few years ago.

In another and broader sense, though, I would rate the program as cost effective to date. The program is serving as a pilot model for learning how to do programmatic research. It is not alone in this role, but the Sea Grant funding has been enough to involve a number of institutions, each exploring different approaches to the same problem. More important, the Sea Grant staff people have had the vision to permit the experimentation and the strength of purpose to insist on measurable progress toward the management goal.

The management techniques being utilized in the Sea Grant Program are being scrutinized by other Federal funding agencies, and I feel certain that the effects will not be confined to Sea Grant alone but will have a considerable

impact on some of the National Science Foundation funding policies as well as U.S. science policy at large.

In a sense, this capsule summation of the Sea Grant Program progress is also a summation of my personal participation over the past years in matters of the sea and ocean resources. The now evident incredible mistake of assuming success in five and ten year time frames is appalling. Some optimism, though, is necessary to a crusade of any kind, and for those who have followed the banner of Spilhaus et. al. one has to regard it as a crudade. I'm still convinced of the essential soundness of the positions taken by those who enthused me with the opportunities which the oceans present. For those of you who are new or relatively new players in the game, I would recommend that you infuse your expectations with a liberal dose of optimism.

In a more personal vein, let me acknowledge the great satisfaction that has come from knowing so many of you and of doing battle in the dual arenas of technical and managerial combat. I consider that I have been privileged to participate with the government and university people in the Sea Grant Program, and I certainly do look forward to an occasional site visit which Bob Abel assures me my emeritus status will permit.

Presentation of the Sea Grant National College Award

The Sea Grant National College Award is presented to an individual in recognition of his outstanding contribution to mankind's utilization of the oceans.

Dr. Lauren R. Donaldson, professor of fisheries at the University of Washington, was named the recipient of the 1971 Sea Grant National College Award. Dr. Donaldson, a leading expert in fish breeding and culture, and on the effects of radioactivity on aquatic animals, was presented the award at the fourth national Sea Grant Conference at the University of Wisconsin at Madison, Tuesday, October 12, 1971. Dr. John A. Knauss, president of the Association of Sea Grant Program Institutions, and provost for marine affairs at the University of Rhode Island, made the presentation. The award carries with it a $500 stipend and a hand-engraved silver plate.

The Sea Grant award was the second national award Dr. Donaldson received in little more than two months. On August 10, he was presented an award by the Marine Technology Society at its annual meeting in Washington,D.C.

The first National Sea Grant College Award, which was sponsored by the University of Rhode Island Foundation in 1968, was presented to the late Dr. Wilbert McLeod Chapman. The award presented to Dr. Donaldson was the first to be sponsored by the Association of Sea Grant Program Institutions and it will be presented annually.

Dr. Donaldson was chosen by a selected committee of six men from Sea Grant institutions, headed by Dr. Herbert F. Frolander, director of the Sea Grant program at Oregon State University.

During his years of fisheries research, Dr. Donaldson developed a brood stock of rainbow trout with an increase in rate of growth, survival and egg production about 20 times that of the usual good rainbow trout brood stock.

He was also responsible for the introduction of coho salmon into the Great Lakes, for which he received a memorial award from the state legislature of Michigan.

At the University of Washington, Dr. Donaldson directed research experiments that established runs of chinook, silver and sockeye salmon, and steelhead trout in the University's holding ponds. His experiments involving the crossbreeding of a select stock of cutthroat trout with a wild strain resulted in the production of fish that mature rapidly and grow to a large size.

Dr. Donaldson is also the former director of the University of Washington's Laboratory of Radiation Biology, which has played a major role in evaluating the biological effects of radioactivity since the early days of the United States' first atomic bomb project.

Dr. Donaldson and his staff conducted field studies on the amount, location and distribution of radioactivity at Bikini, Eniwetok, Rongelap, and nearby atolls, and on the long-range effects of this radioactivity on aquatic and land plants and animals of these and adjacent areas of the Southwest Pacific. He has also been a consultant in many atomic tests in Nevada.

In 1954, he was a special consultant of the U.S. Department of State during the crisis resulting from the contamination of the Japanese fishing vessel "Fukuryu Mary" resulting from atomic tests in the Pacific.

Dr. Donaldson has made several tours, inspecting and lecturing at fish cultural stations, research centers, and atomic energy establishments throughout the world. He has done fisheries research work in Washington, Oregon, Montana, Idaho, Utah, Wyoming and British Columbia, and has published papers on fish nutrition, endocrinology, hematology, radiation effects and histology.

Dr. Lauren R. Donaldson has been a member of the University of Washington College of Fisheries staff since 1932. He received his B.S. degree from Intermountain Union College, Helena, Montana, and the M.S. and Ph.D. degrees from the University of Washington. He was awarded an honorary D. Sci. degree from Rocky Mountain College in 1958, and from Hamline University in 1965. Dr. Donaldson is a native of Tracy, Minnesota. Before joining the University of Washington faculty, he was a high school principle and teacher of science and athletics at Shelby, Montana, and a research biologist with U.S. Bureau of Fisheries.

A Year of N.O.A.A.

Luncheon Address, October 13

Robert White, Administrator
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

It is always a great pleasure and, without exception, stimulating to meet with people involved in one way or another in NOAA's Sea Grant Program. It is doubly a pleasure: NOAA is just a few days over a year old, and this occasion provides a rare opportunity to take a retrospective look at the first year of NOAA's operation, and its stewardship of the Sea Grant Program.

For NOAA, having been brought together within the Department of Commerce from a wide diversity of organizations, it has been an eventful year. It is a feeling which I know you share: as NOAA is a young and dynamic organization, so the National Sea Grant Association is also a new and vital addition to the environmental scene. This Association brings together those in the university community who have a particular interest in the problems, progress and prospects of the National Sea Grant Program. It can be, and I know it will be, an effective means for bringing the views of those most directly affected to the attention of those in government who are responsible for the program. Only through constructive interaction with groups such as yours can we ensure that the government's programs are responsive and relevant to national needs.

I don't intend to belabor the changes we have made in NOAA's organization, except to say that we have totally reorganized our efforts into a form which we believe will make possible effective and innovative management of the Nation's civil programs in the oceans and atmosphere.

After considerable soul-searching, we have defined our major tasks as being four. They include the formulation and execution of a national program for the exploration, conservation, development and management of our ocean resources, including the problems of the coastal zone and the Great Lakes.

They include the development and operation of a national system for monitoring and predicting the state of the global environment, to protect man and all he owns from the fury of Nature and to provide efficient and effective use of environmental information in all of his commercial, industrial, agricultural and public pursuits.

They include the understanding, exploration and development of techniques for dealing with the consequences of the modification of our atmospheric and oceanic environments, whether that modification be intentional or inadvertent.

And they include the fostering and support of the Nation's scientific and technological capabilities needed to prosecute effectively the tasks I have just mentioned.

We have spent a busy year in program formulation and in creating the mechanisms necessary to make the programs work. We think we are now on our way. In an address to the Marine Technology Society a year ago, the Undersecretary of Commerce said, "President Nixon is about to take a giant step forward in assuring a national effort in the exploration, development and preservation of the marine environment which surrounds us."

The kind of steps we shall take in all these areas I have mentioned will, of course, depend on the financial resources available to us. Our first year's experience has not yielded the full extent of the financial resources that the President sought to move NOAA's program ahead. However, it is also fair to say that the resources given to us have been substantial. We have received an increase of approximately $40 million for all of NOAA's programs--a 9 per cent increase in our total budget. A large fraction of this amount may be consumed by inflation, nevertheless, there are funds for new and increased programs both in the oceanic and atmospheric fields. Let me characterize it as a start.

Now, how did the Sea Grant Program itself fare within NOAA this past year? Extremely well, relatively speaking. I have indicated to many of you that we attach the highest priority to the Sea Grant effort. The history of our budget cycle will let our actions speak for us.

Once having been allocated a $2 million increase over its $13 million base in the President's budget, the Sea Grant program never was considered for any cut. Indeed, it was the only program in all of NOAA that did not suffer in the budget cycle once the Presidential allocation had been made. The Congress, happily for Sea Grant, added $ 2.5 million to the amount requested in the President's budget. Sea Grant, therefore, will have $17.5 million to expand during Fiscal Year 1972--an increase of $4.5 million over last year, or about 35 per cent. While this may not be as much money as all of us would like to see, we are glad to find Sea Grant funding moving in the right direction.

I know you are all wondering what the impact will be of the President's new economic policies. As you know, the President has decreed a cut of some $4.5 billion in Federal spending, and has directed a cut in total Federal personnel of about 5 per cent. While the full impact upon NOAA of this action cannot be clearly seen just now, it is plain that many programs will have to be postponed or cutback. However, I feel that the impact of the new economic policy upon Sea Grant will be minimal--something I cannot say for the rest of the organization. Let me sum up the resource picture by saying that we probably will be just slightly better off, NOAA-wide, this year than last, but that Sea Grant will be measurably better off.

Before we look further to the future, let us look backward over the year just past. In the Sea Grant Program, 12 institutional grants were awarded, six coherent projects grants consummated, and 25 regular project grants initiated--the total amounting to about $13 million. We have added the Universities of Delaware and Louisiana State to our Sea Grant institutional network--excellent examples, I might add, of programs which have developed from individual projects to coherent projects to institutional status. It is the kind of progress we like to see in the Sea Grant program.

The Sea Grant Advisory Service has made much progress during the year. It was immediately clear to us that the research and educational aspects of Sea Grant had been moving along well; we are now pleased to see the Advisory Service functions coming into their own. It is natural that these should have developed somewhat later than the research and educational efforts;they are not normally traditional university functions. But it now appears that all the universities receiving institutional support have also developed advisory service programs. In all cases, they are working reasonably well; in some, they are outstanding in terms of their impact upon the people they are designed to help.

One hesitates to cite a number of reports issued under the auspices of any program anywhere as indicating progress. At the very least, it indicates activity and ferment. I was pleased to learn that more than 400 reports have been issued under the auspices of the Sea Grant Program. They represent a highly refreshing diversity of outlook and approach toward the many problems of the use and conservation of marine and coastal resources.

Another product of the Sea Grant Program which has demonstrated achievement during the past year is Sea Grant 70's. We have decided to continue sponsorship of Sea Grant 70's through the National Science Foundation for another year to

permit a chronological follow-through to the categorical arrangement that comprised Sea Grant 70's last year. This will permit the staff and publication to note the miscellaneous reports which have been issued since the appropriate volumes of the publication last year. At the end of the next year, however, NOAA sponsorship probably will be terminated in favor of more conventional sponsorship such as an association, private foundation, or commercial enterprise.

The highlight of the year, of course, has been the designation by Secretary of Commerce Maurice H. Stans of four universities as Sea Grant Colleges. I need not belabor the importance of this designation, as historic in its way as that of the first land grant colleges.

The designation followed almost precisely the recommendations of the Sea Grant Advisory Panel. I know there has, inevitably, been some disappointment on the part of some universities--but let me point out that this is only the beginning of the program, not the finish. We intend to designate additional Sea Grant Colleges as institutions qualify and as they are recommended by the Panel.

What does the designation mean? The Panel was crystal clear on the mutual commitment by the government and the designated Sea Grant College. On the part of the government, it is a commitment to provide a base of funding and support necessary to maintain the infrastructure of the Sea Grant Program within the colleges. While this commitment cannot legally be made except on a year-to-year basis, since the appropriate process is a yearly affair, it does imply a firm Federal commitment in the absence of any upset in the normal Congressional appropriations process. On the part of the Sea Grant College, it is a commitment to maintain a vigorous program meeting certain standard of excellence. The designation is another symbol that this Nation intends to move systematically and unerringly towards a national policy for the development and use of our ocean and Great Lakes resources, and to bring into this process the talent and capabilities of our university, industrial and state communities.

Over this year, which has seen so much activity and reorganization, it may be worth noting that only the Office of Sea Grant, within NOAA, has been left undisturbed. If things are going well, change for its own sake is useless. And, in my estimation, the Sea Grant Program has been going well. Indeed, I consider it one of the better granting programs in the entire Federal structure.

However, if all we had accomplished were to change the home of Sea Grant from the National Science Foundation--which got it off to such an excellent start--to the Department of Commerce, the change would have been meaningless. We have taken steps, and will take further steps, to make sure that the Sea Grant Program is in every sense integral to the total NOAA effort to explore, develop, conserve and manage the ocean's resources. We see an unparalleled opportunity to bring together, in the best sense of the word, the talents and efforts of the universities, consortia of universities, state agencies and industries presently supported by the Sea Grant Program, with other NOAA programs. I am thinking of our fisheries, our non-living resources, our environmental efforts, all of which can benefit tremendously from a comprehensive and well-rounded national program.

By way of example, we are examining NOAA-wide programs in the areas of environmental monitoring, aquaculture, advisory services and underwater acoustics to name several at random. In the past, the Sea Grant Program has fostered extensive work in each of these areas. We expect it to do so in the future, and, in turn, we hope and expect that you will be participating actively in the formulation of NOAA-wide programs.

We confront diverse, complex problems, requiring a broad base of information--technical, legal and social--as we face the task of developing and managing our marine resources, particularly those of the coastal zones and the Great Lakes.

It is important that we keep our efforts relevant to national needs, that we have guideposts to help us through the years to come. President Nixon, dedicating the Ocean Science Center of the Atlantic at Skidaway Island, Georgia, last October had this to say of the oceans:

"What we need is a two-pronged program: one that, on the one hand, will develop the resources of the waters around us for the future benefit and progress of mankind but, on the other hand, will see to it that as we use the oceans, we do not abuse the oceans."

This philosophy, applied not only to the oceans but to all our environmental resources, guides us in NOAA. I believe it must serve as a baseline as we seek the scientific, technical, social and legal information on which decisions must be made.

Our task, you see, is broader than the regulation or control of pollution; this is basic to man's relationship with the world around him, but it is only a beginning. Our task is to seek the best possible use of our resources in the face of multiple, often conflicting, many times

selfish, needs and desires. Fortunately, it is not necessary for our society to make arbitrary, either-or sorts of choices between the preservation of nature and economic or social progress. We can have both, and leave the priceless legacy of an unspoiled environment to our children. Possibly the greatest single challenge facing the Sea Grant Program is to help show the way in which we can best do these things.

There is no marine area of our nation which better illustrates the urgency--and the complexity--of moving toward a workable resource management system than the Great Lakes. This area exhibits to a stark degree all of the promise, and all of the problems, which confront us in dealing with near-shore marine resources.

NOAA is heavily involved in almost all aspects of the Great Lakes problems through its Lake Survey which it inherited from the Corps of Engineers, its Weather, Fishery, and Data Services, as well as through its Sea Grant Programs. It is the task of the Sea Grant Program to carry out applied research on all those problems on which increasing information is required so that decision-makers can be adequately supported. In Sea Grant we have a mechanism for translating information derived from basic research into the full spectrum of practical applications, the institutional mechanisms which can bring together those from law and economics, public administration and sociology, with the scientific and technological groups to focus on a set of problems of great social importance.

Let's look at some of the things the Sea Grant Program is doing in the Great Lakes areas. Two years ago, a Sea Grant was awarded to the University of Rochester for prospecting and experiments relating to the assay and recovery of sand and gravel deposits from Lake Ontario. One of the largest grants we have made has been an institutional grant to the University of Wisconsin for a multi-faceted effort of research and development in the fisheries area, in minerals, in waste abatement in the Lake environment, and of educational and advisory services for the Lakes area.

At the University of Michigan, the Sea Grant Program has been attempting an innovative approach involving a series of closely linked projects and experiments which look at the full spectrum of man's actions and operations on the Lakes. Examining the interactions between the various activities of man, this work will result in a full-scale analysis of their consequences which will be useful to local and state planners, industrial developers and all those interested in the future of the Great Lakes. It is visualized that this analysis will provide for decision-makers all the relevant data necessary for arriving at reasonable decisions, whether they concern zoning laws,

waste abatement procedures and laws, rights of navigation and common usage, or any of the many other problems that can arise. It is expected that the University of Michigan analysis will provide basic data not now presently available.

What we are about is the development of a data base, and concepts based upon the analyses of these data, which will be useful in our management of the Lakes area. There is no more important activity which NOAA can undertake than these kinds of investigations. I should point out that NOAA's activities in the Great Lakes areas are not confined to those of the Sea Grant Program. As I indicated previously, our activities in the Great Lakes area are comprehensive indeed. It is obvious that the effective use of the Lakes area must depend upon adequate charts of the Lakes, of adequate knowledge of the circulation of the Lake waters; this is done by the Lake Survey of our National Ocean Survey. It is equally obvious that operations on the Lakes are subject to the fluctuations of the weather, which in this area is often sudden and devastating. The routine weather forecast and warning services provided for the Great Lakes are indispensible to any activities which may be conducted there.

However, we do not feel that our understanding of the water balance and the water circulation of the Great Lakes is adequate to our needs. When NOAA was formed it inherited the responsibility for the United States portion of the International Field Year of the Great Lakes. This program, part of the International Hydrologic Decade, is joint with the government of Canada and has, as its basic purpose, the basic study of the water balance of the Lakes area. A very large field experiment is now scheduled for the year 1972 on Lake Ontario. We plan to move ahead vigorously with this program. It has acquired the necessary financial resources from the Congress, it has been working closely with its counterpart in Canada and with university groups in the Lake area to design and mount the most comprehensive field observation program ever undertaken for the Great Lakes. Participating in this International Field Year of the Great Lakes will be the Environmental Protection Agency and the National Science Foundation. We are encouraging the involvement of universities in this program. It is my hope that the Sea Grant institutions in the Great Lakes area will want to participate also. It is an extremely worthwhile and relevant endeavor.

The Sea Grant Program is now four years old. A total of $33 million has been invested. At the end of next year, we shall have reached the program's fifth year. This seems a good time to look back upon Sea Grant's efforts to assess the results, to review the procedures, to ask what, if any changes are desireable.

I am asking the Sea Grant staff, the Sea Grant directors and their colleagues to focus upon such an assessment over the coming year.

What are some of the questions you might very well ask yourselves--especially those in universities which have had institutional grants for some time?

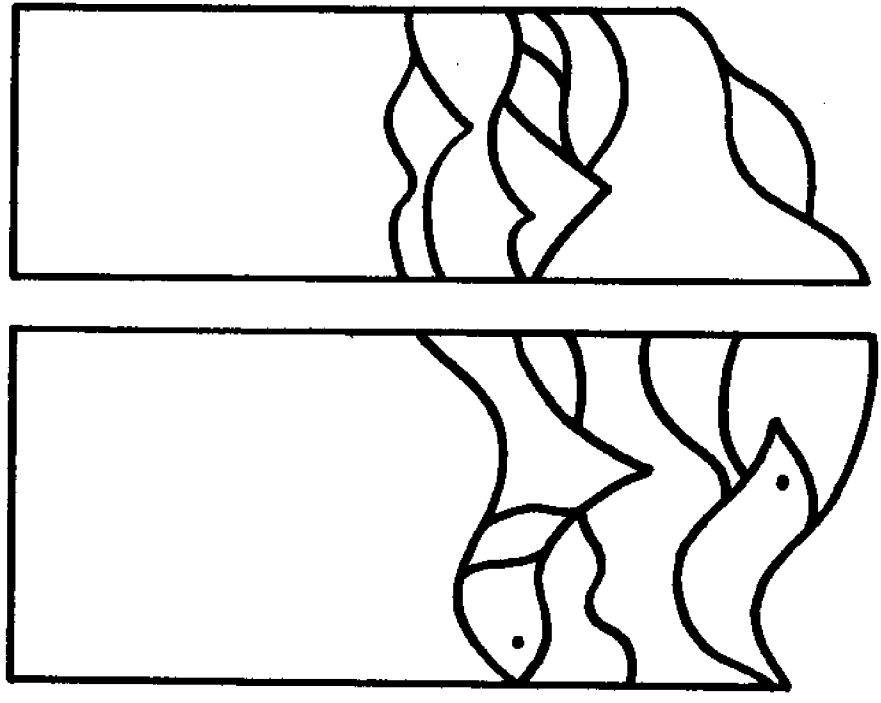
Have your technical programs been heading in fruitful directions, or do they appear to be drying up? Have some of them struck dead ends? Have the past five years seen sufficient changes in your environment to dictate a change in the themes of your programs? Do the results of your initial projects lead you to the same conclusion?

I think you should examine very closely whether you have been successful in truly blending the social and natural sciences in your program, or whether these two aspects are moving independently. It might be well to inquire whether your economists, your attorneys, your public administration specialists and others like them are interacting effectively and making real contributions to the solution of scientific and technical problems--and vice versa.

Are your people working in teams or going in more or less alone? Have the graduates of your program found good positions as they have left--and if not, why not? How are your advisory programs? Are your programs well accepted in your regional communities? Are there new projects and scientists you would like to involve in your Sea Grant Program but cannot for lack of funds? This may be the time to make hard decisions to substitute new efforts for on-going activities--or perhaps not.

Many kinds of assessments must be made to keep the Sea Grant Program relevant and future-oriented, and in this area we shall be looking to our participants and advisors for wise counsel. For example, the Sea Grant Program now sponsors 45 different projects in the field of aquaculture. We regard this as having enormous potential, and would like to see a national aquaculture program in which Sea Grant projects would play a key role. How do these 45 projects relate to one another--to what extent should they so relate--and how can we best bring about the most effective relationships?

I say without reservation that the National Sea Grant Program is one of the most exciting, one of the most valuable, one of the most grassroots-oriented government efforts that I know. We want to keep it that way--a vital, changing program closely attuned to the needs of the American people. With your help, I know we will.



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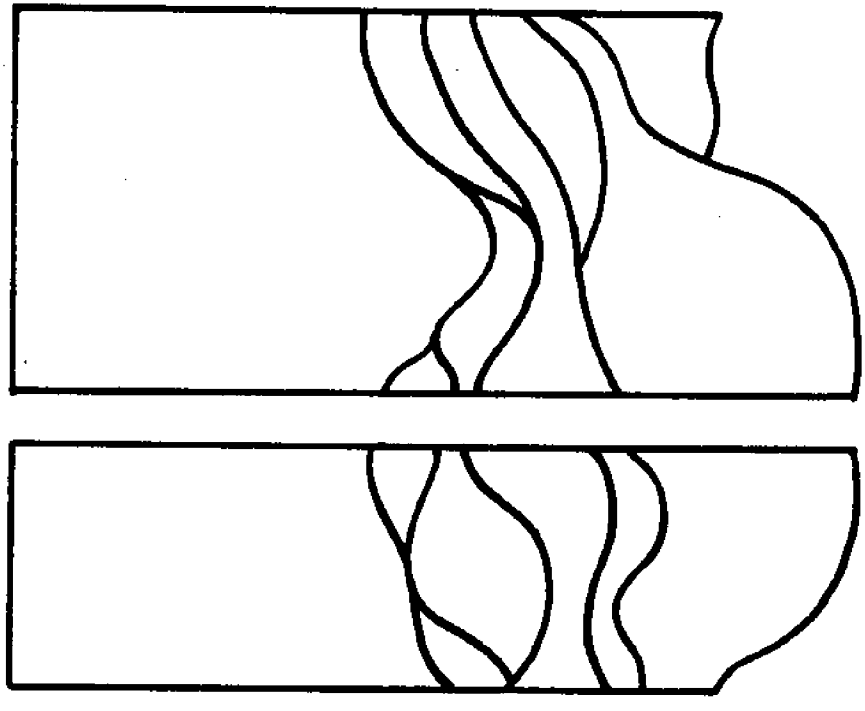


GENERAL SESSIONS

Economic Growth vs. Environmental Protection: What Will be the Outcome?

John S. Steinhart, Session Chairman
University of Wisconsin-Madison

We do not propose to answer the question, how do we resolve the questions of economic development and environmental protection? We will be forced to make difficult choices in this area, and we will be frequently forced to make them before we have all the research we would like to have on the topic. Nevertheless, it is increasingly important for Sea Grant, as a primarily economic stimulation development program, to address this question directly. Perhaps many of us in our own programs will find it possible to continue work on the question itself. The difficulty is, in the present public forum, questions of economic growth versus environmental protection are qualitative arguments and frequently conducted in the arena of demonstrations, court cases, and without much attempt to resolve, basically, a series of difficult dilemmas.

For example, if I look at the growth of Chem Abstracts, a journal many of you are familiar with, as a function of time, since its inception at the turn of the century, it has grown larger and larger. If, instead, I look at how large and how wide it has become, at the velocity with which it is put into library shelves, I find that plotting the velocity on a semi-logarithmic plot fits beautifully. In addition, if this line is projected into the next century to the year 2025, the velocity with which Chem Abstracts is filling library shelves reaches the velocity of light. That will assuredly not happen. Yet many times our present short term policies proceed exactly as though we expected that to happen.

Now, looking at the production of sand and gravel in the United States, again, as with many other variables, it fits beautifully on a semi-logarithmic plot, implying exponential growth with a fixed doubling time. In that case we will not continue that growth beyond about 2235, because this simple projection of the present growth rate - persistent for the past 70 years or so - would imply that somewhere around 2235 or so we would need to dig up and shovel around the entire map of the earth.

However we won't get that far. Somewhere past the year 2200, again with this simple straight line projection, we would find need to remove that part of the United States, to meet U.S. requirements, which is above sea level, and redistribute it. It leaves a difficult problem of where to stand.

These kinds of calculations are consistently made and provide as evidence that economic growth of the kind that we have undergone for the past 50 or 100 years cannot continue. Of course, it can't continue indefinitely. The exponential growth in anything is insupportable over a very long period of time. The question is, if it cannot, when and how can we get it under control.

Secretary Richardson has said if we were to fund one of the bills which looks like it has a good chance in Congress it would cost $20 billion a year of federal government money. This is emerging, apparently, as a very high priority program in the public mind. In addition to these domestic claims on our future growth dividends, there is great concern for the lesser developed countries of the world. What kind of help can advanced nations be to Indonesia, to certain Latin American or Asian countries, to the larger countries of the world, mainly India and China, who have faced desperate economic problems? We have many different claims on the future growth dividends that we hope are coming along.

Technically, some economists have been exploring the possibility that if we correctly counted our economic growth, we would list as a negative item the degradation of the environment that is going on. There have been competing estimates. I don't know enough about the budget to know which one makes much sense. Some have said if we review the environmental degradation since the end of World War II, it would cancel out the measured growth benefits. Others claim this is absolute nonsense -- that the environmental degradation cost is minimal, and whatever it is it couldn't possibly be as big as the positive addition to economic growth and measured improvement in leisure.

Add the difficulties of environmental protection most economic developments carry with them--side effects which we think are degrading or otherwise deleterious--and one faces squarely a set of difficult problems, which are not only relevant to the Sea Grant Program, but extremely important offshore or in the coastal zone. To that end we have with us this morning two economists who will try to present some views relevant to this matter.

Robert Lampman
Department of Economics
University of Wisconsin-Madison

As I understand it, you stand in your roles oftentimes at a point of friction between economists and ecologists. Your concern then is with the competing goals and the alternative means to achieve those goals suggested by these two disciplines. It might be useful, on this topic, to indicate briefly two points of difference between these studies. One has to do with the end of societal effort as seen by these two different groups. The other deals with the means that are preferred or that are apparently given priority.

It is sometimes said economists are people who know the price of everything and the value of nothing. On that score one might say ecologists are people who know about things that are priceless, things of infinite value -- life and death, the survival of the planet, the qualitative matters that make life enjoyable.

If they have that difference, economists and ecologists have a similarity -- both have earned the title, at some time or other, of dismal sciences. In Carlyle's time in England, economists were thought of as people with very dismal proposals and predictions concerning the future. Malthusian thinking is economic thinking of a kind, and it certainly is among the more gloomy forecasts. Malthus, however, by contrast to contemporary ecologists, sounded like a benign and hopeful person. He saw a problem of human population increase outrunning the increase in food supply. And he saw that people were likely to live at subsistant levels most of the time. Beyond that, plague, war and pestilence would correct the matter, and an equilibrium at subsistance levels of living would be reestablished.

That was a benign prediction compared to Paul Ehrlich, Dave Forrester and other current writers of ecology, who say that if we upset equilibrium very far, the prospect of life on earth will be endangered. It wasn't just a matter of hovering around subsistance living as Malthus believed. In between Malthus and Ehrlich have been other dismal forecasts. People have said we are running out of irreplacable natural resources. When I was an undergraduate I heard we were going to run out of oil in 25 years, timber in 10, iron ore in 50, and coal in 2000 years.

In each piece of Malthusian thinking, and in some of the latter day resource economist's we have seen technology overcome the hazard, at least in certain times and places. We have seen the writing of the balance in favor of more hopeful possibilities in the future. We have learned that Malthus wasn't entirely right, at least in regard to western countries.

In the short run, roughly 175 years since he wrote, we have learned that people do have different patterns of population growth, do have different capabilities with regard to increasing food supply. For various reasons Malthusian predictions have not entirely come true. Because of technological inventiveness, we have found substitutes for certain key natural resources. Because of the workings of the price system, we have seen self limits on the exploitation of certain scarce resources.

Is it likely or plausible that some of the more dire predictions made by ecologists these days are altogether right? I will leave that as an open question. What is the end of economic growth, in contrast to the end for the environmentalists? Economic growth is defined as increases of output of things that people value, want to and are willing to pay for. Economic growth is a process of increasing inputs of land, labor, capital, technique and management skills, education and many other things of a qualitative nature that go into the process of production of goods and services. As a matter of fact, it is worth emphasizing that most people in the American economy now are in the production of services, rather than commodities. And the process is successful to the extent that we do produce things people want, with less input. So economic growth means improvement of efficiency. It means we have a greater quantity of the things people want, with less effort and with less utilization of valuable inputs.

Economic growth is synonymous with efficiency, according to one definition of it. The largest single cause of economic growth, we think, is improved technology and improved knowledge. And growth goes forward roughly at the same rate as the accumulation of knowledge. It is very hard to stop economic growth, and hard to stop man's efforts to improve his efficiency. Yet some people have talked about that as a desirable thing because of its environmental consequences. It is argued by some people that we must work out a stable or zero growth situation.

To work out a zero growth situation with an increasing population, we would have to accept lower living standards. Some people would have to accept lower standards even though their present standards are not very high. This proposes many social and political issues in itself, and also overlooks the fact that growth is a possible way to improve the environment.

Growth is a means by which we can direct part of our resources to improvement of environment. In our system, and in most systems around the world--communists as well as capitalists--growth has been seen as a necessary condition for social advance. We have taken the benefits of growth and applied them to education, for health, for better housing for people, to more mobility for people, to enlarging the range of choices of individuals and of groups. One of

the ends we may have is to improve the amenities of living that come from a clean environment. One of the competing claims these days for the dividends of growth is the protection against the hazards of the various types of pollution, the various types of environmental degradation which surround us. But one should clearly mention at the outset that this is only one of the possibilities for future growth dividends.

There are very strong claims from people in the United States and other countries as well, for redirection of some of our resources toward the elimination or reduction of poverty, the control of crime and social disorder, overcoming the long blight of discrimination against non-whites, against women, against others who have suffered in the past. We have seen strong pressure for more educational investments. One issue having great strength behind it these days is the pressure for child day care.

People have increased their social welfare as much by increased leisure as they have decreased their social welfare by environmental degradation. In brief, the economic growth goal, or the economic growth purpose we have is different from the goal of the environmentalist who would assert that we have to, as a matter of higher priority, preserve the gift of nature which enables life on the planet, that we are endangering that very possibility by continued economic growth and disregard of environmental degradation.

What about the question of the means of environmental improvement and the controversy we see there? Economists argue it is important to use the price system to handle the problems of environmental degradation. They say, for example, we have managed the problems of certain scarce resources by means of the price system. We urge that there is a self limit in the system. When resources are at a scarcity they become more expensive, and people work out a way to conserve them. You don't have to have a set of laws to get a desirable result. All you need is a way of pricing these appropriable resources. That is better than a whole set of direct prohibitions, of direct limits on individual activity by governmental rule or regulation.

The environmentalists for the most part have refused to go along very far with this idea of using the price system to manage the environment. They have tended to look on the problem not as one of optimizing, but as one of maximizing. They have looked on these problems of environmental hazards as so serious as to brook no limit on the direct activity of government.

Economists, on the other hand, have tended to put this into a larger context from their point of view, as saying the environmental problems are very similar to earlier ones

we have had. For example, it's similiar to the problem of handling industrial accidents. To limit industrial accidents, one theory is to charge industrial accidents to the employer, and thereby let the product bear the cost of the blood of the worker. That particular method of handling the cost of industrial accidents through Workmens' Compensation is cited by many economists as a forerunner for a new method of inducing and requiring manufacturers and other processors to bear the direct charge of whatever environmental degradation they occasion. This will be built into their price structure and passed on, of course, to the consumer. But, in the mean time, you will set up signals to the various actors on the economic scene so they will, without direct regulations, undertake to minimize the environmental hazards.

This suggests a very important difference between economists as a group and environmentalists as a group. Economists have tended to see problems as marginal in character. You can have a little bit more pollution or a little bit less pollution, as you choose. You can move along these cost lines in such a way as to find an optimal amount of pollution.

It often shocks people when economists talk about an optimal amount of crime or an optimal amount of poverty, or an optimal amount of race discrimination. Many times people see that these are bad things, and therefore the best amount of them is zero. But from another point of view, there is an optimal amount of each of these. That is where the benefits from further efforts to reduce the hazard or the social cost or the benefits from it are equaled by the costs involved in attempting to reduce it further. This view of a marginal thinking and of an incremental approach to problems is such an issue in the debate among economists and others concerning environmental problems, that ecologists have tended to see these problems as all or nothing. They see them, in some cases, as involving explosion points or irreversibility, and hence they regard economists insights as not applicable.

If there is at least a possibility that by proceeding with some kind of environmental degradation we will reach a point of no return, then, I suppose, it could be argued that you can't afford to fool around with a little bit more pollution. And you can't afford to calculate the extra social costs of reducing pollution a little bit. This is a fundamental conflict in understanding the issue.

In summary, ecologists and economists in recent years have been in rather sharp conflict regarding the importance of economic growth and its role in a desirable social result. They have also been in much conflict over the par-

ticular means to use in trying to achieve a desirable or optimal amount of environmental degradation.

William Lord
Department of Agricultural Economics
University of Wisconsin-Madison

In amplifying some of the things Bob Lampman said, there is a question, here, on the definition of what is meant by economic development in the way things are counted--in gross national product. There are many discussions of this in the literature, but there are some curious anomalies in our calculations of gross national product. For instance, my work in talking to you is counted in GNP, whereas my wife's work at home is not. If you buy an automobile that lasts ten years, and I buy one that is much less well-engineered and send it to the repair shop more frequently, my automobile is worth more than yours in GNP because I spend not only the purchase price, but perhaps several times over that purchase price to keep it running.

This obviously is a curious definition of productivity in the economy. Similarly, the costs of ameliorating pollution are included in the gross national product, even though the costs represented by pollution may not be counted adversely or negatively in the first place. This brings up one of the basic difficulties with the definition of economic growth in the economist's point of view. These are what economists call externalities, or third party effects. They get slighted in these calculations. Bob Lampman alluded to this briefly when he talked about the several conflicting estimates that have been made on the importance of these externalities in our economy: how important pollution effects may be. The reason these estimates are in conflict and uncertain is that we are dealing with effects that don't pass through the market. We don't get a chance to value them in dollars, directly, the way we do automobiles, eggs, and all the many things that are consumed. We have to use some kind of trick to put a dollar sign on them, if we are going to consider them commensurate with the ordinary market outputs of the economy.

One thing Bob Lampman said was that our preoccupation with increasing material living standards seems to be declining, at least in the United States (certainly not in any underdeveloped countries) and that it's not necessary to view economic growth simply as a matter of increased material output in the economy. When the economist really

wants to be specific about what he means by growth, when he says growth is good, he is using a wider definition that goes far beyond simply increased material output. Many economists would perhaps agree that not only is our preoccupation with material output nonsensical, but that we can look for it to decline in the future. As we look more and more to the consumption of services, to the use of leisure in an advanced society, the key question is what people want. There are a number of problems. The definition of economic growth relies upon a set of tastes and preferences desired of people as they express them in the market. To the extent that those tastes and preferences represent real underlying values that people hold, it is fine. To the extent that they have been manipulated and inflated through such things as advertising, we're likely to be in trouble.

There have been a number of critics on this issue, including my very eminent colleague John Kenneth Galbraith.

Turning to environmental protection, I think it is obvious each of us is increasingly dependent on each of the rest of us. In the kind of society in which we live, with more of us packed together in urban areas, more of us in the aggregate and in the nation, we are multiplying our power and our technology. This is really the problem we are facing. We are stepping on each others' toes increasingly, and increasingly hard. And that can be expected to continue.

Externalities, then, are really examples of people's toes getting stepped on. There are other names for this: third party effects, spillovers, etc. Water pollution is a good example. The industrial plant puts effluent into a stream only to find that those downstream who plan to swim or fish or make some other use of the water are adversely affected by the effluent that remains in the water when it reaches them.

Highway traffic is another example. I drive downtown in Madison in the morning. This may be a beneficial activity. For most people it is more beneficial to jump into their car than to stand on a corner and wait for a bus or ride a bicycle. The difficulty, here, is the individual actor considers only those benefits and costs that accrue to him. What doesn't enter into his decision-making system are other costs, mainly those inflicted upon his fellow motorists as congestion increases. The value of each of thousands of people trying to drive downtown drops, the annoyance rises, the time it takes rises, the frequency of accidents rises, and so forth. Each one is getting fewer benefits as I nose my car out into the stream of traffic. People who are not motorists are suffering as well from the effects of automobile exhaust. This, then, is what we are talking about when we say externalities.

One feature of an externality is that there are consequences of what I do when I'm a producer of externalities that I am not motivated to consider. In other words, they do not affect me directly in any way. This is true of the industrial polluter. In using the river, he is not motivated to consider those adverse effects downstream because they don't infringe upon him in any direction or measurable way.

This gives clues as to how we may handle the problem of externalities when they do occur. Externalities are becoming increasingly more important in our society, as we ban together and are technologically more able to create them. Economists used to think that these were anomolies; that these were small and curious aberrations in the operation of the economic system; that they produced problems to be sure, but by and large they could be relegated to the footnotes in the economics text.

We could go ahead and put more into the traditional things that preoccupied economists, namely those effects which are reflected directly within market prices and market outputs. Recent studies have shown this to no longer be the case. Externalities are very important in our society. Here again it's difficult to measure them because they aren't commensurate, but there is no doubt the evidence of the census confirms this.

We must increasingly find ways to deal with them; and our output measures--to the extent that they don't consider externalities--become more questionable. They are diffuse. The example of the auto pollution, for instance, is a good one. The emissions from the exhaust pipes from my car don't affect any one individual very much--they affect many people slightly.

The effects of many motorists together affect every one of us in major ways. This makes it difficult to pin down exactly how important these consequences are. Nonetheless we should look at this more carefully and with more energy than we have to date.

What are some of the ways, then, we can deal with questions like this? There are several ways. One that Garrett Harden has used is found in a widely reprinted article from Science, "Tragedy of the Commons," published about three years ago. The pasture is in the center of the village, open to all views. And the livestock of all the people in the community are allowed to graze on the commons. This is good, except that as with our highway example, the individual owner of livestock is motivated to keep on adding animals to his herd. More and more animals, then, use the commons until the carrying capacity of the grassland is damaged, sometimes irretrievably so. It is no

longer productive for anyone's livestock.

The individual is motivated to keep adding animals to his herd because he receives the benefit of one more animal worth of grazing and shares only a very small part of the reduction of the forage that was available to each of the animals already there. How do we solve the problem of the tragedy of the commons? One way is to carve it up, to sell it off if you will--to divide the commons into individual units of private property. No person can put animals on any pasture other than what belongs to him personally, and no one else can put animals on his pasture. This solves the problem. And indeed many economists have suggested that this is the way to solve the externalities problem we deal with so pervasively in environmental matters. We should develop the institution that will assign private property rights to the resources with which we are concerned. It works sometimes, but in modern society the commons is just too simple an example. There are too many interrelationships between us with respect to the way we use resources to permit us to solve the problem that easily.

In the automobile example, for instance, it's hardly possible to sell off portions of the public streets, or the air that is effected by the emissions from exhaust pipes. For technological reasons, we are unable to use the easiest and perhaps most attractive solution. What then can we do? There are a number of different ways to handle it. One, certainly, is to resort to public ownership and regulation. This we frequently do. We are increasing the involvement of the government in the economy every day. There are those who protest this; there are those who will not on idealogical grounds. But on technological grounds it is probably unavoidable. As the interrelationships among us with respect to these resources become more and more apparent, more and more numerous, more and more important, the public interest in how these resources are handled becomes more and more manifest. There simply isn't any way to avoid stepping on each others' toes without producing this kind of public decision making.

What, then, are some of the things that Sea Grant researchers ought to be doing to address problems of economic development in the environment? They should identify and evaluate the externalities that exist with respect to the use of estuarine marine resources. These things aren't just economic. These things require interdisciplinary research of a high order. They are basically physical and biological systems at work here, and it takes people from those systems to identify them. The economist doesn't occupy a central role here, although his preoccupation with the problem first alerts us to its importance.

But we need not look to the notion of employing an economist to put dollar values on all these externalities simply to make them commensurable for decision making. It's an illusion to think we ever can develop meaningful dollar values for these things. At most, we can hope to describe a number of them clearly. Politically, we can determine how important they are. In this connection, the Federal Water Resources Council has been developing new federal project evaluation procedures. This is a new wrinkle on the old benefit-cost theme. They need some help here, and Sea Grant Institutions can participate here. They have not only an economic development account, but an environmental account, a social well-being account, and a regional development account. But they are not quite sure what they mean by these things. Once we have identified the externalities with which we're concerned, the next step is to conduct research on how we might solve the problems created by those externalities.

To use a horrible barbarism of the economist, we want to find out how to internalize those externalities. In other words, we want to find out how to get them inside the decision making calculus of the person responsible for creating them. We've mentioned several ways in which to approach this--through property rights and regulations.

One other point Bob Lampman mentioned is the use of the price system--the market system. This is a system of information exchange and almost unrivaled in efficiency. There are many things wrong with markets. We become more and more aware of them every day. There is much wrong with the unhampered operation of private market institutions. But they have some terribly important advantages; one is efficient transfer of information and another is the lack of requirement for a centralized calculation and coordinating center or capability. We look for a new pricing mechanism to help internalize externalities in the notion of the effluent charge. This Bob Lampman did not call by name, but alluded to when he talked about putting a price on pollution.

The right-to-pollute idea is terribly attractive to an economist even though it sounds like anathema to most non-economists. But it makes a good deal of sense, because it transmits a signal to a polluter that tells him just what the social costs of his pollution are. And if the benefits that he provides to societies by continuing to pollute are indeed greater than that cost he is creating--including the social cost of the externalities he is causing--then he'll continue to pollute. But if they aren't, it is in the interest of society and himself to reduce pollution, and he will use all his ingenuity to find out how to do that.

There are many ways that we can address the problems of environment and environment protection and the melioration of externalities. Certainly, we ought to be doing research in the Sea Grant Program directed toward some of these ways.

Energy Production and Environmental Consequences

Richard Balzhiser
Office of Science and Technology
Washington, D.C.

As a recently departed academician I welcome the opportunity to return to campus and share with you some observations I have made which I believe are of some relevance to your meeting here these few days in Madison. I must say it also provided me with the opportunity to return to the midwest on one of the biggest weekends in Michigan -- namely the Michigan State-Michigan football game. As much as I would like to talk about the outcome of that affair, I will move on to a rivalry that I think matches that particular one -- the rivalry that seems to be developing between the utility people on the one hand and the environmentalists on the other hand, particularly from the point of view of energy and its environmental impact.

First I would like to take a quick look at the energy picture. It's large, it's complex, and it wasn't until I tried to put it into a five minute package that I realized it was virtually impossible to do so. At the last minute I decided to use this very fine graphic illustration (Figure 1), contained in a pamphlet which was just distributed in Washington at The National Energy Forum and appears in their book NATIONAL ENERGY POLICY CONSIDERATIONS FOR THE UNITED STATES IN THE 1970'S.

Secondly, I would like to discuss briefly our power plant siting activities in Washington in the Office of Science and Technology. It has played a major role in the formulation of that program and I think its progress will be of much interest here.

Thirdly, another topic that is of considerable interest today in Washington, and I would imagine is of interest to you is the Judge Skelly Wright/Calvert Cliffs decision, and the plans which the Atomic Energy Commission have for following through on it.

Fourth, I hope to take a very brief look at some of the new technology and new developments that we see on the horizon and how they will affect people in Sea Grant Programs and others with an interest in and a responsibility for water resources. If I manage to get all of that in before lunch I will have done a better job than I think

I am capable of.

Our Sources of Energy

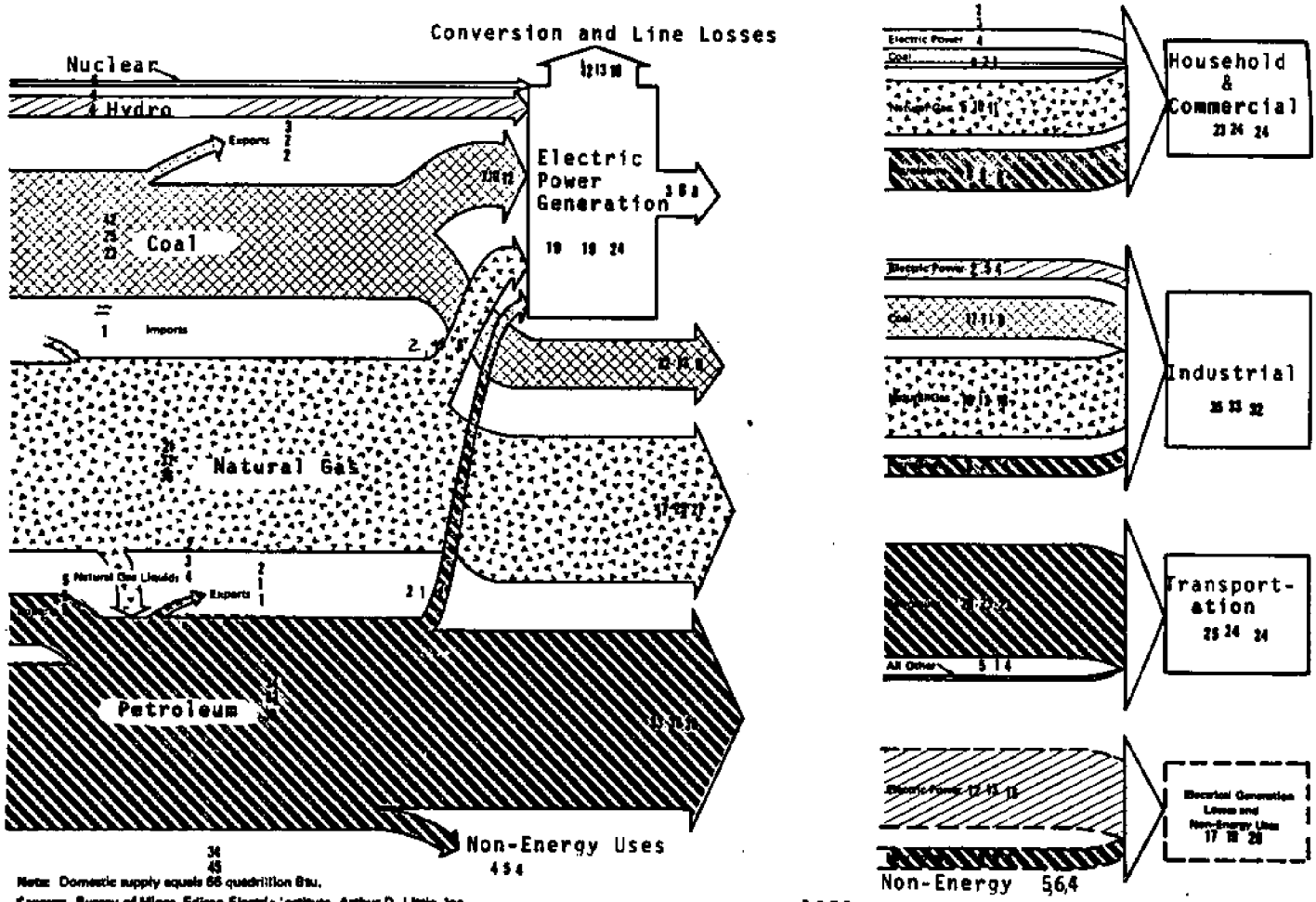
Figure 1 shows some of the complexities of the energy picture. In the last column, we have a flow diagram broken out by major energy sources. We have 1950, 1960, and 1969 figures. The scale indicates the relative magnitude of various energy sources on the left, and on the right, the end uses to which these sources are put. We can see for example, that in 1969 petroleum accounted for about 40 percent of the total energy source. The chart also shows the amount that is actually imported to this country as opposed to what is recovered domestically, along with exports and non-energy uses of these materials. It is clear that most of the petroleum that comes from our resources goes into the energy uses some place in the system. A small portion of our petroleum sources are diverted into the production of electrical energy. Non-energy uses, like manufacturing petrochemicals, account for a relatively small amount.

Natural gas represents the next largest primary energy source -- about 36 percent of the total. Again, imports amount to very little of what is used but we are beginning to get a whole industry built around liquified natural gas. The chart shows a portion going into electric power generation, with industrial and household use among the major consumers.

Coal accounts for about 23 percent of our total energy supply. We have virtually no coal imports but do have some coal exports. Hydro-electric provides four percent of our energy needs and nuclear power is not yet significant enough to show as more than a little band at the top of the chart. This source becomes extremely important, however, when we look very far into the future.

Only eight percent of the total energy consumed by the nation is used in the form of electrical energy. With this, there are conversion and line losses, all of which must be discharged to the surroundings. In fact, about two-thirds of the energy consumed in generating electrical power and distributing it, is ultimately discharged to the environment.

The chart designates four end use categories: household and commercial use (electrical and space heating, etc.) comprising 24 percent of the total energy utilization; industrial uses comprising 32 percent; transportation uses (petroleum, gasoline, diesel fuels, etc.) comprising about 24 percent; and finally electrical generation losses and non-energy uses which make up about a fifth or 20 percent. Electrical power loss is a big component as is the petrochemicals consumption in this



Note: Domestic supply equals 66 quadrillion Btu.

Sources: Bureau of Mines, Edison Electric Institute, Arthur D. Little, Inc.

FIGURE 1: U.S. ENERGY SUPPLY, 1969 (PERCENT)

particular category.

Recent environmental legislation and many other concerns, which haven't yet been translated into legislation, have begun to create real perturbations in this distribution. Keep in mind that this is a 1969 flow diagram. For example, the limitations that have been and are being placed on SO_2 emissions have begun to cause shifting in the allocations of these fuels. Natural gas is our cleanest and cheapest fuel and it is now in short supply. The fact that it can be burned without any SO_2 problem has created a tremendous demand for it. Coal which has been supplying the major amount of energy for electrical energy generation has a very serious sulfur problem. Petroleum on the other hand varies -- some of the low sulphur crudes can be consumed with very little SO_2 problem. The problem is that most of those crudes come from the Middle East and that gets us into a completely different arena of considerations.

The nuclear ribbon on the chart is very small but if we look a decade or two ahead (electrical requirements of the country are predicted to double every decade) it becomes apparent that the only resources we really have in sufficient abundance to meet these needs -- beyond the year 2000 -- are coal, fissionable materials, and ultimately, assuming we can bring our hopes to fruition, the sun and the sea.

In the case of either fission or fusion power, we are talking about a nuclear program with large scale conversion operations that must of necessity be located near some body of water. In each of these cases, these conversion operations are limited by the laws of thermodynamics. What they tell us is the best we can hope to do is to throw away about one unit of energy for each unit that we send into a transmission line or across a distribution network. Today we don't do nearly that well, but there is a tremendous amount of attention being given to the problem right now. Nuclear energy will grow rapidly in the future and, with it, will grow the amount of energy that will be discharged to the environment -- either to the atmosphere or to the lakes and oceans.

As we seek to try to maintain or improve our reserves of petroleum and natural gas, there is a greater incentive to go into the offshore region. There has been a good deal of exploration over the years within the 48 continental states and that is continuing but the real interest today is offshore. The President's Energy Message of June 4, 1971 announced an acceleration of the leasing process on the continental shelf with emphasis on insuring that environmental considerations are not ignored. There will be continued interest on your part in the exploration process, and the reviews that they are subjected to as these efforts move forward.

The Energy Industry

The energy industry, is a capital intensive industry. It absorbs a tremendous amount of capital and requires a long lead time to shift its course. You can't decide today that you are going to go with a nuclear facility and expect to have it on stream in one, two or even five years. Energy, of course, has been closely linked with the gross national product. Only recently has the growth in our utilization of energy begun to exceed the rate at which the gross national product is rising. And yet, we find that private utilities spend only about a quarter of a percent of their gross revenues on research and development.

One of the important problems we need to address is the fact that utilities really need a greater incentive to spend more in the R & D area. Being regulated, a utility lacks the incentive of a typical member of the private business sector. Although we see some encouraging signs, we have just begun to scratch the surface if we're going to address the problems that manifest themselves in the picture presented here. Earlier speakers talked about the externalized costs, and clearly the energy industry is one that has taken for granted the air and the water, and discharged its thermal or chemical pollutants with a great deal of freedom. There is a real need for internalizing these costs; and the consequences will be felt rather rapidly by each of us.

Power Plant Siting

Power plant siting legislation is pending before Congress. This administration bill was proposed by the President in his February 8th Environmental Message. The background work on this was done by the Energy Policy Staff in the Office of Science and Technology, in conjunction with other elements of government, utilities, environmentalists and conservation groups.

The substance of the legislation is based on three principles. First of all, the theory behind this proposal is that the utilities themselves should be responsible for the long range planning and site selection process rather than a Federal agency like the Federal Power Commission.

The second point is that the power to review and decide whether or not a site is appropriate should reside at the state or regional level, not at the federal level. The decision should be made as close as possible to the people on whom the decision will have an impact. We don't believe, ultimately, that factors such as thermal pollution and other technological considerations will govern the decision. These problems will be resolved and the decisions will relate more to zoning con-

siderations. Land use decisions should not be made at the federal level by some all-powerful board or commission; they should be made as close to the people affected as possible. Since the impact of these facilities is generally regional we look to some sort of a regional review system as opposed to either the federal or community approach.

The third major point is balanced participation by all parties concerned. This includes the utilities as well as the community. We have tried to provide for a forum where all involved parties can become part of the deliberation. The bill provides for a 10-year planning process during which certain actions must be taken at ten, five and two year points,well in advance of construction.

The bill also calls for the establishment of a state certifying agency. This agency will be backed up by a federal agency in cases where an acceptable, viable, state procedure fails to surface. In such cases, the legislation would presumably be administered by a federal agency, hopefully residing with the proposed Department of Natural Resources.

Three discreet steps in the 10-year planning process -- the ten, five, and two year points -- require the following specific inputs. The bill calls for the utilities within a region to prepare a ten year plan, which should encompass the concerns of a region -- not just a particular community -- and consider any overlapping grids and networks that are essential That information should be made available to the state certifying agency and the public ten years in advance of construction and should be continuously updated. Utilities are also asked to select their sites and make them public ten years in advance so that others affected by their decisions can enter into the deliberations.

Two years in advance of actual construction, the utilities must apply for a construction license. At that point, hopefully, all concerns will have been aired and some decision will have been reached. Prior to the five year point, the distribution network does not become a part of the deliberations. One must anticipate however that if a power plant site is agreed upon, transmission lines to get the power from the plant into the distribution network will be a part of the package. We hope, as we continue with R&D efforts, that more and more of these lines will be underground and so, less offensive to those concerned with problems of visual pollution.

In a nutshell, that is the position of the power plant siting legislation. A rather modified bill was reported recently from Congressman McDonald's subcommittee. We are continuing to follow it closely and fight for the principles that went into the initial submission. Hopefully the Senate will act on it some time after the first of the year, and a bill will emerge that will address this very important area of concern.

The Skelly Wright/Calvert Cliffs Decision

In July of this year, Judge Skelly Wright in the District Court of Appeals, Washington, D.C., made a rather important decision relating to the licensing of atomic energy facilities. In the past, the licensing procedure had considered primarily radiation and other operating hazards and had really ignored the total environmental impact of nuclear generating stations. Judge Wright's decision said these facilities should be judged by precisely the same environmental criteria used to evaluate other facilities -- namely he said that each nuclear plant requires an environmental impact statement just like a fossil fuel plant or any other governmental installation. The impact statement should consider the question of thermal pollution and other forms of environmental degradation and it should consider the cost/benefit ratio of other alternatives.

The consequences of this decision were quite significant to the Atomic Energy Commission. In late August, Chairman Schlesinger chose not to appeal it. Instead, the A.E.C. mounted the effort required to write close to one hundred environmental impact statements for plants that were covered by this decision. That included five that are already constructed and operating, as well as a number that are back in the planning stage. Many of you probably come from parts of the country that are rather significantly affected by this decision. In Two Creeks, Wisconsin, a 525 megawatt reactor, about to go into operation, is now affected by this decision and four other such reactors across the country are in a similar situation. Eleven plants that have received construction permits, but not yet operating permits, are also affected and the list goes on.

The utility industries are very much concerned since this procedure could add two years to the time they need to get their facilities on stream. The consequences of this, with regard to the power picture in some areas of this country in the next year, are particularly severe. In the east, a one year delay creates serious problems which were described by the Edison Electric Institute in recently completed studies of the implications of the decisions. A two-year delay would have rather serious consequences in other parts of the country as well.

In Michigan there are two reactors that are very much affected by this decision. These are intended to replace several facilities which are probably more offensive from a pollution point of view than the new nuclear facilities. Yet there are clearly some environmental concerns that must be addressed, -- along with continued concern for safety and other factors. The public is entitled to as near absolute assurance as technology can provide that its health and safety is adequately protected along with the environment. The

procedure that came out of the Calvert Cliffs decision requires that the initial draft of an environmental impact statement be submitted and then circulated for comment both in and outside of government, and that after comments have been received, a final statement must be prepared.

There are certain delays built into this procedure. First of all, the construction permit or operating license cannot be granted until 90 days after the draft statement has been issued and until at least 30 days after the final detailed statement has appeared. Assuming that everything else goes smoothly, the first delay is within the Atomic Energy Commission because it simply does not have the manpower to prepare all these statements. The A.E.C. is putting together an effort that will involve sixty man-years of effort over the next nine-month period to try to generate these statements. Then there is the big uncertainty of how the licensing board and the public will react to them, and how much debate will go on before the decision is made. It is these unknowns that lead to projections of up to one or two years delay in the ultimate operation of facilities.

The Atomic Energy Commission will be writing the environmental impact statements. The decisions will be made by the Atomic Safety and Licensing Board with input from all sectors concerned. In Judge Wright's words, the National Environmental Policy Act requires the analysis to "consider and balance the environmental effects of the facility and the alternatives available for avoiding and reducing adverse environmental effects, as well as the environmental, economic technical and other benefits of the facility. The cost-benefit analysis shall to the fullest extent practicable quantify the various factors considered. To the extent that such factors cannot be quantified, they shall be discussed in qualitative terms." This is the portion of the decision to which the A.E.C. is presently attempting to respond.

New Technological Developments

In the President's June 4 message, which was devoted primarily to energy, he made a major commitment to the liquid metal fast-breeder reactor as our hope for the latter decades of this century. At the same time he called on industry to participate in its development with dollars -- not just with talk -- because these are multi-million dollar development programs. We have been pleased so far with the response from the utility industry -- close to $250 million have been pledged to assist in the developmental effort. The President was so overwhelmed with this response that at Hanford recently, he announced plans to go ahead with a second developmental fast-breeder reactor.

It would appear, barring other diversionary actions in the next decade or so, that by the 1990's we will experience a rather dramatic influx of fast-breeder reactors. For those of you who may not be familiar with the fast-breeder reactor, it is a nuclear reactor which produces more fuel than it consumes. The period over which we could operate is lengthened tremendously by this approach.

Another interesting approach is the offshore siting of large nuclear power stations. At a briefing recently in Washington, a proposal was discussed to build reactors in a shipyard, like ships, and then float them out three to ten miles offshore. Water depths might be up to 50-60 feet and so some kind of breakwater would have to be built to protect the plant from storm damage and stray ships. This facility would actually float offshore and generate power from there. The technology to transmit the power back to the land where it is used, is still being developed but the problem will be solved with time. This concept is seen as coming on stream in ten years. It's an interesting possibility in terms of the thermal effects. The temperature of water in the vicinity of the reactor would be elevated about 5° and spread over a five acre area. This presents some interesting opportunities for people concerned with marine sciences and aquaculture who might develop projects in conjunction with such power plants.

Eleven hundred-megawatt units would be constructed in a standardized form that could be floated anyplace. This would decrease the utilities' costs significantly. If they can find an efficient way to transmit power to shore, then they may really have something. People like you in Sea Grant can work with them, better defining the difficulties they may encounter and the environmental consequences, as well as opportunities, that could affect the economics of the operation. There are a number of other very interesting R&D developments, some of which relate to programs of interest to Sea Grant, but many of which are somewhat removed and do not bear discussion at this time.

It's highly probable, however, that over the next ten years we will devise ways of improving the efficiency with which we convert thermal energy to electrical energy. The only real way we can use nuclear energy in a practical sense for societal needs, if we want to limit ourselves to activities on this planet, involves conversion to electricity. There are other processing and industrial applications which could make use of thermal energy, but clearly this very large increase in the use of nuclear energy for electricity is going to increase the thermal burden on the environment.

This brings me to the final point which relates to national energy policy. I can attest to the fact that there are some 43 different studies that either are underway or have been completed in the last few years. The interest is there. There

are a number of industries -- coal, oil, natural gas, nuclear, the utilities -- and, much to my surprise, the first time that these people all got together and discussed common problems was just a few weeks ago at The Energy Forum in Washington. They put their problems out on the table for the first time. Hopefully from that we can enter an era where we can begin to work in a more rational way to allocate our resources so that they can be best used to meet societal needs. We may decide that our fossil fuels or our hydrocarbons are more valuable to us when used to make petrochemicals or plastics, as opposed to being used for energy -- these are all complex decisions which need attention.

I have said nothing about consumption technology. Let me state that this deserves a great deal more emphasis, research and interest than we have given it in the past. We know the demand will grow; the efficiency with which we use electrical energy is really a sad commentary on some of our individual and societal priorities. We have promoted more and more energy utilization and it's time to carefully re-examine this promotion, and give as much consideration to the efficiency with which we use energy as we are giving to the question of where we are going to find it.

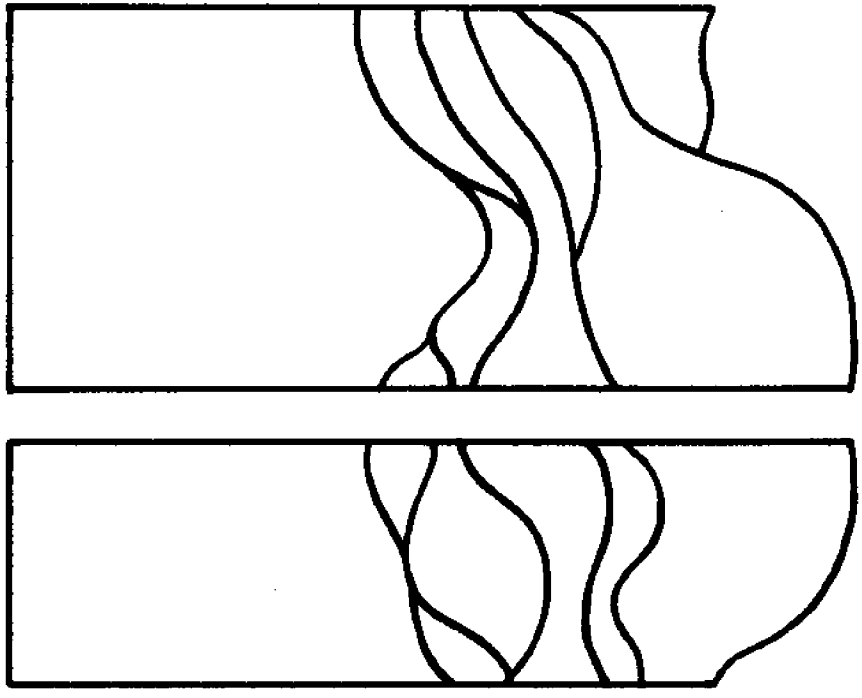
To some, the picture I have painted may perhaps be filled with gloom, but I would imagine that the more perceptive and imaginative might see some new and interesting opportunities emerging. There are clearly some certainties that I think we must recognize. Foremost is that the demand for energy is going to grow and that the electrical component of this total is going to grow within that total growth. This, of course, is going to mean more and more thermal discharge that hopefully we can use productively. This is something we don't have to look at as a burden to the environment.

Secondly, the second law of thermodynamics is not likely to yield. We may be able to circumvent it in a few selective instances, but the possibility of pushing aside the Carnot principle is slim. Third, society must and I'm sure will accomodate. I think it is imperative that the utility industry cooperate with both the academic community and also governmental agencies to increase the amount of support they put into resources, research and developmental efforts in conversion and consumption technology.

The American Gas Association has recently announced a significant contribution to R&D efforts relating to natural gas technology. These are long over due, but they are very much appreciated. Hopefully we can find ways of further increasing such efforts. The consumer must also learn the true value of energy. This is certain to occur once we begin to internalize many of these costs that have been externalized for years.

The real challenge to those of you assembled here, however, relates to profitable ways to use this wasted energy. Is it really as big a liability as we have made out in the past? Or can we find some productive way, i.e. through aquaculture or desalinization to use the enormous amounts of energy that will otherwise be lost. I read Future Shock and I came away with the feeling that you people have the future of the world in your grasp.

In the Office of Science and Technology, we have responsibility for the areas of energy, environment and natural resources. We have people who are trying to follow the progress that you and your colleagues on the campuses are making. We hope that from your laboratories and campuses will come alternatives that will permit us to use these vast amounts of energy in a productive way to meet other needs. Futhermore, I hope that we can convert the adversary relationship that exists today between utilities and environmentalists to one of partnership, productivity and progress, but without pollution.



AQUACULTURE

Economics of Aquaculture Development

Jack R. Davidson, Session Chairman
University of Hawaii

Entirely new, massive additions to the sum total of human accomplishment have largely been in response to intuitively felt needs and anticipated benefits, rather than in response to the more routine "economic" calculations made by individuals and small groups. That is to say, a society may decide that it needs the unknown benefits of pyramids, turnpikes, or aquaculture. That society must then engage in more or less collective efforts to provide the environment and technical expertise that allow the addition of this entirely new field of activity to those that have proven "economic".

Most papers on aquaculture begin by speculating on the critical shortage of protein in many parts of the world and implications of the increasing deficiency as population grows. The question of how much food can ultimately be obtained from the oceans is then considered. There are essentially three schools of thought on the question of feast or famine in the coming decades and how much of the needed food can be obtained from the ocean. There are the super optimists who see the sea meeting much of man's future needs; the doomsday prophets such as Paul Ehrlich, who states that "for the immediate future, sea farming offers no hope at all", [1] and the guarded optimists, such as Bardach, who suggest that many promising new sources have been exposed, and while they are not alternatives, they are part of a valuable arsenal of weapons to be deployed in the attack on protein deficiency.[2]

With the spectre of famine ahead for greater numbers of mankind it seems prudent to explore all avenues. At the present state-of-the-arts, it appears there is sufficient promise of benefits from aquaculture to permit society not only to rationalize present investments but justify a truly massive effort to assure a higher quality of life to a larger number of people.

However, our era does not appear to be one of large far reaching social commitment but a period in which we must proceed by small steps with the funding for the subsequent steps dependent on short term results. Therefore, future progress in development of aquaculture is tied to our ability to move such social investment as is now available to us into those areas where economic soundness can be demonstrated at early

stages. This paper will attempt to: (1) achieve a measure of perspective with respect to special problems faced in moving aquaculture forward and then (2) to focus directly on problems of development of commercially viable enterprises.

Bardach suggests that in the early stages only intensive culture of luxury aquatic products will produce substantial economic benefits. He has outlined biological properties of organisms that would lend themselves to intensive culture:

1) They must reproduce in captivity or semiconfinement.
2) Their eggs and larvae should be hardy and capable of being hatched and reared under controlled conditions.
3) The food habits of larvae and young should be such that natural foods can be readily increased or they should be able to take prepared feed from their early stages.
4) They should gain weight fast on items that can be supplied cheaply or that can be readily produced or increased by man in the areas of culture.[3]

Bardach points out that there are few cultured aquatic organisms which would not violate one or more of the four above mentioned qualities.

For many species conditions under which the plants or animals will reproduce are not defined. In some cases, collection of eggs and larvae before they are eliminated by natural predators is possible, however, this precludes mass selection for desirable characteristics.

We have had breakthroughs such as the work at the Oceanic Institute in Hawaii in spawning of the mullet. However, they have not yet succeeded in raising a significant number of the spawned larvae. Larvae rearing is often the difficult part of the operation and in some species, little is known about the many stages in larval development. Little is known about the interactions of marine animals in confined spaces. More work needs to be done on the nutrition of various species. Frequently aquatic animals which are highest in market value are also high on the food chain. This means that their production involves large losses of energy in the conversion from food to new animal tissue. Little has been done in genetic selection of aquatic plants and animals for desirable characteristics of growth and feed conversion and market acceptance.

The Development Problem

Many of the problems in developing aquaculture parallel those faced at earlier stages in agricultural development in the United States. The result is a unique institutional framework designed to protect agriculture against the harsher economic forces and to enhance prospects of firm survival and success. Some obvious features of modern diversified agriculture are subsidy, tenure and use of rights protection, credit, re-

search, extension, and cost-price control. Most new agricultural developments in the United States in the past 30 years have been on Bureau of Reclamation project lands. Such developments usually highly subsidize the basic factors of production. On a Bureau of Reclamation agricultural project, for example, costs of developing the irrigation system are initially paid by the government and are to be repaid by the farmers over a 50-year period. Actual repayment starts in 10 years with interest on the investment heavily subsidized by federal government. In addition, many costs are written off as attributable to other uses such as power, recreation, conservation, etc. As a result the individual farmer and farmers as a group actually repay only a small portion of the investment. In addition, the crops grown on reclamation land frequently enjoy the benefit of price support programs creating an overlapping subsidy.

For terrestrial farming development, land titles, tenure conditions and rights of use and provision for protection of these rights usually can be clearly defined, enabling the individual proprietor to assess his status from a legal point of view. The government has a highly effective credit system for agriculture to supply credit of all types. Much of this credit is also very highly subsidized. Subsidies continue in the form of the research and extension service previously developed and and ongoing at the 51 agriculture experiment stations, thousands of county extension offices, several regional research laboratories, and thousands of specialized field research stations. It is often pointed out that the employees of the U.S. Department of Agriculture now outnumber farmers. It is certainly true that there is a very extensive network of services available for the farmer's use. While the farmer still has reason to complain of a cost-price squeeze and unfavorable terms of trade compared to other sectors, some control of prices and costs has been accomplished in some commodities.

No such network of services, money subsidies, and cost-price control exists for the entrepreneur pioneering in aquaculture. Individuals or concerns committing capital to aquaculture not only must be in a position to finance the development phase but be willing and capable of waiting for a considerable period for returns to equal or exceed costs. His products must compete for the consumers food dollar without protection or noticeable subsidy.

The aquaculturist can now request help from the Sea Grant Advisory Service in his state if he lives in one of the twelve states with such programs. However, no backlog of information nor the reservoir of scientific manpower and skills is available to draw upon, comparable to that available to agriculture. The state-of-the-arts is such he can expect little help with respect to immediate problems of production, management, marketing, determining the size of operation, equipment to buy, etc.

Agriculture institutions developed over many years. In

many cases the cornerstones were laid in eras in which the agricultural constituency had great political influence. Aquacultural development has been slow partially because of the agricultural success story in providing the nation's food. Development has depended largely on individuals and small groups seeing opportunities for profits. The way is fraught with many risks and obstacles. As a consequence, development has been very slow indeed.

Need for Multiple and Interdisciplinary Cooperation

For commercial aquaculture to develop rapidly, large social investments must be forthcoming. And if aquatic products are to add significantly to the world's food supplies in this century, available scientific resources must be functionally combined into a coordinated attack on the technical, institutional and economic problems. The Sea Grant Program with its emphasis on interdisciplinary efforts is a step in the right direction. To date aquatic biologists have conducted their studies with little interactions with other animal and plant scientists. Although biologists have had the advantages of up-to-date basic science training and modern equipment, one does not have to look long to observe a laborious retracing of paths followed by the pioneer terrestrial scientists as a commercial focus begins to emerge; or to observe that the development of the production functions for the organisms is at a very primitive level compared to the knowledge available in agriculture.

The evolution of specialists in marine animals reproduction, nutrition, genetics, etc. from marine biology is just beginning, and reasonable could be expected to take several generations. An effective short cut could be the marriage of the now available and highly refined skills in terrestrial animal and plant science with those who understand the aquatic life processes best. This would permit immediate attack on the pressing problems faced in development in commercial aquaculture. In addition, it would insure that the very next generation of aquatic scientists (now graduate students) would have those speciality skills required together with a state-of-the-arts working knowledge of the organisms with which they are dealing. Securing the necessary economic input should be less difficult. The methodologies to analyze and evaluate many of the economic problems of aquaculture are well developed in the field of agricultural economics and await only imaginative adaptation.

When Economic Analysis?

When does the economist enter the picture? Obviously he can do little work on the costs of production until the aquatic scientist can at least specify a rudimentary input-output relationship for the organisms being considered for culture in a given area. It is apparent, however, that if commercial pro-

duction is the goal and rapid development of a viable profit-making enterprise is desired, the economist needs to be on stage when the question of which species is determined and to specify needs for information for economic analysis. Otherwise, a valu-albe opportunity may be lost to generate the data needed to a assess profitability of the subsequent production. Provisions should be made at each level to utilize new data as it is generated from experimentation or experience in field operations. The next level where valuable economic input can be offered is when development of commercial production is under active consideration.

Comprehensive Feasibility Studies

To determine aquaculture potential of a given region, a comprehensive feasibility analysis is required. This study will determine the quality and quantity of resources available and the impact of relevant institutions on their use. The impact of the location of an enterprise on costs of development and on operations must also be assessed; existing and potential markets must be analyzed.

This initial assessment of markets, location, and locational resources is a multi-disciplinary undertaking. If the present use of the area under consideration is a relatively meaningful component in the locality or region's income, then further studies are usually required to determine the economic impact.

The economist then can offer the following analytical input to such a comprehensive planning effort.

1) Studies to assess the impact of legal, social, political, and cultural climate on resource availability and use.
2) Demand studies to guide the choice of plants and animals to be produced and to guide market development.
3) Simulation of costs and returns studies to provide basic profit outlook over time.
4) Capital budgeting studies to assess capital positions and needs over time.
5) Regional and local impact studies to assess incidence of benefits and costs to various sectors, communities and regions.

Profitability is a function of costs and returns. The returns from aquacultural enterprises depend on market value and hence, consumer taste, preferences, incomes and institution factors. If the product is new or the market area limited, estimates of demand and demand elasticity will be less reliable than if a substantial market already exists. The need for follow-up studies as developments occur should be clearly recognized.

Costs depend on the technology used in conjunction with the resource endowment of the site and the prices of the productive inputs. Determination of costs depends, at the initial stage, on the information the aquatic scientist is able to provide concerning resource requirements (feed, space, water quality, etc.) for raising animals or plants to a marketable size in the particular local environment. Lack of knowledge at this level makes cost of production estimates little more than guesses. Consequently, risk of failure due to inaccurate planning is high. As operational experience is gained and technology improved, the production function and associated costs will decline. We know from agriculture that even if experimental data and the results of pilot studies were available, that laboratory conditions can rarely be duplicated in the field and that only limited extrapolation is possible in making production costs estimates.

Although the consumer's taste and income ultimately determine prices which will be paid for given quantities of a product, the location, size and number of enterprises tend to affect f.o.b. site prices for any particular economic venture. Proper appraisal of prospective returns indicates that each of these factors receive adequate attention. Finally the demand and price expectations must be analyzed keeping an eye not only on present conditions but also on the impact of industry growth on the market.

To survive as a going concern, an aquacultural enterprise must not only be capable of producing profits, but it must do so in a timeframe compatible with investors and creditors expectations. Hence, simulation of the flow of expected profits over time is necessary to permit comparison of the aquaculture venture with investment alternatives.

Study of the local and regional impact (including environmental) and delineation of the incidence of costs and benefits can be expected to be required in order to gain access to marine sites and to enlist local support.

Experience in Hawaii

At the University of Hawaii we are attempting to inject economic input into ongoing studies at the time when the greatest benefit can occur given available resources. One project in which an economic input has been made is the farming of the red algae eucheuma in the Philippines. This product is being farmed to supply carrageen to the American industry. The product is a vital component in such items as your instant breakfast and is in great demand by the American dairy industry. Professor Maxwell Doty, University of Hawaii, has developed a basic farming method in conjunction with Marine Colloids, a private company, and the Philippine government and is conducting pilot farming operations in the Philippines. Marine Col-

loids is now interested in expanding to full scale farming operations. Last winter a graduate student in Agricultural Economics went to the Philippines to make an economic analysis of the project operations. Mr. Barry Hill, a former Peace Corps worker, spent approximately six months in the area. During this time he was called upon to manage the operation as well as to conduct the economic analysis. He was able to carry on both functions quite successfully. The economic analysis provided valuable guidelines for initiating farming operations but was less than optimal due to the lack of data from which to measure costs, levels of inputs used, output of harvested crop and the impact of exogenous factors such as weather. A market study was not undertaken at this time. At present, demand far outstrips the supply and it was easy to determine the on-dock market prices.

Major benefits from analysis will be the ability to design a record keeping system to permit more adequate evaluation of profits and to provide immediate feedback data to improve the operation management.

If data collection is not continued and the analysis refined and used to guide decision, then by the time full-scaled farming operations emerge there may be considerable loss. An assessment of the political environment and analysis of uncertainty arising from weather and other exogenous variables is needed. As production expands, an assessment of market potential will be needed.

Another aquacultural project at the University of Hawaii, where economic analysis is being incorporated, is the development of Artemia production on Christmas Island. Christmas Island has a complex of saline ponds providing unique natural area for production of Artemia or brine shrimp, the eggs of which are valuable in the tropical fish industry and for other uses. Basic production surveys have been completed and an assessment has been made of the area as a production site. There is a high degree of interest by industry and the Gilbertese government. While physical aspects appear favorable, an economic feasibility study is needed to guide development. A team will depart shortly to Christmas Island and will include an economist. This trip will help establish the extent to which production costs can be estimated. A market study is already underway. An earlier economic input would have been of some value but it appears the timing is about right now for maximum contribution in the decision-making process. Again, for the study to be of value once operations are established, a framework for feedback will be needed.

Resources for Economic Analysis

Many economists would be unwilling to work within the framework I have suggested, in as much as data would be very sparse at

early stages and would present little opportunity to do refined, professionally prestigious analysis. Maximum economic contribution would require willingness to work with fragmentary data and to work directly with the disciplines generating the basic input-output relationships. This cooperation between economists, biologists, nutritionists, etc. is certainly possible. Past experience shows a great tendency to withdraw into the safe confines of the various disciplines. Physical scientists often object to being steered by economic information requirements. Economists would like to have the physical data in hand and then proceed directly to the economic analysis. They tend to be impatient at the very slow process of generating data and the necessity of making estimates of profits on a few points on the production surface.

I view cooperation as absolutely essential if we are to raise aquaculture to somewhere near its potential in a few years rather than several generations. Full cooperation among those who are gifted and knowledgeable should permit rapid proliferation of economically viable development. In our University of Hawaii Sea Grant Program, we have some very good starts on interdisciplinary cooperation.

I am enough of an optimist to think the stage is set for more joint efforts. The apparent development of a social responsibility among some scientists is encouraging. I am less optimistic about society moving boldly to supply the resources needed to close the gaps in knowledge in the shortest possible time.

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Some Remarks on Aquaculture

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A preoccupation with the ocean sciences after World War II, the realization of an impending protein gap in the world as well as some successful endeavours in rearing aquatic animals both in the U.S. and abroad, mainly in Japan, have led to a rise in interest, during the last decade, in aquaculture and its potential.

Outside the U.S. aquaculture is mainly pursued for food production and for the rearing of special commodities such as pearls, while in North America (and to some extent in Europe and Japan) reared aquatic stock may also serve to enhance recreation (e.g., the Coho salmon in Lake Michigan, trout stocking, and put-and-take fishing in ponds for catfish.)

For various historical, socio-cultural and bio-technological reasons, fresh water aquaculture is most advanced. The rearing of fish, crustacean and mollusk in brackish water follows, while true mariculture is still in its infancy and will require for its development substantial inputs of basic and applied research in many disciplines of the natural and social sciences.

The theoretical potential of aquaculture is very high. It encompasses not only the upgrading of present operations but also the large yields that could be obtained from likely as well as technically possible advances in rearing methods. In fact, over centuries the bulk of the harvest of the seas, lakes and rivers may well be derived largely from cultured species supplementing and finally exceeding the yield that comes from the traditional taking of a barely managed surplus from untended, common property stock.

In the intermediate range of the next few decades, however, one must consider that some agricultural experts foresee gains in the rearing of terrestrial livestock. The spread of existing, and development of new, high yielding strains of staple crops to the extent that base-food importing nations become self-sufficient is expected. These experts also predict the diversification of agricultural production to the extent of diverting a developing local grain surplus into animal feed. Perhaps to the aquaculturist such an outlook is not too rosy, for one might expect these events to compete with and depress the demand for aquacultural products. Fish appear to be replaced

easily in the diet by meat of warm-blooded domestic animals if the latter can be produced at prices geared to country's rising economic level: the changes in the Dutch diet over the last 30 or 40 years and that of the Japanese over the last 10 years are cases in point.

Green revolutions with their attendant possibilities of turning surplus crops into animal meat are under way in some countries; they will no doubt continue. But the world's population will also continue to increase and in the next century will strain severely the theoretical, let alone the practical, capabilities of land areas to nourish mankind. Algae farming. and the cultivation of yeasts from petroleum by-products may be developed in time to alleviate some food shortages, difficult as it may be to overcome the problem of making such highly unconventional foods palatable. Without population stabilization one can never hope to banish the spectre of famine from all mankind; in fact, man's ultimate survival depends on his realizing the urgent need for curbing his numbers to the replacement level. On the road to attaining this state he will continue to strain the food producing capacity of the land; he has already begun and will continue to do the same with the earth's waters. Competition of aqua- with agri-culture that now co-determines the size of markets for aquacultural products will be far less severe in the endeavours to supply animal protein to many more billions that are sure to clamor for food in the future. Whether or not the world's protein needs can eventually be supplied in some part through aquaculture will depend very much on the extent to which oceanic pollution can be curbed and brought under international control.

During the next few decades various other factors may work to constrain the development of aquaculture. While the use of a combination of well selected species as biological filters in the purification of domestic sewage may be more effective than tertiary sewage treatment, produce food and still be economical in the bargain, cultural restraints could well mitigate against this ecologically acceptable solution of one of man's pressing problems. It is even more likely that affluent societies driven by economic pressures, will opt to use their shore lands on lakes, rivers or the sea in a manner that would preclude the placement there of extensive water bodies destined for food production. Such a trend is indicated in the impending decision to discontinue the sewage carp ponds of the Bavarian Hydropower Company near Munich which have yielded 500 kg./ha of fish flesh with a favorable mix of fixed and variable production costs for the last 50 years. The land hitherto occupied by ponds for fish production from a sewage-river water mix is not more valuable when used as industrial and residential sites.

It appears then that aquaculture till the end of the century - in high income nations at least - will have to become surface intensive and relatively highly automated if its pro-

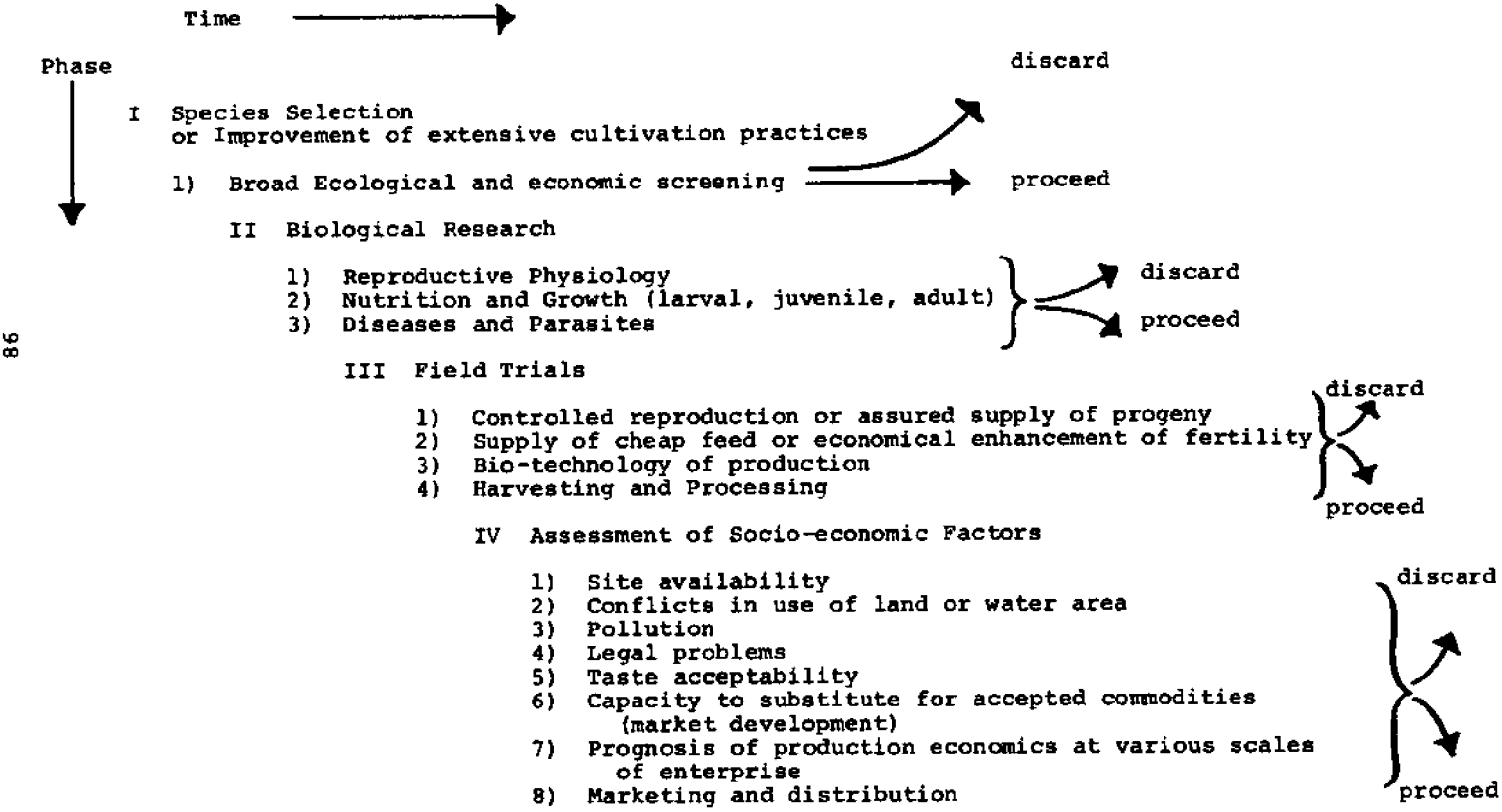
ducts, by and large of a luxury kind (oysters, shrimp, salmonid fishes and a few others), are to compete with animal flesh from terrestrial stock. In the developing world, site competition may be less pressing and extensive or semi-intensive aquaculture may be practiced there with profit. However, skills and capital may be lacking not to mention deficiencies to be remedied in administrative and distributive infrastructures. Vast potential aquacultural sites, as well as species now not even under subsistence tending, yet with suitability for intensive cultivation exist in the tropics. It must be remembered however, that intensification of food production of any kind in the developing world, must be accompanied by employment possibilities for surplus hands.

The aquacultural planner, then, is faced with a variety of problems, requiring expertise from biology to law, economics to engineering, anthropology to public administration. Simplistic as it may be, one may find it valuable to outline, in broad, schematic form, the phases through which some or all species must go before they can be put into aquacultural production of a level that is competitive with meat marketed from land animal industries, (Table 1).

The various steps and/or problems indicated may exist, in any one species, to a greater or a lesser degree. For instance, shrimp culture seems desirable from an economic viewpoint, provided that the commodity can be produced at acceptable cost. Furthermore, the ecology of the species indicates that a satisfactory technology could be developed; the bottlenecks are, in part, in phase 2 and much more on phase 3 of the hypothetical sequence. Inexpensive feed for shrimp has not been developed, at least in the U.S., nor has there been sufficient work done on controlled reproduction and the nutrition and growth of the crustaceans.

The matter is somewhat different if one were to consider the suitability of a highly prized species for culture that is now only available as a product of sea fisheries and with which no previous attempts at culture have been made. There may be a broad market for snappers but their ecology is such that real culture, including control over its progeny, seems impractical to consider. The alternative of foregoing control over reproduction of a species and to rear its larvae or juveniles (yellowtail in Japan, pompano in the U.S.) also rests on broad ecologic considerations. Eventually, though, it becomes advisable to govern reproduction and larval life of the species under culture, a quest that is particularly difficult with fishes that have pelagic larvae remaining in the plankton even for periods of several months. It is here that the biological research and field trial phases become crucial. A number of federal and university laboratories, the latter with federal support, are presently engaged in various more basic research projects with the biology of potential aquacultural species; it is not too early to think of the need for field trial sites.

Table 1. Schema for the development of an aquacultural species



With the exception of salmonid hatcheries, these units are none too plentiful, certainly not when compared with the prevalence of agricultural experiment station destined to adaptive research (field trials) with livestock. It would behoove NOAA and the Sea Grant Administration on the one hand and Sea Grant Colleges on the other to look into the establishment of aquacultural experiment stations, for aquaculture would profit greatly if it were given the same kind of "hidden subsidy" through broad federally supported research which agriculture in the U.S. has enjoyed for decades.

One may look towards industry also for cooperative ventures in the field trial phase, especially in the area of supplying cheap feed for aquacultural animals. It must be remembered, however, that with the exception of salmonoid culture and perhaps the rearing of catfish in the Southern U.S. there is not yet a critical mass of aquacultural enterprises to make massive industry investments particularly attractive. Yet, industry-government partnership ventures in this field seem feasible.

Still another partnership venture in research and field trial phases seems indicated. So far aquatic biologists have spearheaded aquacultural research operations. Often colleagues from other basic biological disciplines, such as endocrinology, have been coopted when the need for hormone purification was recognized to improve the induces spawning of fishes. There exist in most Sea Grant colleges departments of animal sciences, hitherto completely land-agriculture-oriented. In the University of Hawaii Sea Grant Program land animal nutrition and disease experts are now beginning to cooperate with aquatic biologists, lending the latter their experience of long standing. Land as well as water animal husbandry have generic problems in common: the provision of cheap feeds, the control of diseases due to crowding, the breeding and genetic selection of stocks. It is expected that such cooperative ventures will be salutary in the long run.

When one comes to the final phase in the development of aquacultural species-assessment of socio-economic factors - one has to note that aquaculture has not been big industry. Consequently agricultural economists have not paid much attention to it. Experts in law and public administration who could be expected to have an interest in problems concerning renewable natural resources management also have tended to ignore the merits of aquaculture. Furthermore, the development of mariculture at least, is still mostly in the species selection and biological research phases. Until one has reasonably accurate information on fixed and variable costs as well as land or water use patterns for commercial mariculture, work on this phase of aquacultural development may seem like a futile exercise. However, in certain aspects of "assessment", this may not necessarily be so. Early in the meteoric rise in southern U.S. catfish growing, had an attempt been made to

appraise market development problems - substitution by catfish of other, widely accepted meat products - economic losses to individual entrepreneurs might have been prevented or alleviated. Similar considerations pertain to the earlier mentioned utilization of sewage, where multi-species, biological recycling filters would use the high nutrient levels in domestic waste waters for the production of edible proteins. While biological research in this area has proceeded in a few places in the U.S. to the field trial stage, there are indications that the process is most advantageously employed in the tropics or subtropics. Thus, it would be advisable to bolster this research even now with inquiries into potential land or water use conflicts and into socio-cultural problem of acceptance of meat, in part rather directly derived from human excreta. For if the latter obstacle exists in Judeo-Christian culture, and if the former conflicts preclude such ecologically sound use of space, research to make the latter possible could be relatively unproductive, even if highly successful.

Some socio-economic factors will be assessed by guess or research through efforts of aquacultural entrepreneurs. Marketing and distribution, per se, as well as market saturation will certainly be investigated by them. But such entrepreneurs are less well equipped than federal agencies or universities with Sea Grant support to deal with problems of taste, site conflicts, law and pollution. It seems reasonable therefore to recommend enhanced preoccupation in research and factfinding in these areas even while production problems are not yet solved. In sum, an appraisal of the influences on and constraints to the development of aquaculture should be approached through systems models where initial, crude modeling leads to the definition of specific research needs. As such research is undertaken, its results are fed back into more refined models, hopefully soon to answer the overall question: what is the true potential of aquaculture and how can it be attained?

Aquaculture: Economic Feasibility in the Great Lakes Area

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I am happy to have the opportunity to discuss with you today some of my thoughts on the economic feasibility of aquaculture in the Great Lakes area. My research on this topic began relatively recently (mid-1971). Accordingly, the work is in its early stages and some of the findings discussed are preliminary in nature.

Forms of Aquaculture in the Great Lakes Area

Wisconsin and other Great Lakes area states have well-developed hatchery and raising facilities which provide the game fish for stocking streams and commercial pond fishing enterprises. Because of the importance of fishing in recreational programs of the area, these aquacultural systems probably will grow in importance. However, today I will focus mainly on the commercial raising of food fish in controlled environments, a type of aquaculture that has received less attention in the Great Lakes area.

Interest in the economics of raising food fish by aquacultural methods is strong in the Great Lakes area because aquaculture represents an alternative source of supplies to replace the declining commercial catch from the Great Lakes and because aquaculture represents a potential economic use for the large quantity of thermal effluent discharged from area electric power generating plants. The value of the U.S. Great Lakes catch has declined sharply since the late 1940's (Table 1). The composition of the catch can be partly attributed to overfishing, the sea lamprey invasion, thermal pollution, pollution from agricultural and industrial wastes, and DDT residues. According to processors and government officials I discussed the fishing business with recently, DDT contamination poses a serious threat to the important chub business. Recently polychlorinated biphenyl (PCB) contamination of fish has become a problem.

Advantages and Problems of Aquaculturists

Area fish processors and dealers who depend upon the Great Lakes catch for a portion of their supplies are aware of the implications of these developments. As a result a

Table 1. Value of U.S. Great Lakes fishing catch, by species, 1948[a/] and 1969[b/]

Species	1948 Value of catch	1948 Percent of total value	Species	1969 Value of catch	1969 Percent of total value
1. Common Whitefish	$3,783,922	29.8	1. Chubs	$1,549,995	25.6
2. Lake Trout	1,753,326	13.8	2. Common Whitefish	1,421,466	23.5
3. Yellow Pike	1,316,781	10.4	3, Yellow Perch	678,258	11.2
4. Chubs	1,256,531	9.9	4. White Bass	364,731	6.0
5. Blue Pike	1,218,117	9.6	5. Alewives	331,912	5.5
6. Lake Herring	1,176,275	9.3	6. Lake Herring	295,980	4.9
7. Yellow Perch	754,540	5.9	7. Catfish	293,745	4.8
8. Suckers	207,635	1.6	8. Carp	266,294	4.4
9. Catfish	192,297	1.5	9. Yellow Pike	218,510	3.6
10. Carp	189,034	1.5	10. Lake Trout	172,575	2.8
11. Sheepshead	187,217	1.5	11. Smelt	116,442	1.9
12. Smelt	177,639	1.4	12. Other[c/]	350,116	5.8
13. Tullibee	103,809	.8			
14. Other[c/]	372,459	2.9			
Total	12,689,582	99.9		6,060,024	100.0

Source: U.S. Department of Commerce (13), Great Lakes Fisheries Statistics.

[a/] The value of the U.S. Great Lakes catch reached its post-war peak in 1948.

[b/] The statistics include the value of the catch from the following international lakes: St. Claire, Lake of the Woods, Namakan Lake and Rainy Lake.

[c/] Includes all species with catches valued at less than $100,000.

few of them are attempting to raise their own fish supplies. Interest appears to be greatest in raising yellow perch, pike and trout, species for which the demand is relatively good in this area.

The economic advantages which might accrue to area processors and dealers from raising fish in aquacultural facilities rather than relying upon the catch of wild fish are numerous and important. Fish could be produced more nearly to specification in aquacultural facilities. Spoilage problems could be reduced. Chemical contamination of fish, which has been troublesome in the area, could be eliminated or sharply reduced. Supplies would be more uniform and dependable. All of these factors would facilitate more effective marketing and merchandising. If early experience with catfish farming is reliable, the aquaculturally raised fish also might bring growers a price premium over that received for wild fish.

However, despite these advantages not much capital is likely to flow into aquaculture in the Great Lakes area unless certain problems can be solved. Because of the cool temperatures, it is likely that most of the fish produced in the Great Lakes area aquacultural facilities will be raised in artificially heated water in tanks. One problem will be to keep water heating costs down. The Skidaway Institute catfish studies show that with an open cycle system which continually supplies fresh water for the fish raising tank, large quantities of heated water are required to promote efficient fish growth. For example, an Institute researcher reports that with an open cycle system about 1,000 gallons of water heated to about 80°F are required per catfish raised from the fingerling to one pound size (2, p. 21). In some northern areas where ground water temperatures are low, closed cycle systems which recirculate filtered, heated water probably will be necessary to keep water heating costs at acceptable levels. A processor whose plant I visited recently, plans to use a closed system in the facility which he hopes to have operational within a few years.

Potential growers in the Great Lakes area, in many cases, appear to have little experience with the complex problems connected with aquacultural production. Thus, if the industry is to develop efficiently, methods probably will need to be found for supplying them with information on intensive culturing of species such as perch and pike. A desirable program of public assistance to growers might include a research program covering nutrition, engineering problems and production economics such as that being conducted at Skidaway Institute in Georgia and an extension program to disseminate the information to growers. Worthwhile results also might be achieved through more modest programs. For example, growers might be informed in non-technical language of the management implications contained in recent biological,[2] and nutrition studies. Growers also might be given information from the recent catfish studies and descriptions of successful practices in game fish hatchery operations.

Other forms of useful assistance would include helping growers to locate broodstock and low cost credit. Adequate credit may assume importance since growers are not likely to succeed unless they have sufficient capital to weather the financial problems which accompany getting a risky new enterprise started.

Longer-Term Prospects for Aquaculturists

Although trends are not yet well defined, it appears that initially, at least, aquacultural production in the Great Lakes may be carried out mainly by existing fish processors and dealers or by others who have experience with some aspect of the fishing business. If processing and marketing firms become the dominant producers, they should experience few problems with fish marketing in the near-term. The processors and dealers can use their established market channels to market fish raised in aquacultural facilities. However, if aquaculture is successful and large quantities of several species of fish are produced in aquacultural facilities, it may be necessary for growers to give attention to demand expansion and promotion.

According to processors, the demand for fish in Wisconsin, at least, varies rather sharply from area to area. Consumer demand for perch and pike, for example, is strong in the eastern portion of the state but less strong elsewhere. Consumer demand for catfish is moderately strong only in areas near the Mississippi River and in Milwaukee. The weakness of demand for catfish may be caused partly by the poor image of catfish in portions of the state. Given these demand conditions, prices may decline substantially if the introduction of aquaculture results in a sharp increase in fish output. Vigorous programs of advertising and promotion might reduce the price weakness.

National demand conditions must be considered when the longer-term demand and profit aspects of aquaculturists in the Great Lakes and other areas are considered. Per capita consumption of fish in the U.S. was 14.1 pounds in 1969 (Table 2). This figure is relatively low in comparison to per capita consumption of meat and poultry which averaged 161 and 48 pounds respectively, in 1969. Per capita consumption of fish has remained within the relatively narrow range of 12.9 to 14.1 pounds per person during the 1955-69 period. The stable consumption figure contrasts sharply with that for poultry in particular which has increased strongly in recent years.

Table 2. Per capita consumption of fish, meat and poultry in the U.S., selected years (12, p. 577)

Year	Total Consumption of Fish, Meat, and Poultry (Pounds/capita)	Fish Consumption (Pounds/capita)	Meat Consumption (Pounds/capita)	Poultry Consumption (Pounds/capita)
1955	191.8	12.9	152.2	26.7
1960	194.4	13.2	146.7	34.5
1965	203.1	13.9	148.0	41.2
1969	223.4	14.1	161.2	48.1

The income elasticity of demand for fish in the U.S. is moderately low. The three estimates in Table 3 which average .31 compare to Brandow's income elasticity estimates for beef, pork and chicken which are .47, .32, and .37, respectively. Thus, other things equal, as consumer incomes increase the quantities of fish consumed probably may not increase as fast as consumption of beef and chicken.

If the .31 income elasticity is appropriate and real income of U.S. consumers continues to grow at the three percent rate of the 1960's, increases in income (other things equal) should cause total fish consumption in the U.S. to increase by 1.4 to 1.5 percent per year. It is possible that species such as perch and trout may have substantially higher income elasticities than those for all fish. If this is the case, increases in income would increase the demand for these species substantially faster than for all fish. It is also possible that consumers will seek increased variety in their diets in the future and show increased preference for fish rather than meat and poultry. This would increase demand and exert upward pressure on prices.

Price elasticity of demand estimates for fish provide information on the probable effects of increases in prices on consumption and the effects of increases in output on the total revenue received by producers from the sale of fish. Brandow reports a -.65 figure for all fish (Table 3). For species that might be commonly raised in the Great Lakes area (trout and perch) some of the elasticity estimates are less than minus one. When the elasticities are less than minus one, prices decline proportionately less than sales increase when output is expanded.

Table 3. Price and income elasticities of demand for fish and substitute products.[a/]

Investigator	Product	Market Level	Price Elasticity	Income Elasticity
1. Brandow (3, p. 17)	All fish, U.S.	Retail	-.65	.42
2. Christy & Scott (4, p. 35)	All fish, U,S.	Retail		.3
3. FAO (6, p. 58)	All fish, North America	Retail		.2
4. Purcell & Raunikar (9, p. 219)	Shellfish & Finfish	Retail	-1.58[b/]	
	Shellfish & Finfish	Retail	-.82[c/]	
	Shellfish & Finfish	Retail	-.36[d/]	
5. Nash (7, p. 28)	Lake Trout	Wholesale	-4.29	
6. Nash (7, p. 26)	Lake Whitefish	Wholesale	-1.09	
7. Nash (7, p. 26)	Yellow Perch	Wholesale	-.56	
8. Anderson & L'Esperance (1, p. 12)	Yellow Perch	Ex Vessel	-1.0 to -1.5	
9. Brandow (3, p. 17)	Beef	Retail		.47
	Pork	Retail		.32
	Chicken	Retail		.37

[a/]The price and income elasticities represent the percentage change in quantities demanded resulting from one percent changes in prices and incomes, respectively.

[b/]Based on week-to-week first difference price changes, consumer panel data.

[c/]Based on quarter-to-quarter price changes, consumer panel data.

[d/]Based on year-to-year price changes, consumer panel data.

If aquaculture resulted in increased output of those species for which the demand is elastic (< -1), the result probably would be an increase in the total revenue of producers of these species.

Thus, in summarizing the demand outlook, it appears that aquaculturally produced fish will possess characteristics that make the product easier to market and merchandise than wild fish. However, in the absence of strong advertising and promotion efforts, the demand for fish may grow slowly. It is difficult to generalize about the overall economic impact of the demand forces, however, since the demand conditions and profit prospects facing producers of the different species will differ.

Use of Thermal Discharges for Aquaculture

Electric power use recently has doubled about every ten years in the U.S. This has sharply increased the amount of thermal effluent which is discharged into lakes and streams. Increased use of nuclear power generating facilities will accelerate the production of waste heat since for plants with the same kilowatt rating, a nuclear plant produces about 50 percent more waste heat than a fossil-fuel plant (11, p. 151). Because of increased amounts of effluent generated by both nuclear and fossil-fuel plants, more than a twelvefold increase from 1970 levels in the amount of waste heat added to Lake Michigan has been forecast to occur by the year 2,000. (14, p. 4).

In the Great Lakes area interest in using thermal effluent for aquaculture is strong since, as mentioned earlier, obtaining the heated water required for efficient fish growth from other heat sources might be expensive.

Most work involving use of thermal discharges for aquaculture is in the planning or experimental stages. The Wisconsin Department of Natural Resources is attempting to arrange an experiment with a power company to determine whether water temperatures in an earthen pond can be maintained within the relatively narrow limits desired by fish raisers by adding varying amounts of thermal effluent.

Catfish raising experiments or projects which use thermal discharges from power plants have been tried at Colorado City, Texas, Jackson, Mississippi and Gallatin, Tennessee (8, p. 48). At the Texas and Mississippi locations, growers raised fish in the effluent only during the winter months since they believed that the water temperatures would be too high in the summer for fish raising. At least one of the experiments has been successful. The other catfish projects are too new to draw conclusions about.

Experiments in Japan and Great Britain are among the most encouraging concerning the prospects for economic use of thermal effluent. Aquacultural experiments where shrimp and yellowtail were the chief species raised were being conducted at five power stations in Japan in 1970 (15, p. 32). In the Japanese experiments, fish raised in water heated by thermal discharges exhibited rapid growth during the usually nonproductive winter months, with no loss of commercially desirable characteristics. The success of experimental work in Great Britain with use of power plant effluent for raising plaice and sole has prompted British experimenters to seek funds for large scale field trials. Richardson (10) estimates that, given adequate development funds, a commercially viable system using power plant effluent might be developed in as little as 5 to 10 years.

Use of thermal discharge for fish raising is not without problems. The fluctuating output of effluent from power stations may make it difficult to maintain the water temperatures at desired levels in the fish raising area. It may be necessary for growers to arrange to have available standby water heating equipment to prevent problems in the event that power plants shut down entirely. Growers also will need to obtain a high degree of cooperation from management of power companies to prevent lethal doses of algicides and corrosion inhibitors used at the power plants from being dumped into the effluent used for fish raising. According to Coutant (5), operators of present generation nuclear power reactors customarily dispose of small amounts of radioactive materials by dispersing them to the environment via the cooling water. The amount placed in the cooling waters is small and evidently harmless, but there is a stigma associated with radioactivity that may influence the sales of fish cultured in the cooling water from the nuclear plant.

Ecologists have suggested that use of thermal discharges for fish raising may simultaneously reduce thermal pollution and provide the inexpensive source of heated water required for profitable aquacultural enterprises. It may not be possible to achieve these objectives simultaneously. Aquaculture produces organic wastes that consume oxygen, metabolic wastes that stimulate plant growth (euthrophication) and it consumes oxygen itself. In addition, most of the heat may remain in the effluent that ultimately flows back into a lake or stream. These problems lead Coutant (5) to question whether the effluent discharged from the aquacultural facility might cause more degradation of the receiving water than would heated water alone.

It is too early to estimate whether economically viable aquacultural systems in the Great Lakes area can be developed which use thermal discharges as a source of heated water. In connection with our research we plan to visit catfish raising facilities where experimental work on use of thermal discharges has been conducted to get more first hand information on the

subject. However, I interpret the experimental information to suggest that economically viable systems of this type might be developed given a suitable resource commitment. Incentives might be strong for power companies to develop advanced aquacultural systems in connection with their plant operations if these firms can find ways to avoid creating aquacultural pollution in the process.

Summary

Incentives exist for the development of aquaculture in the Great Lakes area to replace the declining catch from the Great Lakes and provide an economic use for thermal discharges from power plants. However, a number of technical and economic problems must be overcome before a viable aquaculture will develop in the Great Lakes area. Whether aquaculture develops in the region will depend partly upon the outcome of experimental projects now underway and upon the amount of private and public resources committed to aquaculture. If aquaculture does begin to develop, growers may need to expand efforts to increase the demand for fish products in order to obtain further growth of the industry. If a viable aquacultural industry develops, it could contribute significantly to the continued economic growth of the Great Lakes region.

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Recent Developments in Salmonid Aquaculture

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During the last few years the agencies charged with the responsibility for the regulation of our salmon industry have been faced with an unusual dilemma--what to do with the hatchery surpluses of both fish and eggs.

In the fall of 1970 a total of 599,811 adult salmon and 125,000 coho "jacks" returned to the hatchery racks at the 26 hatcheries operated by the Washington State Department of Fisheries. This great surge of spawning fish, which had survived the very extensive sport and commercial fisheries in the ocean and rivers as they returned to the hatcheries, far exceeded the numbers needed to maintain the hatchery runs.

The migration is complicated by the complexity of the races that make up the fishery. Many of the "natural" runs are so depleted that any increase in catch would be disastrous. However, attempts were made to harvest the excess of hatchery fish by extending the season, expanding fishing areas, and concentrating the fishing in congested areas. In spite of the efforts to harvest the runs, many more fish arrived at the hatcheries than were needed.

From the surplus fish collected at the hatcheries in 1970, the State of Washington sold 1,589,664 pounds of "bright" salmon for human food and 2,498,808 pounds of darker colored fish were processed for animal food. This is a far cry from the disastrous records of a few years ago when hatcheries had to rob wild runs to get enough eggs to continue their operations.

It is too early to calculate exactly the ratio of catch to escapement for the 1970 brood year, but if we use the ratio of 1 to 4, as determined for previous years, the hatcheries of the Washington State Department of Fisheries contributed as many as 2,400,000 fish to the catch.

As an insurance that the salmon runs will continue, at least for the next few years, the State of Washington hatcheries in 1970 released a record total of 126,498,234 young salmon, weighing 2,869,337 pounds. To rear this great number of fish, the hatcheries used 4,717,391 pounds of food, or 1.64 pounds of food for each pound of salmon released.

University of Washington Experimental Hatchery

The University of Washington maintains a small experimental hatchery for carrying on research on chinook, sockeye, coho, and chum salmon, as well as rainbow and steelhead trout. Fingerlings are released from the experimental hatchery after a period of rearing. The fish return to the campus pond as adults after a feeding period in the sea, providing spawn for continuation of the run, but again there is a great excess over the number needed.

A total of 3,092 salmon returned during the fall of 1970. In the return there were 2,806 chinook, 176 coho and 110 sockeye salmon. In each case, many more eggs were harvested than needed to continue the run. The chinook provided the greatest excess, with over 5,000,000 eggs harvested. From the excess eggs, 4,030,000 eggs were shipped to others for research or to start new runs. Table 1 lists the organizations receiving eggs and the numbers shipped.

Table 1. Chinook salmon eggs transferred from the University of Washington to other programs, 1970.

New York Department of Environmental Conservation	100,000
Pennsylvania State University	50,000
Nova Scotia Fisheries Department	150,000
Alpena College, Michigan	150,000
Oregon State University, Marine Science Center	130,000
National Marine Fisheries Service, Auke Bay, Alaska	50,000
Quinault Indian Fisheries Development Program	1,300,000
Manchester Marine Aquaculture Program	100,000
Japan Salmon Resources Preservation Association	2,000,000
TOTAL	4,030,000

In addition to the eggs transferred, 860,051 fingerlings, which weighed 5,462 pounds, were transferred or released. The Lummi Indians were given 210,438 fingerlings to start their aquaculture program. The program of Ocean Systems, Inc. at Manchester received 455,123 fingerlings for use in their feasibility study of commercial farming, and the balance, 194,400, were released into Lake Union to continue the present run.

Indian Aquaculture Programs

Quinault Resource Development Program:

The Quinault Indians have embarked on a tribal aquacultural

program as part of their Resource Development project. The aim is to increase the production of their lakes and rivers so that the tribe will have a larger harvest of fish returning from the sea.

Funds from the Federal Government have helped build a modern salmon hatchery on a tributary of the Quinault River, but not enough eggs are available there to stock the hatchery. The supply of chinook salmon in the Quinault has been reduced to a token run by overfishing. To rebuild the chinook run, over a million eggs a year have been given to the tribe from the University of Washington excess. The eggs have been fertilized with sperm from 5 to 7 male chinooks that were captured in the Quinault River. It is felt that the interracial hybrid will have a much better chance of survival in the Quinault system than would nonhybrid stock introduced from another system.

In addition to the chinooks, the hatchery rears and releases coho. A lake rearing program for steelhead fingerlings is also underway in an attempt to increase the crop in the Quinault River.

Lummi Indian Aquaculture Project:

With Office of Economic Opportunity funds, the Lummis built dikes and ponds and carried out a feasibility study. Based on this demonstration, the Economic Development Administration funded the tribe with $1,500,000 to build their own 750-acre commercial production aquafarm. The dike surrounding the aquafarm was completed by the Lummis on June 4, much to the surprise of the experts.

The Lummis are now building a fully commercial shellfish hatchery. The plans are to grow both cultch and cultchless oysters from the seed produced. In the warm waters of the ponds the oysters grow very rapidly, doubling their weight every two weeks between March and October. Crassostrea gigas (Pacific oysters) can grow from 1/4 to 4 inches in five months.

A modern salmon hatchery is under construction on the Nooksack River to provide for the freshwater rearing of the trout and salmon before they reach the smolt stage and are transferred to the salt-water ponds for further rearing. In addition to the 210,438 chinook fingerlings provided the Lummis, 359,080 rainbow trout fingerlings were given to them to get their aquafarm underway. To provide for future needs, 342 large rainbow trout of the University's select strain were transferred to the holding ponds on the reservation.

In order to provide skilled workers for their farm, the Lummis have carried out two year-long training schools, which

have graduated 78 students, The graduates have covered a comprehensive course that includes fish nutrition and feeding, fish disease diagnosis and control, fish hatchery operations, transportation, pond rearing, oyster hatchery operations (spawning, setting, and rearing), food algae production and control, commercial oyster growing, hybridization and selective breeding.

Commercial Salmon Farming

A very important piece of legislation, Senate Bill No. 142, was passed by the State of Washington and signed by the Governor on March 9, 1971. This new legislation changes the old law to make fish farming possible.

> The director may authorize by permit the cultivation of food fish and shellfish or other aquatic animals for commercial purposes, also known as fish farming or aquaculture, under such rules and regulations as he may prescribe. Cultivation shall include all aspects of breeding, obtaining eggs or young of, raising, preparing for consumption or for market, and marketing of the food fish, shellfish or other aquatic animals. Cultivation may be permitted on privately owned uplands, shorelands or tidelands, as well as on publicly owned uplands, tidelands, shorelands, or beds of navigable waters in accordance with procedures established for administration of such areas.

Operating under a permit from the Washington State Department of Fisheries, Ocean Systems, Inc. is conducting a feasibility study into the commercial farming of coho and chinook salmon in pens near Manchester in central Puget Sound. Progress has been good and it now appears that the pilot study will make the projected goal of marketing 200,000 pounds of young salmon by December 1 this year.

Aquaculture Research at the Skidaway Institute of Oceanography

James Andrews
Skidaway Institute
Savannah, Georgia

The Skidaway Institute of Oceanography, a unit of the University System of Georgia, initiated an aquaculture research program during the spring of 1969. The initial experimental work involved adapting the flowing water intensive techniques utilized in trout or salmon production to the culture of channel catfish, penaeid shrimp and flounder. Additional experiments are being conducted on the culture of rainbow trout in brackish water, sea turtles, stripped bass, pompano, and Palaemonetes shrimp.

To facilitate the development of economical and effective methods for high density tank or raceway culture, the program utilized a multi-discipline approach combining personnel with backgrounds in nutrition, biochemistry, physiology, crustacean and fishery biology, poultry industry, Japanese methods of fish culture, engineering, and agricultural economics.

Preliminary results of this work to date indicate that the multi-discipline approach can be beneficial in the development of an aquaculture industry which is both modern and efficient and which can produce a commodity that will be able to compete with those of other food production industries.

The following section contains summaries of results and publications in the area of aquaculture at Skidaway Institute.

Catfish Research Program

Original Objective: To develop methods for high density culture (tank or raceway) of catfish.

Accomplishments (March 1, 1969 to July 1, 1971):

1) Initial culture studies have established that catfish can be reared in round culture tanks at densities up to 8 lb. of fish/ft.^{3} of water (1-3).

a. The highest overall production was obtained at a projected density of 8lb./ft.^{3}, and an exchange of water every 2hr. The total production/ft.^{3} of tank space under these conditions was 11.2 lb./200days or an extrapolated production of approximately 20 lb./year/ft.^{3} of water.

b. Under these conditions fingerlings averaging 20 g. at stocking were reared to an average weight of 453 g. (1 lb.) in 180 days (6 months). The overall survival rate for this group was 93%. An average weight of 453 g. was obtained in 160 days at a lower stocking density (a projected density of 2 lb./ft^3) with a water exchange every 5 hr., but the total production was much less than from higher density groups.

c. Several high density culture diets were tested and a diet was developed with which fish were reared from fingerlings to 1 lb. with a food conversion ratio of 1.6 lb. feed/lb. gain.

2) Environmental studies demonstrated that the ideal environmental temperature (for best growth rate and food conversion) for high density culture of catfish was between 28 and 30°C. (82.4 - 86.6°F.) (4-7).

a. Catfish reared at high temperatures deposited a higher level of total lipids and a lesser amount of polyunsaturate fatty acids in their tissues than those reared at lower temperatures.

3) Studies on the utilization of various lipid sources by catfish have demonstrated that catfish utilize lipids in the triglyceride molecular form more readily than in the ethyl ester or free fatty ester form (6-9).

a. These studies also established that beef tallow and fish oil lipids were more readily utilized by catfish than lipid supplements containing short chain fatty acids (C4 and C6), medium chain fatty acids (C8 and C10), coconut oil, olive oil, safflower oil or linseed oil.

b. Diets supplemented with high levels of linoleic and linolenic acids ("essential fatty acids" for man and other terrestrial animals) promoted poor growth of catfish.

4) A study of the effect of varying photoperiod (0, 6, 12, 18, and 24 hr./day) indicated that this variable had little effect on growth of catfish under the conditions of this experiment (10).

5) Attempts to rear catfish from fry to fingerling size in tanks indicated that it is possible to carry out all phases of catfish rearing in high density culture (11-12).

6) In a study of the calcium and phosphorus requirements of catfish, best growth was obtained with a diet containing dietary calcium and phosphorus levels of 1.5 and 1% of diet, respectively. Poor growth, food conversion, low hematocrits and bone ash values were obtained when the phosphorus level was 0.5% of diet (13).

7) Catfish fed at a constant rate (3% of biomass

daily) grew as well when maintained in water which contained an average oxygen level of 60% of saturation than 100% of saturation. Extremely poor growth was obtained in groups maintained at 35% of saturation(14).

8) Oxygen requirements were determined for various size catfish in a well-fed, over-night starved, and 3-day starved condition (15).

9) Cooperative studies with the Georgia Experiment Station's Food technology Department revealed that catfish can be stored in an ice pack for up to 12 days and refrigerated for up to 8 days (16).

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Shrimp Culture Research

A research project for intensive mariculture of commercially important penaeid shrimps has been implemented at Skidaway Institute of Oceanography. During the past year these studies, funded by the National Sea Grant Program of the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce, have established preliminary nutritional and environmental requirements necessary for the culture of penaeid prawns.

A series of experiments were conducted to determine the environmental conditions necessary for optimum growth and survival of adult shrimp (1). A suitable water flow rate, type of substrate, oxygen level, stocking density, and light intensity were developed through appropriate experimental designs.

Having established these environmental prerequisites, preliminary nutritional studies using purified pelleted diets have been conducted during the past year. Physical qualities of pellets such as length, diameter, texture and binding properties were tested. Eighteen different diets which varied in level and quality of protein, carbohydrate, lipid, vitamins and minerals were evaluated by growth rate (biomass increase) and percent survival. Rates of ingestion under given environmental conditions (2-3), rates of assimilation of specific radioactive labeled biochemical entities, calorie-protein relationships and respiration rates are currently being studied.

In the experiments described above, excellent survival rates (90-100% routinely) and growth rates (increases in biomass of approximately 200%) have been obtained with adult

shrimp. Furthermore, knowledge of general feeding behavior and metabolism of penaeid prawns has been increased through a better understanding of ingestion and assimilation processes and rates.

Recently, preliminary studies have been initiated on the culture of Macrobrachium rosenbergii. These experiments include studies of the texture and type of pellets, calorie-protein requirements, and stocking densities. Growth and survival rates have been excellent in the initial experiments. The potential for commercial culture of the large freshwater shrimp is promising because of the fact that they can be spawned in captivity, are aggressive feeders of pelleted feed, have a fast growth rate and are a high value product.

Several studies are being designed to transform the basic information obtained in this program into an economically feasible method for commercial culture of shrimp in this country. Major emphasis will be placed on developing a cheaper and more effective pelleted diet for shrimp.

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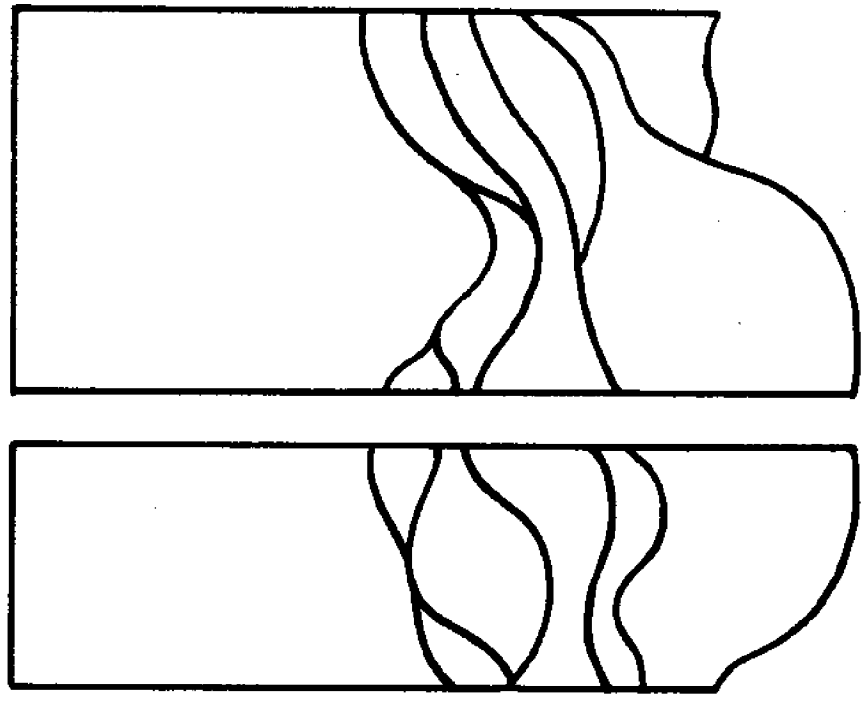

ADVISORY SERVICES

Advisory Services Session Summary

Walter Gray, Session Chairman
University of Rhode Island

Marine advisory services were reviewed and discussed in sessions on both days of the conference. Chaired by Walter J. Gray, Director of the Marine Advisory Service at the University of Rhode Island, the sessions provided a forum for discussion on many facets of advisory service work, from using the media more effectively to identifying the needs of marine resource users.

In open discussions following presentations by selected speakers, the following concepts evolved:

1. Marine advisory services can take many forms:

   a. One-to-one relationships with a specific user, such as a fisheries specialist relaying gear developments information to a commercial fisherman

   b. Workshops, seminars, conferences

   c. Publications and information services to specific audiences as well as the general public

2. In-service seminars and workshops patterned after the successful marine advisory workshops conducted by Oregon State University and the University of Rhode Island are needed. At least two types are called for: one that would address itself to high-level administration (directors and coordinators of federal programs, including Sea Grant) to bring about a better understanding of advisory services, purposes and procedures; and another that would be concerned with specific types of advisory functions to present procedural ideas to persons conducting advisory activities.

3. Greater use should be made of mass media. Newspapers, television and radio provide an inexpensive and effective way of reaching the public. Magazines and trade journals can be used to reach specific audiences. Mass media techniques should be a part of every advisory services program.

4. A variety of published materials can be used to transmit information, ranging from technical reports to advisory bulletins. Publications are only one information transfer mechanism, however, and should be exposed to some evaluative process. Abstracts can be used on some technical reports. Some publications can be sold to determine true interest and use.

5. Determination of user need is a long-term process. Seldom is a real need presented in a clean-cut perspective. One hinderance in need definition is that often the user does not recognize his own problems. Assessments techniques must be developed by advisory services personnel, who must often infiltrate the user group to fully understand its needs.

6. Cooperative arrangements between state and federal agencies and Sea Grant advisory services to accomplish complementary programs should be undertaken without sacrificing the autonomous nature of either group.

7. Some other nations, such as Norway, have approached fisheries advisory programs on a greater scale than has the U.S. Investigation into their methods may provide some suggestions for Sea Grant fisheries advisory work.

8. Although work with fishermen provides tangible evidence of Sea Grant advisory services in an industry where help is vitally needed, food resources is not the only area in which advisory services function. More needs to be said about advisory work in such areas as coastal zone management, marine science education, transportation, and recreation and tourism development.

9. Advisory services activities are inextricable from research and education activities. Advisory personnel must be prepared to participate equally with researchers and educators in order to keep the three-pronged Sea Grant concept operating at its greatest capacity.

What is "Sea Grant Advisory Services?"

Robert E. Harris
University of Washington

In starting an advisory services program a newcomer faces several basic hurdles. He knows that advisory services is a major area in Sea Grant. But the first hurdle is--what is it? What is it supposed to do?

Existing written guidance is found in one short paragraph on page 4 of "Suggestions of Submission of Proposals", NSF 67-18 dated September 1967--and in two equally short statements in the "National Sea Grant College and Program Act of 1966", Public Law 89-688, Section 204 (b) (3) and 204 (i) (4) (C). The three paragraphs together are not as helpful as they might be in getting a cohesive program started.

The University of Washington finally worked out for itself (with some rather pointed prodding from the National Sea Grant Panel!) the following. What is advisory services? A full-time two-way communication system between Sea Grant and the marine communities. What is it suppose to do? We decided advisory services has three interrelated functions. It is a program that 1) actively seeks information on marine resource needs, particulary local ones, 2) initiates response either from the advisory program itself, or by supplying input to the research and educational programs, and 3) actively distributes marine resource information to the people who can use it. Once those concepts were established, we could plan an advisory program oriented to our local marine situation and the resources that could be available.

Recently the University of Washington came into possession of a draft copy of "THE NATIONAL SEA GRANT PROGRAM--Suggestions for Submissions of Proposals" written by Hal Goodwin, and dated September 1, 1971. It has a Section VIII entitiled "SEA GRANT ADVISORY SERVICES", and a copy appended.* Section VIII includes very helpful information.

The draft Section VIII also retains the very necessary potential for local flexibility and innovation that has been emphasized in Sea Grant since its beginning. The broad freedom permitted brings up the basic second hurdle faced by newcomers. Only the local people can determine an

appropriate mix of advisory services for their particular region. So there is no set pattern to follow; how our own program does what advisory services is supposed to do is up to us (so long as the Sea Grant Panel concurs!) And two points, I think, should be closely watched.

1. Advisory Services is supposed to be for service. Our definition and our customer's definition can be different. Our definition may be better, but always remember that his is important.

2. Advisory Services is supposed to provide good and useful information. We must be particularly careful with our reproduced materials--and be prudent in their distribution. Recipients who find publications useless sooner or later wonder who paid for them.

A newcomer's third hurdle is the ballpark of manpower and money involved in a Sea Grant advisory services program. This will of course vary widely with the situations in each locality. I did however check it out for the established advisory services programs in some Sea Grant Colleges, and I can give you the following broad guidance:

	UW, OSU, URI Range
Amounts of latest Sea Grants	$1.1-1.7 million
% in AS Programs	11.7-17.2%
Full-time equivalent professionals	7-12.5
Full-time equivalent secretarial	1.5-4.5
This year's Sea Grant AS support	$162-199 thousand
This year's non-federal AS support	$81-150 thousand

And that completes "Harris's Helpful Hints" to people bugging out their Sea Grant advisory services programs. Good luck. If it is any comfort to you, I do not think the "bugging out" process--in advisory services programs--ever stops.

The following is an excerpt from Hal Goodwin's draft of "The National Sea Grant Program--Suggestions for Submissions of Proposals", dated September 1, 1971

VIII SEA GRANT ADVISORY SERVICES

"Advisory Services" is a general term for the variety of means by which the results of scientific research or engineering development are communicated to those who will apply the results to obtain ecomomic or social benefits. The methods may include publications, conferences and seminars, mass media, or personalized extension services.

Feedback Through Advisory Services

In addition to dissemination of useful information a self-designed and staffed Sea Grant Advisory Service is also an improtant source of information and guidance to the Sea Grant institution, providing a "feedback loop" through which problems and opportunities, as seen by user communities, may be communicated to program administrators and researchers.

Advisory Services Concepts

Sea Grant Advisory Services do not deal only in information developed under Sea Grant; they collect and prepare for dissemination from any source information of use to the communities they serve. Such information may be obtained from Federal laboratories, state agencies, business and industry (when not proprietary in nature), from other Universities--whether or not part of the Sea Grant system--and from other nations. For reasons of credibility, as well as common courtesy, the source of a particular item is always given full credit.

Eligibility for Advisory Service Activities

Normally, Advisory Services are conducted by Sea Grant Institutions. When such institutions are Land Grant Colleges, the existing Extension Service may provide an excellent base on which new or additional activities may be built.

In addition, seperate Sea Grant Advisory Service Projects are considered when such projects would fill a regional need.

Identification of Audiences

Proposals for Advisory Services should identify, in specific terms, the audiences or communities to be served, and should show a history of prior contact with such user communities, at least to the extent of determining needs and the most cost-effective means of filling those needs.

Oregon's Marine Extension Workshop: Visited and Revisited

Daniel Panshin
Oregon State University *

From the outset of Sea Grant, the advisory function has occupied a crucial role. On the other hand there has been considerable uncertainty on the part of Sea Grant institutional recipients on just how to implement meaningful advisory work. In recent months Oregon State University decided to respond to this need, and accordingly presented a marine extension workshop during the summer of 1971.

The concept of the workshop was to provide an opportunity for those who were employed, or expected to be employed, in marine advisory work to get together in a structured program. The workshop focused on consideration of aspects and dimensions of our marine economy and a discussion of the philosophy and methods of extension work.

The pilot offering of the workshop was one week in length, taking place from August 30 - September 3, in Corvallis and Newport, Oregon.

The workshop consisted of a mixture of philosophy and methods. A variety of presentations was used, including lectures, discussions, demonstrations, group problems and a field trip. There was also an individual problem, the same for everyone and handed out in advance; the participants were expected to prepare most of their response prior to the workshop and refine it during the week. The emphasis of the workshop was on the problem-solving process and on interaction between people rather than on the correctness of answers and rote learning.

The results of the workshop have been variously described. Most agreed that it was a tremendous success. One participant described the workshop as a "happening where he got high on Monday without the benefit of drugs and stayed high until Friday afternoon." Another participant called the week " an exhilarating experience." Certainly, the workshop was a unique experience and a rare week for those who participated.

*Now with the National Sea Grant Office

Elements of Success

Some of the success of the workshop was determined beforehand. The workshop started as a raw idea--which was subsequently challanged, tempered, modified and added to by all OSU Marine Advisory Program staff members as well as others. Once the idea survived and developed into a more vital and comprehensive form, one person then planned and carried out the program. Critical decisions were to focus on the practical rather than on the theoretical, and to pursue a consistent theme throughout the workshop. Another element of success was requiring applications from prospective participants and then making a selection. In this way, the workshop was able to stay at a reasonable size (35 participants) and, at the same time, include a broad variety of participation in terms of geopraphy, experience, and subject matter speciality. Yet another factor was the use of individual and group problems which dealt with real, rather than with imaginary textbook problems.

Some further elements of success were associated with the actual running of the workshop. Fundamental were the tight organizations, timely execution and businesslike atmosphere of the program. Also important was the full-time, whole-hearted participation by all, including the ten Marine Advisory Program staff members. Another factor was the candor and frankness of the presentations; successes were discussed but also were failures, frustrations, and difficulties. And a final element was the extentions of the workshop experience: "eating, drinking, and sleeping marine extension" as one participant described it. Distractions were few; the week demanded freedom from telephone, appointments, and mail.

Critique

By contrast, critical consideration of some of the weaker areas of the workshop may prove useful. The most severe difficulty was the late development of the workshop. The decision to offer the workshop was not made until April, brochures were not mailed out until early June, and as a result it was incompletely announced. In addition, detailed information on the workshop was not available until July, posing severe hardships for several prospective participants as they tried to make plans and arrangements. Unfortunately, all Sea Grant institutional recipients were not represented at the workshop.

The workshop itself was too fish-oriented and would have benefited from fuller attention to all of the areas of Sea Grant interest and concern. The program was too dominated

by Oregon State University, and another offering of the workshop would do well to invite others to make some of the presentations. The workshop also ended up spending more time on philosophy than on methods, in spite of the reverse intention.

Future Workshops

There will be another marine extension workshop next summer, similar to the first. The workshop will again be one week in length and restricted to 35 participants. There will be added emphasis on methods. Next summer's workshop will be more oriented to those actively involved in marine extension work as agents and specialists. A wider variety of participants, however, is at the same time desirable and hopefully we can involve selected marine users, researchers, administrators, and state and federal agency representatives.

Real problems and problem-solving techniques were vital to the first workshop, and even more emphasis will be placed on these items. The next workshop will also schedule more variety in presentations, such as increased discussions, role playing, demonstrations, and interacton between participants.

What are we really talking about? We are not talking about a marine extension workshop as much as we are about marine extension work. The essence of the course dealing with how to plan and conduct marine extension work, and how to select and train marine extension people.

The ensuing comments represent my own feelings and are not necessarily those of Oregon State University. How does one select a marine extension agent? Without question the prospective agent must be competent in the subject-matter field. But more than his academic qualifications is that of his personality: the ability to get along with people, a genuine liking for people, and skill at working effectively with them. How does one train a marine extension agent? My answer is that the best training comes through on-the-job experience supplemented by periodic workshops.

Some have said Oregon State University should establish a marine extension institute. If it does, it should not offer regular academic courses a term in length. If it does, it should not offer graduate degrees. If Oregon State does establish a marine extension institute, it should offer a series of one-week workshops, perhaps two to four a year. Some of these should be general in their treatment, like the first workshop and like the one proposed

for next summer. Others should be more specialized; early prospects include public information, marine science education, marine extension field work, and a marine extension workshop for Sea Grant administrators.

Finally, if Oregon's marine extension workshop was a success, success must not then be measured by attendance in university graduate courses, or by marks received, or even by friendships made. Rather, success must be measured by how marine extension programs are different and better as a result of the workshop.

Working with the Media

Arthur Isbit
Rutgers University

The basic principles of successful media relations are: delivering your message in terms your audience is accustomed to understand; and providing material whose quality matches the minimum standards of the various media you want to supply.

Successful media relations requires a degree of empathy that puts you mentally into the thinking pattern of your constituents. You must use language they understand, you must respect the limits to their reading and listening abilities and you must scrub your message clean of words, sentence length and paragraph length that may cause your audience to lose interest in what you have to say.

Print media ideally want your copy to supplement the copy staff writers supply to their editors after returning from an assignment. If editors react to your copy by having to rewrite it, then your message acceptability suffers. If you can provide copy whose style indicates an appreciation of journalistic professionalism, you'll achieve more frequent successful placement.

If you supply taped programs to radio stations, you must deliver a combination of copy quality and voice quality that fits the image a radio station has (or imagines it has).

If you have no background in either the mechanics of newspaper or radio writing or a voice that carries overtones of confidence, seek out people at your university who can help you with the necessary coaching and advice or take the opportunity to audit a course teaching these techniques.

The size of your task is one you'll readily understand if you spend any time in a newsroom when the morning mail arrives, and the copyreaders begin examining the daily flow of news releases. Your material must compete with what arrives in the mailbag for the limited space in the "news hole". Most of the news releases end up as waste paper because they are not pertinent to the local audience, lack in news story quality or sound like copy for an advertisement.

Writing for print media is easier than creating material for radio. Radio material is easier than creating materils for television.

Writing for print media requires only the ability to use words. Radio material requires an appreciation for words and voice quality. Television material requires those two and visual quality besides. If you fancy yourself as having television potential, you must deliver language, voice quality and the indefinable something called "personality".

In all three kinds of media, you must become your own most severe critic, if you are determined to be the source of material. You must be just as severe as if you will be hiring someone to put out those kinds of material, because your image hangs on what you will distribute.

In all media, learn to express yourself in the active, not passive voice. Write or talk, to some particular imaginary fisherman, charter-boat owner, or shipwright. That will keep you from foundering, or floundering, in a sea of your own murky verbiage. Remember that "verbiage" is "verbal garbage" commonly found as a pollutant in channels of communication.

Evaluating Publications: An Educated Guess

Letha Miloy
Texas A&M University

Perhaps the largest information system in the nation -- as far as universities are concerned -- is that of the land grant institutions. Sea Grant should be aware of this system in order to learn from its successes and to improve upon its mistakes.

In 1968 Pennsylvania State University put out a pamphlet on "Publications Work" for extension services and agricultural experiment stations in 33 land grant universities. These schools accounted for 7,222 publications at that time, costing $3 million. Iowa topped the list with 920. The average number of publications was 219 (192 extension and 27 experiment stations).

Add to these the U.S. Department of Agriculture's Office of Information 2,900 publications, plus the Forest Service efforts, and you get some idea of the magnitude of agricultural publications. Between 40 and 50 percent of these publications go into county agent offices.

Sea Grant has the advantage of capitalizing on the forerunning land grant operations. We already have begun to do so in our publications efforts. Sea Grant has, for instance, directed much of its printed material toward extension service-type documents -- advisory bulletins. Like land grant, some Sea Grant institutions are progressing toward a distinct split between extension and research. I believe we should think carefully before committing ourselves to this dichotomy.

Even though Sea Grant is young, we seem to have scored well since 1968 when the first awards were made. As of October 1, 1971, an estimated 500 publications -- including journal reprints -- have come from Sea Grant sponsored activities.

In spite of our obvious ties to land grant, there are some important differences between the two concepts. Agricultural information has taken almost a century to evolve. The development has been steady, evolving slowly and serving a prime target audience that has been steadily decreasing in number. In the U.S. today, agriculture feeds 200 million Americans plus another 160 million around the world, yet it employs less than 5 percent of the population. And the percentage is still shrinking. This is a tribute to the success of land grant

developments.

Marine resources information systems, like Sea Grant, cannot identify a target audience as readily. Sea Grant is not solely concerned with food production.

Another difference between the two is that of a rapidly developing technology. The three innovative stages -- discovery, application, and impact -- no longer require 50 years to complete. Before 1920, the average time span between application and peak production of household appliances was 34 years. By 1959, the lag had shrunk to only 8 years.

Publications and other information mechanisms for dissemination of the results of the technological engine must be prepared to perform in this compressed time cycle.

It is fairly evident, also, that Sea Grant must deal with greater concentrations of people. Forty-five percent of the nation's population lives and works in the Sea Grant laboratory, the coastal zone. The thrust, then, is urban rather than rural.

Educationally the Sea Grant audience of today is vastly different from the initial land grant audience. For one thing, Americans have received more formal education in public schools. More importantly, they have been exposed to a dramatic change in information "inputs." The ordinary citizen of the present industrial society is flooded with a maze of messages, carefully edited to achieve the greatest impact.

Those who read newspapers spend 52 minutes a day at this task. In addition, the ordinary citizen is surrounded by other printed messages. He takes in between 10,000 and 20,000 words per day. He hears -- through radio and television -- another 20,000 to 25,000 words.

If he is a scientist or engineer, he also is exposed to a rising volume of scientific journals and articles. More than 100,000 reports and 450,000 articles and papers are generated from the U.S. government alone. Worldwide, the science and technology literature amounts to 60 million pages annually and the volume is doubling every 15 years.

All this constitutes a constantly rising pressure of engineered messages bombarding today's man. And into this sea of information we have launched a tiny tub called Sea Grant.

The foregoing statistics should provide some stimulus for the thinking writer/editor. With four years of effort to reflect upon, Sea Grant must slow down long enough to ask some important questions.

(1) Where are we going in our publications/information effort?

(2) What are the most effective means of reaching a specific audience?
(3) What types of published material are needed?
(4) Are we flexible enough to bend easily with technological changes and with public demands?
(5) Are we addressing ourselves to the real needs of the information user?
(6) How do we know whether or not we are successful?

When we begin to ask these questions, there are no easy answers.

As a scientific discipline, the study of information needs and uses is largely a semi-enlightened trial and error procedure. The predictive value of communications theory is still very poor. The understanding of information uses involves a mixed clustering of several areas of behavioral science; it is not a coherent research area. Information needs vary with time, user, purpose, location, and alternatives.

Publications: Purposes and Processes

Because it is the one I know best, the Texas A&M University Marine Resource Information operation will be used to illustrate some of these points.

First, let me define "evaluation." Since Sea Grant publications are generally educational in nature and their evaluation is tied to behavioral science, the definition comes from the Dictionary of Education: "Evaluation . . . the process of ascertaining or judging the value or amount of something by careful appraisal."

In order to determine the value of a publication, one must revert to the reason why the publication came about, and then apply some yardstick to see how well the publication meets the purpose.

For example, Sea Grant 70's was developed with the specific purpose of documenting all Sea Grant publications. It has been, in fact, an accession list for Sea Grant reports. The story line which accompanied this bibliographic listing was designed as a modified abstracting technique. The result was a running narrative on Sea Grant publications. To those who expected a newsletter on current Sea Grant events, it was not successful. To those who wanted tangible evidence of Sea Grant accomplishments in the form of published works, it was a success. The measurement, then, must be tied to the purpose.

Five categories of publications and purposes for each have been developed at Texas A&M. Some elementary evaluative devices are also underway.

(1) Public Information. Though really not publications, news releases and magazine articles are important and fairly inexpensive ways of reaching the public. They are part of the image-building for the program. Characterized by use of a wide variety of news media, the purpose of public information is to create an awareness of a new development, to present newsworthy information.

One measure is easy to apply in this category. How many newspapers or TV stations carried the message? Clipping services should be used occasionally to get a true measure. Most charge 10 cents a clipping and will monitor a variety of print media.

With the news media, too, another evaluative device comes into play. The judgement of the newspaper editor or TV station. When you put your information in the same marketplace as the Viet Nam war, campus riots, and international affairs, it must be able to hold its own.

At a Sea Grant workshop with Texas news media representatives we were reminded not to jeopardize our credibility with media by overexposure. Don't flood the media with trival news.

Some general criteria for public information, especially as it applies to magazine coverage, include:

I. Content
   Informative value -- timeliness, newsworthiness, subject matter.

II. Style
   Readability -- grammar, sentence length, organization.

III. Approach
   Treatment --- interpretative, explanation of technical phrases.
   Photographs -- good quality, strengthen story.
   Appearance -- neat, well-spaced source identification, clearly reproduced.

I personally believe that Sea Grant should make a concentrated effort to use the existing media to its fullest. The audience has already been identified, the distribution system is handled by someone else, and the costs are greatly reduced. An important drawback, however, is that the feedback system is hampered.

(2) General Information. Publications are designed to create program awareness and explain a position or problem. The audience is still the general public with emphasis on lay leaders. In our system, the purposes of general publications are fairly vague, making it more difficult to evaluate them. How do you know when you have "created an awareness" of a program or a position? One way is to set up a good feedback system. Make wide use of these publications at meetings and

workshops and thereby create the right atmosphere for feedback. Provide sample materials to groups who may be able to use this material in their own meetings and programs. Responses from readers or users also can be solicited in survey or questionaire form. As a measurement device, surveys can show how the publication was used but cannot, of course, show cause and effect.

Reader response is a measurement device. A recent article in our newsletter, University and the Sea, on sludge disposal through bioengineering techniques has caused a torrent of letters -- almost 100 -- requesting additional information. Since January, 2,600 persons have written, asking to receive information and to be placed on our distribution lists.

The American Association of Agricultural College Editors holds an annual contest for land grand agricultural publications. Some of the criteria used by the judges, who are themselves usually agricultural editors, include the following, rated on a 5-point scale:

I. General appearance and function of publication
   - Appeal or Impact (appeal to specific audience)
   - Title suitability
   - Function (fulfill purpose)
   - Originality
   - Quality
   - Relationship of Production Elements (how well does it go together)

II. Design
   - Size
   - Layout
   - Color or White Space
   - Cover
   - Continuity (organization)
   - Use of illustrations
   - Design by typographic elements

III. Copy Elements
   - Headlines (tell the story)
   - Writing/Editing (clear and interesting)
   - Audience-oriented
   - Effective message

IV. Production
   - Typography (sharp, clear)
   - Printing (uniform, sharp)
   - Binding (trim and fold)

In addition, judges are asked to comment on the publication. In "county fair" fashion, publications are then awarded red, blue or white ribbons. Although this is a judgement by a peer group, it at least directs itself to some of the elements necessary for a good publication.

(3) Technical-Scientific reports provide a method for disseminating highly discipline-oriented research results.

They provide more rapid and more detailed reporting than journal articles. The distribution is limited generally to others with a professional expertise in the same or similar area. This is the publications category generally attributed to the agricultural experiment station aspect of land grant. For Sea Grant it is the classification which is often left to fall through the slats. Actually, technical reports may be the most important element we have going for us, for they provide the basis for what could become advisory bulletins addressed to specific user groups. Because of this possibility, technical reports should not be overlooked in Sea Grant information systems, nor should they be left completely to the principal investigator.

Generally, the project leader will write a report, produce enough copies of it to satisfy his grant requirement, keep three or four on his shelf, and forget about the rest of the world. To overcome this problem, at Texas A&M we have established a fairly elaborate technical report system that is designed to take the load off the project person and place it in the Department of Marine Resources Information.

Project leaders are instructed to contact the department when they have technical reports ready for press. Department personnel read the document, edit it where necessary, see that it is printed in a quantity sufficient to meet the needs we foresee, and handle the distribution. Recently we have also set up an informal review panel of project leaders who have agreed to act as reviewers for some technical reports.

With technical reports running as long as 100 to 200 pages, this process can get expensive and time consuming. As the mandatory distribution list from national Sea Grant expands, technical reports can quickly eat up the publications budget. For the first year of the marine resources information program, we strictly abided by the national Sea Grant program rules and everybody on the list got a technical report -- whether they wanted it or not. We have since begun a new system, however, and we think it will reduce the number of technical reports that are simply shelved or filed in the round file.

Aside from five copies to national Sea Grant and 50 copies to NOAA for use by the National Technical Information Service, we now send out abstracts for every technical report. These are color coded. Those who receive free copies get a green a abstract and those who will be charged $3.00 get a purple abstract. Sale of publications is at least one measure of effectiveness.

It's still early to say precisely how the system is working but we feel like we have begun to identify specific audiences for technical reports. Already we have sold 60 technical reports. As the system progresses, we will continue to build up our distribution list of those who will receive abstracts.

Since technical reports are generally directed to scientists and engineers, we did some searching for information about what types of publications these users need. Briefly, here are the results of some recent research:

-- All make heavy use of personal collections and files.
-- Teachers make more use of abstracts.
-- Researchers make heavier use of announcements of new publications and they also indicate a strong desire for annotations and abstracts in bibliographic listings.
-- Scientists also show a heavy use of periodicals with a strong interest in faster receipt of new publications.
-- All make less use of library catalogs and reference librarians than any other available source.
-- Informal communications channels still remain the most readily used. The importance of these channels was brought out in the report by the Committee on Scientific and Technical Information (SATCOM) of the National Academy of Sciences and the National Academy of Engineering. A recommendation for national policy from that report deals with encouraging research sponsors to provide adequate opportunity for informal communications at meetings and through reasonable travel policies.

(4) Advisory Bulletins furnish information written in easily understood language and are designed to transfer technical or scientific information to a specifically identified user audience. These types of publications are the backbone of the advisory element of Sea Grant. The identification of a specific audience is the work of the advisory service personnel. The content of the bulletin is based upon the observations made by advisory service people and the feedback as to its usefulness generally comes from these specialists.

In advisory bulletins, one of the most critical decisions is audience identification. If a specialist, for example, is assigned to assist the fishing industry he must know a great deal about this group and he must have some notion of where the industry is headed in the years to come. On the Gulf coast, the trend is toward fishing companies and corporations as shrimp fleet owners. Is the audience to be reached the actual man on the boat or the manager of the company who will make the decisions? The information contained in the advisory bulletin depends upon the answer to this question. The input to a corporation executive will be considerably different from one to an individual fisherman.

Feedback from the user provides valuable insight into the effectiveness of advisory bulletins. Make sure these channels remain open. I have some serious reservations about the arbitrary placement of advisory bulletins in county agent offices. It seems to me that this is a dead end street so far as follow-up is concerned.

The same criteria for style and format that were outlined in general publications also apply here.

(5) Educational materials are generally publications to be used in classroom presentations ranging from technical schools to university level. Syllabi, class notes and outlines are developed to assist in the creation of new courses and curricula. At Texas A&M these are usually interim publications for use before final presentation to an outside publisher. The audiences are the teachers and instructors who use the material in the classroom. Feedback from students helps to revise this first draft approach before final printing.

Like technical reports, the evaluation for this type of publication before printing is internal through peer proup review. Limited quantities are produced and the cost of production is generally part of the project grant. The Department of Marine Resources Information is involved simply to help the project leader and to keep track of what's going on in the educational program. In some instances, such as the material developed for a recent short course in acoustics, an outside demand for the publication can be identified in advance. In these cases, educational materials are handled like technical reports.

Conclusion

One of the real difficulties in evaluating publications is that they constitute only one element in a communications system. Publications are tools in the Sea Grant program, representing one way to transmit information. In a sense they are service products for the three Sea Grant areas -- education, research, and advisory services. The degree of success attributed to publications can be assessed only when the whole system is considered.

Some evaluative devices are available to Sea Grantees which do not involve complicated and costly surveys. Some of these have been presented here:

(1) Audience identification
(2) Use of information by mass media
(3) Responses from readers
(4) Quality control of publications
(5) Sale of publications
(6) Identification of user needs through surveys, personal contact
(7) Internal review systems
(8) Requests for additional information

Evaluation of the whole information transfer system involves a complex interaction of many variables. At this stage of the art, assessment is little more than educated guess.

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Identifying User Needs

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There will never be enough money for us to be all things to all people, even if that foolish desire was our goal. Yet to provide the thrust which Sea Grant fathers envisioned and many of us espoused--we had better find ways to be useful to the broad spectrum of marine resource users.

Although each of us from a university or agency is confronted with industry users needs, the identification of real problems can cause many headaches and much stumbling in the dark. Further, after identification, selection of those projects which: 1) we are capable of doing something about, considering backup resources; 2) we have reasonable chances of accomplishing, given time and staff; 3) contain a mix of high and low profile emissions--to keep funds alive and clients happy; and 4) relate to a set of long-range goals, can cause all of us to lie awake at night and sweat during the day.

Marine Advisory Program goals at Oregon State University are designed to contribute to increased employment opportunities in marine-related industries, to encourage more complete and efficient use of marine resources, and to improving public understanding of the ocean's potential and limitatiions. Intertwined with this is the hope to develop human resources of "sea people" thereby contributing talent to the pool of community leadership.

Thus, as we set about "stalking our prey" it is necessary for us to have a plan--to act instead of react. Universities, save the few with a true service interest, are somewhat cautious about permitting the uncleansed public to sully "our" disciplines--or interfere with favorite research topics. The indentification of industry needs, therefore, can be both an internal and external project for the aspiring marine advisory program. Compounding the situation, there is not true ocean "constituency" such as that enjoyed by identity of labor, farm, and environmentalist blocs. We have a unique opportunity to help build an American ocean constituency through development of a cooperative, symbolic partnership with mariners. In so doing, we might help to solve a few "needs."

Let's turn a bright, young marine extension agent loose in a seaport town. He may have a bag full of goodies to sell, but where are the buyers? If we accept the music hall song which goes "you've got to know the territory" how does he learn the territory? There may be many steps involved and easier ways of doing it, but I look upon it this way:

A) Systematize. Study all the demographic and geographic data you can find. Learn what makes the segments of your marine industry tick.

B) Infiltrate. Let them teach you. Get to be an "insider" with the groups you hope to help. This may require a change of dress, speech, and habits--either up or down. Make the group's interest your interest. Continue this until you have acceptance and trust. Endurance is required. You may never make it.

C) Identify the leaders. Leaders in name may not be leaders in fact. Who are the "movers and shakers" or the "power shakers?" Who is the true majority?

D) Request THEIR help--to design research and training programs of the university or the agency that you represent.

E) During steps A through D, the priority needs of the industry segment should begin to surface. An advisory committee could have been formed in stages C and D, perhaps not formally. At this point you may consider development of and/or identification of permanent standing committees and some of the ad hoc committees which will be needed. At this step also it may be safe to ask your clients what problems they have. Probably you have already found out.

F) Isolate the need. Define with industry how to solve it through the use of either formal or informal committees.

G) You may never obtain full concensus, so after this series of steps charge ahead. Don't be surprised if the needs turn out to be social rather than technical.

The programs for identifying marine industry-user needs elaborated above pinpoints a number of my biases. These include:

1) A need to enlist for the long haul in this education-for-action program. Most identified needs will not be solved overnight. Preparing the recipient to confide his need to us takes time.

2) Recognize that our clients (students, audience) have needs (problems), but universities have departments.

3) Our marine advisory staff must be committed to informal education. This is a difficult role for most. It implies working with people where they are (technically and socially). It is not very convenient at times--the 8 to 5 grind is not enough. It requires close contact with clients.

4) At the university level, the extension educator must continually rebuild its credentials to be accepted by his research counterpart. He must maintain a close association with research people and provide inputs to research through such avenues as identification of research projects.

5) Evaluation of marine advisory program efforts takes place in several areas. An important evaluator is the "gut feeling" about what happened in a particular project of event. Although we have to justify programs to renew funding, untimately the only evaluation that counts is from within the marine communities. Did the marine advisory program make a difference?

There are simpler more direct methods of identifying marine-resource users needs. For example, when a series of wild Oregon winter storms eroded a luxury housing beach spit area it was an easy task to gather 125 homeowners from all over the United States to discuss what would be done to alleviate the problem. When the Russian fleet, more than 100 ships strong, turned up off the Oregon coast in 1966, it was not difficult to gather a group of fishermen to talk about the Russian problem. Focal points like these provide opportunities to convene a conference or workshop. Thus, another keystone in identification is timing. Patience is also a virtue. It's difficult to sell fallout shelters until a bomb is imminent. Remember,however, that interest is often clouded by emotion instead of fact, and a long-term educational project may suffer from the emotion. At times both short- and long-term methods of planning and identification of need can be combined. This fall the Pacific Sea Grant Advisory Program hopes to combine some elements of both methods in determining regional needs.

Media can play a fruitful role in developing awareness, creating interest, and sometimes obtaining polarization. Once again care must be used to interpret this as an educational program. At times, even the best media program may have a "gee whiz" effect, but not an educational impact. The various visual and printed methods are essential tools

toward an educational end rather than an end in themselves.

We all recognize that there are pitfalls involved in attempting to identify client needs. These pitfalls may extend back to staffing patterns for our extension personnel. Bob Abel (Director, National Sea Grant Program) remarked recently, "Advisory education must be an art, not a science." Extension educators are first and foremost practicing sociologists. Although we talk about natural resources and technical problems, we are actually dealing with human resources and human problems. We use a technical matrix around which to construct the social action model. What we are really attempting to do is change--change the industry and change the people within the industry. If change is undesirable, in my opinion the extension education program is not needed."

In summary, identification of user-industry needs is a vital step in development of a useful marine advisory program. The marine extension effort currently underway in the United States is an idea whose time has come, but how difficult it seems to get going. The extension problem, simply stated, is how to get people and knowledge together. This problem requires far more than putting out bits and pieces of information to legitimize what has already happened. It is more difficult than captive classroom teaching. It requires working on many educational levels with a broad group of interest among our clients. Perhaps most importantly, it requires the best staff educators we can find, train, and develop.

Identification of industry users needs, when done correctly, is a slow process and a continuous process. There are no real shortcuts to take the place of a commitment to the long haul of informal education for a wide variety of marine industry and public interest needs.

Our Marine Extension Commitment

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National Oceanic and Atmospheric Association

We in the National Marine Fisheries Service recognize that it is absolutely essential that the NMFS and the Sea Grant Program demonstrate through expanded cooperation "action" programs, a united and coordinated effort in the planning, implementation, conduct and evaluation of user oriented programs. Before we can have meaningful cooperation, all must realize that each agency or cooperator has complimentary capabilities and resources. These capabilities and resources must be identified and somehow meshed together in "action" programs if we are to have an effective oceanic education and technology transfer effort in this country. It is essential, therefore, that those of us in NMFS understand and recognize what Sea Grant is doing.

Development and expansion of grassroots education and technology of transfer programs for marine resource users must also include a cooperative effort between other government and state agencies, universities, industry trade associations and professional societies. In Challenge of the Seven Seas (William Morrow and Company, Inc.), Claiborne Pell and Harold Goodwin eluded to this in quoting the Science and Technology Committee of the National Citizen's Commission on International Cooperation. In their report issued at the end of the International Cooperation Year, the Commission pointed out that: ". . . the application of technology does not take place automatically or easily but is an extraordinary complex and difficult process. Moreover, in many cases political and social progress must take place before the introduction of new technology is feasible. A concerted cooperative attack on the over-all-problem, therefore, is required."

Expanded, coordinated grassroots programs for marine resource users is a major key to insuring innovation and improving the economic stability while preserving the integrity of the marine environment.

Obviously, there is already a great deal of understanding and togetherness on the part of the NMFS and Sea Grant. Clearly, we will have immense opportunities for expanding

and cooperation between us. During the splendid workshop on Marine Extension Methodology held recently at Oregon State University, I pointed out that our agency has long recognized its responsibilities to be a more effective partner and cooperator in fisheries extension work, but have simply not been able to, in all cases, respond to the needs and opportunities in the conduct of our extension activities.

Be that as it may, the facts are that we routinely perform--and have been routinely performing for many years--numerous valuable extension activities in each of our regions. Our work includes demonstrations, workshops, and on-site visits regarding fishing gear, marketing, processing and packaging fishery products and on-and-off-vessel sanitation; forecasting intelligence on the location of fish stocks and even the funding of extension activities through Federal Aid (P.L. 88-309). Conservatively, we are annually spending over 2 million dollars on identified extension activities at the present time.

Perhaps our most successful extension activities have been performed by professionals in our marketing program and in our food and fishing gear technology programs. NMFS marketing staff has pioneered in fishery related educational activities with wholesale and retail food personnel, food editors, mass feeders and others. Their efforts have provided a better understanding of the merchandising and utilization of sea food and its importance in our daily diets. Our food technologists, while being primarily research oriented, have contributed greatly to the improvement of fish processing methods, in packaging and storing fish products and in developing new and safe products from the sea. Our fishing gear researchers have worked closely with leading commercial fishermen to put the latest fishing gear technological developments into practical use.

Other examples of the NMFS's involvemnnt in fisheries extension programs include our Albacore Advisory Program in cooperation with Oregon State University's Sea Grant Albacore Central Program; P.L. 88-309 funding of fisheries extension programs such as those in Maryland, Florida, Massachusetts and Maine; and informational and educational services provided by our Statistics and Market News Staffs. There are many other examples. Many of our accomplishments were achieved through the personal commitment and concern of certain of our staff. They simply saw a problem and did what they could to solve it. I appreciate this ad hoc work more and more as I become more knowledgeable about the NMFS's programs and activities in our five regions.

In many respects, our historic modis operandi could be compared to a "picket fence." We have a multitude of programs oriented to users groups with a few "connecting slats" (coordinating mechanisms) between the pickets (programs). The Advisory Commission on Intergovernmental Relations calls this a "vertical functional autocracy" (Tenth Annual Report, Jan. 1969). Former Governor of North Carolona, Terry Stanford, was speaking of this when we wrote: "The lines of authority, the concerns and interest, the flow of money, and the direction of programs run straight down like a number of pickets stuck into the ground. There is, as in a picket fence, a connecting cross slat but that does little to support anything. In this metaphor it stands for the Government. It holds the pickets in line; it does not bring them together. The picket--like programs-- are not connected at the bottom" (Storm Over the States, McGraw-Hill Book Co., 1967 p. 80).

We in the NMFS are excited about the opportunities to build and expand "connecting slats" with Sea Grant programs through the expansion of coordinating communication mechanisms.

In October 1970, a number of historic events took place, not the least of which was the establishment of the NMFS Extension Division. This served to formalize and expand the NMFS Extension program. New emphasis and direction provided under NMFS, together with enthusiastic interest, concern and support from many sectors, has made clear that extension has a crucial role to play in meeting NOAA commitments to living marine resource users. The new role of extensions in NMFS is currently being finalized and we are in the process of implementing a 10 Step Action Plan.

By way of definition, extension, within the NMFS, is an inter-disciplinary activity that uses an informal problem oriented educational and informational process. This involves the interpretation and dissemination of practical use of marine research results and available resources to fisheries related users. It is the communicative link between the researcher and the user that converts problems to opportunities in a manner most responsive to "real life" situations.

The mission of the Extension Division complements the mission of the NMFS and NOAA. Specifically, it is to implement and insure an effective, expedient and cooperative system for providing NOAA and NMFS information, technology and expertise on living marine resources to commercial, recreational, educational and esthetic user groups in a manner most responsive to their needs. In accomplishing this mission, we will be guided by the following objectives:

1. Expedite the identification and solution of user problems.

2. Encourage more effective use of living marine resources.

3. Promote a greater understanding of living marine resources and their environment.

4. Minimize user conflicts through an awareness of technical and scientific knowledge.

5. Expand opportunities for marine resources users.

6. Enhance the innovation and increase economic stability of the fishing industry.

The NMFS extension program is following a ten step program for FY 72 and early 1973.

Step 1: Completion of a Program Development Plan

NMFS Extension officials are developing a comprehensive program development plan that will serve as a "road map" to outline "where we are," "where we want to go," "how we're going to get there" and "how we will evaluate our efforts."

Step 2: Memoranda of Understanding

We can no longer afford to operate as a "vertical functional autocracy." We feel that both formal and informal working relationships with certain Federal and State agencies are essential. We view this as crucial to the negotiation of "Memoranda of Understanding" with such groups as the USDA Extension Service (and possibly State Cooperative Extension Services), the Office of Business Services in the Department of Commerce and the Office of Sea Grant. We recognize that many splendid examples of cooperative programs and relationships already exist between these agencies and the NMFS. It is our responsibility to build upon these splendid relationships and to expand them to the point that the great work presently underway in some places becomes common practice throughout the country. We are initially working with the Office of Sea Grant in order to insure a coordinated program for marine extension/advisory programs within NOAA.

Internally, we will be striving to develop appropriate coordinating mechanisms between the Extension Division and other program divisions within the NMFS. This is necessary so that we may achieve the maximum program efficiency and prevent duplication of effort within the NMFS.

We have the greatest accumulation of marine fisheries related talent and expertise in the world. You and others associated with state agency-and/or university-based extension programs must have more widespread access to this great reservoir of expertise and the knowledge and new technology they develop and/or posses. For us to effectively do this, we need your suggestions and comments.

Step 3: Regional Staffing

We are moving to organize within each of our regions a modest extension staff. They will develop working relationships and communication channels with fisheries and/or marine extension workers and leaders. They will also be working to organize and expand on-going extension programs within NMFS and will provide a more organized appraoch to obtain "feedback" from universities, state agencies, industry and other groups within their region. The Regional Extension staff will be an arm of the NMFS Regional Director but will be required to work closely with the Washington Office on matters of program planning and implementation so as to assure a well coordinated program throughout the nation.

Our regional extention staff will start small and will be expanded as needs and opportunities dictate. We have no desire or intention of providing "on the dock" and "in the processing plant" services to the users, except in special situations. We feel that, in most cases, this is the responsibility of the states and universities, particularly Sea Grant institutions. Where such services are presently lacking we will not hesitiate to continue, and funds permitting, expand our efforts to provide needed extension services. It is quite clear to us that the job to be done is so extensive and so complex that no one agency, group, university or state can do the job alone. We must pool our resources and talents to the maximum extent possible.

Step 4: Fisheries Extension Publications

Historically, the NMFS has maintained a fairly steady flow of scientific and technical documents, reports and publications relative to fishery matters. In recent years, we have also published a number of attractive booklets on fish cookery. Informal, easy-to-understand publications are important tools for extention publications that will assure an organized means for the dissemination, in published form, of NMFS and NOAA research in a non-scientific and less technical fashion.

The Extension Division will provide a focal point with-

in NMFS for the preparation of extension publications and will closely coordinate its efforts with other programs divisions of NMFS and appropriate offices elsewhere. We see many opportunities for the joint preparation of fishery related Sea Grant materials and publications. We are impressed, for example, with what the Pacific Sea Grant Advisory Program (PASGAP) is doing relative to publication of bulletins and other materials that have multi-state application. The northwest states Cooperative Extention Services has demonstrated that this can work efficiently on agricultural subjects. PASGAP is proving that it can work equally as well with fisheries and marine-related subjects. The New England Marine Resources Information Program and the Coastal Plains Regional Commission provide other example of multi-state cooperation. We certainly want to be a part of such cooperative efforts wherever they exist and to work with you to develop such efforts where they are now lacking.

Step 5: Inventory of Resources and Expertise

As most marine extension workers have a very limited knowledge and understanding of what is available to them from the NMFS, we will be developing a "Yellow Pages" on a regional and national basis to identify "who's doing what," and "where they are doing it." We feel that "Yellow Pages" are essential if Sea Grant advisory workers and others are to have any idea of what the NMFS has to offer and how to take advantage of it. We hope this will provide a concise breakdown of our capabilities and that it will expedite use of these resources by state-and locally-based extension workers.

Step 6: Inventory of User Groups

A detailed inventory of user groups must be compiled so that we can plan and implement, cooperatively, fishery extension programs for specific user groups, there will be great difficulty in working, in an organized fashion, with users to identify problems and needs and to develop responsive educational programs.

Step 7: National and International Fisheries Extension Directory

It is essential that we in the NMFS and NOAA have knowledge of on-going extension work in the area of living marine resources. Without this knowledge, we cannot fulfill our responsibility to provide backup and support to state and locally-based extension programs. Thus, we are developing a national and international directory of fishery related extension workers.

Step 8: Business Management Systems

Several programs are presently in existence that provide electronic recordkeeping systems for certain business operations in this country. We are exploring some of these systems with the idea of establishing a cooperative program whereby fishermen and small fishing related businesses might have access to these systems. It is our feeling that fishermen and fishing businesses can benefit from electronic recordkeeping just as much as any other segment of the society. Certainly, fishermen have a need for improved recordkeeping systems so they can keep a better check on their business, make better management decisions and more easily report social security and income taxes.

We are presently exploring the feasibility of a pilot program that would be linked with the Electronic Farm Account Program (ELFAC) currently operational in the Northeastern states and the eastern provinces of Canada. ELFAC is a non-profit educational organization, organized May 25, 1964, under the District of Columbia non-profit cooperative statute. It is cooperative effort involving the northeastern state Cooperative Extension Services. If we are successful in tying into this system, it will be a concrete demonstration of what we hope to accomplish in linking with existing programs operated by the states. Certainly, this will lead to improved capability and proficiency through greater practical use of technology in the day-to-day operations of the fish business.

Step 9: Operations Manual

Obviously, some sort of general program notebook or manual will be necessary as a refernce document. Therefore,we plan to develop an operating manual or notebook for use by our regional extension staff and others, as appropriate. Such a notebook would include copies of documents, information memoranda concerning program planning, implementation evaluation and other such material.

Step 10: Educational and Informational Meetings

Many citizens who obtain their livelihood and recreation from the sea are not aware of what government is doing to help them or of the latest technology available to them. We are, therefore, considering a series of educational and informational meetings in each NMFS region. The purpose of these meetings would be to: 1) provide an opportunity for NMFS regional personnel to get aquainted with local users groups and extension workers; 2) explain NMFS projects and programs so as to expedite and enhance the practical use of existing technology; and 3) deter-

mine specific subjects and problem areas that might be covered in future meetings, seminars or workshops. One of the immediate subjects upon which we hope to focus attention is marine game fish programs.

I wish to make clear that it is not our intention to set up a multitude of educational meetings involving user groups . . . on our own. In doing this, we hope that you will assume a leadership role and that you will actually be the ones setting up such meetings, arranging for publicity, meeting places, etc.. We simply want to be co-sponsor or cooperate with you and others so that together we can somehow simplify the highly complex matter of technological transfer. At the same time we can together contribute to the destruction of what Terry Stanford described as "vertical, functional autocracy."

In traveling the road ahead, we must work as partners, for sea problems can only be solved through united effort. Extension education must be a keystone from which we embark to solve these problems. We cannot satisfactorly attack them from only an engineering or transportation point of view. Like the ecological food chain, sea problems are usually highly complex. They are woven together like yarn in a knitted sweater. What we do in fisheries has bearing on important matters of state; what we do in the area of sea transportation affects national security and economic growth.

It is on this premise that oceanic education and technology transfer programs must be expanded and intensified at the grassroots level. We in the NMFS want to work with you, for by working more closely with you, we can apply the progressive and innovative work originating today in extension to the marine area. We want to make this marine extension business the greatest! Our effectiveness in doing this will not be the outgrowth of a few men of genius but the collective worth of all our efforts. This is our commitment!

Norway's Fishery Advisory Program

John P. Doyle
University of Alaska

The Norwegian people have a long and proud tradition of utilization and development of the sea's natural resources. All people have benefited from their exploration and far-sighted approach to the maritime challenge. The names of famous explorers such as Fridtjof Nansen and Roald Amundssen are known to all who hold an attachment to the sea. No less highly respected by their countrymen are the thousands of unknown people who struggle for a living from the sea. These are the fishermen and the mariners.

Off the coast of Norway is a continuous belt of fishing banks providing a wide variety of fish. About 6% of Norway's male working population are employed in the fishing industry. In 1970 there were 50,000 fishermen operating 36,000 boats. The high number of privately owned and operated vessels is quite similar to the Pacific Northwest of America. The harvest is 1970 was 2.7 million metric tons of fish--more than double the harvest of 1960. Norway ranks fifth in the world fisheries production, having replaced the United States in that position in 1968.

This increase was due, in large part, to the increase in landing of caplin and mackerel; for example, caplin harvest increased from .13 million metric tons in 1960 to 1.3 million tons in 1970. This increase was due to technological breakthroughs in harvesting, processing, and marketing. The development required close cooperation between government and private research and development, and a highly integrated industry structure. Let us look at a part of that structure which played a major role in the development of Norway's fishery and the formulation of the Norwegian Fisheries Advisory Program.

Norges Fiskarlag

The *Norges Fiskarlag*, formed in 1926, is the nationwide association of fishermen and fishing vessel owners. It is made up of 950 local societies and 13 regional societies. There is a regional society centered in each of the 13 coastal *fylker*. (A *fylke*, most often translated county, is the

second major political subdivision in Norway. It may be equivalent to a province, prefecture, or state under the U.S. term of reference.) Under the control of *Norges Fiskarlag* are 15 marketing cooperatives. Each cooperative has the responsibility and is restricted to marketing certain species of fish in a given locale. Examples are the Fresh Fish Society (*Norges Råfisklag*) which handles the first sales of cod and cod-like fishes. Through special legislation the fishermen's cooperatives have obtained a powerful monopoly position regarding first-hand sales. The men who are responsible to the cooperatives must have good knowlege of the fishery, and a good theoretical understanding of economic law in order to provide the development seen in Norway's fisheries.

An important function of *Norges Fiskarlag* has been education of its members in a broad sense. Each county society has a welfare officer who often moves with the fleet providing educational and other services. In many of the fishing communities the association will have a building housing a library, classroom, showers and writing room for the use of itinerant fishermen. Chests of books may be checked out and returned to any of the association libraries. The Welfare officer's function is a dual one. First, he provides direct services to the members and secondly, he provides a close liason between individual fishermen and the association. This continuous interaction is the strength of the *Norges Fiskarlag*.

Fisheries Advisory Program

The major architects of the Norwegian Fisheries Advisory Program have been the fishermen themselves through their association. An act of *Storting* (Parliament) was passed in 1971, providing for an authorizing the organization of the Fisheries Advisory Program throughout Norway. The system was patterned after a program which had been developed in North and South Trøndelag. These two counties have been conducting a joint program for several years.

It is pertinent to ask why a government sponsored program of education was created when the association already had an effective program. There are several reasons. The fishery and technology are becoming more complex. The problem of dissemination of information was becoming larger than the association could handle. There are also many areas of technical need in which the association had little expertise. Since education is a function of the state, rather than tax the resources of the organization it was logical to approach the state to cope with this specialized area of adult education.

The law provided that in every local area where there are fishermen there will be a local board of five or seven people who have a knowledge of the fishery and fishery question. The local branch of *Norges Fiskarlag* designates a majority of the members. The local advisory agent is to be secretary of the board. The board has the function of:

1. Directing the activities of the Advisory Program
2. Identifying problems of fisheries in the area
3. Deciding on loans for fishermen for new boats, gear, ect.
4. Monitoring the amount of fishing effort in the area

All questions concerning fisheries, including research, management, processing needs, etc, of the area must pass the board before being forwarded to the administration, including the activities of the Directorate of Fisheries at the local level.

There shall be established in each county a board of fisheries consisting of five members. The chairman and two members shall be elected from the *Norges Fiskarlag*. The county board shall have the responsibility to take up a wide range of problems in the area of fisheries to promote harmony in the industry. This shall include but not be limited to:

1. Technical problems in harvesting, marketing and processing
2. Social welfare of fishermen
3. Research and management needs

Questions concerning the Directorate of Fisheries put forward by local boards are reviewed by the county board. The county board can direct the Directorate of Fisheries of Norway to investigate specific problems in biology and management.

Under the above system several communities may form a single board and two or more counties may join under a single advisory program, but each county will have its own board. The Advisory Program leader, the Fishery Sheriff, supervises the local or community agents.

The costs of the community program are covered 50% by the federal government, 25% by the county and 25% local. There is little risk to the local community as the bulk of their share will be returned to the locally collected income taxes paid by the advisory agent. The county effort will be funded 50% by the federal government and 50% by the county. The Director of Advisory Programs will be paid by the federal government.

North and South Trøndelag have been conducting fishery advisory work since 1969. This was the first Fisheries Advisory Program in Norway. The staff of six is organized as a team of specialists. Three are located in fishing communities. These included the specialties of a fishing methods and equipment specialist, a fish processing specialist, and a marketing specialist. In the county office at Trondheim are an engineer, a fish processing specialist and an economist. In 1972, three additional fishery advisory agents will be placed in other communities in the counties.

The long-range project is to construct a developmental plan for each cmmmunity. Information is gathered on total population, fishing population, fisheries production, potential increase of ocean harvest, harvesting and processing capacities. At this time a plan for the future development of the community of Frøya has been drawn up with projected expenditures of 18 million kroner (about $2.5 million). There is a high probability this project will be undertaken within the coming year. Short-term projects include the usual extension education program; short courses, directed technical assistance to individuals and processors, etc. The total staff and the advisory committees meet twice every three months to work on local problems and initiate short-term projects.

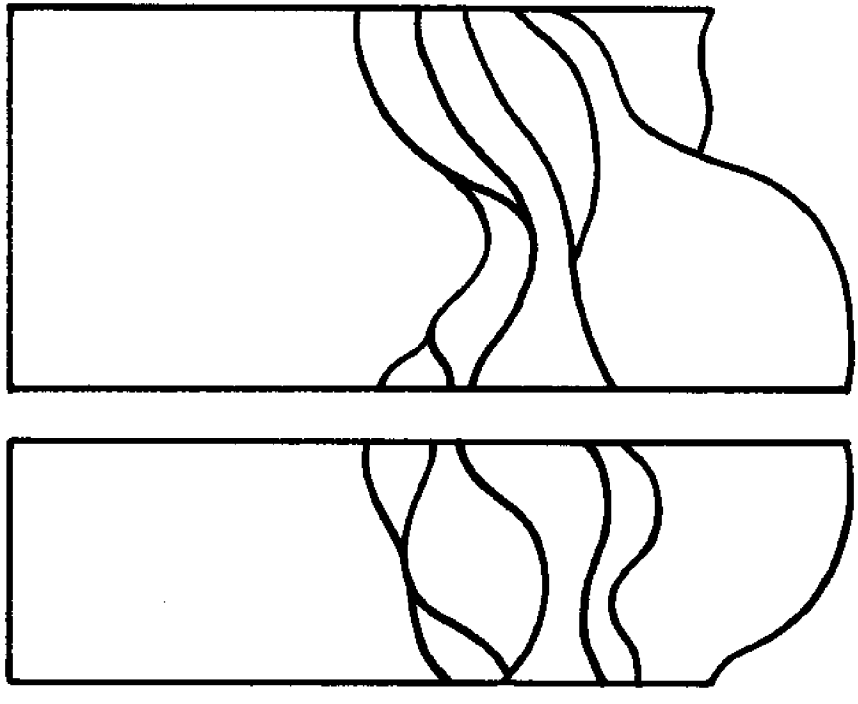
My discussion with industry people, both fishermen and processors, indicated a high degree of enthusiam for the Fisheries Advisory Program.

Conclusions

The Norwegians are without a doubt among the most accomplished fishermen in the world. Based upon their many years of experience, they have evolved a unique advisory program. Their program developed from the ground up, based initially upon *Norges Fiskarlag* welfare officers; primary responsibility is derived directly form the fishermen involved. This is not merely a very democratic system (as opposed to a bureaucratic system), it is a system designed to respond rapidly to the real needs of the users.

I am not suggesting that we should adopt the system outlined; however, it does raise the critical question: Should the advisory program start at the top of the bureaucratic mass and filter down or should it start as close to the user group as possible? I believe we should choose the latter. The program must come from the user group in a form they envision working on the problems they, the user group, identify.

I am indebted to Mr. Anders Tangen, Secretary of *Norges Fiskerlag*, for his translation and summary of the enabling act, and for providing me with the opportunity to observe the fishery and the working of the association. I am likewise indebted to Mr. Kaare Pettersen, Director of the Fisheries Advisory Program for providing me with information on their program.



COASTAL ZONE

Coastal Zone Summary

William Gaither, Session Chairman
University of Delaware

This is the result of the two integrated sessions on coastal zone programs, the first was chaired by W.S. Gaither and the second was chaired by J.M. Goodman, both of Delaware. This is a combined summary and recommendations from both sessions.

Session 1 was devoted to speakers who answered the questions: what steps has your state (or federal government) taken to develop and implement a coastal zone management program; and how can Sea Grant universities help carry out these management programs via research and advisory services?

Session 1 (Tuesday, October 12) panelists were Dr. David Hickok, Alaska; Mr. Harold Bissell, California; Honorable Austin Heller, Delaware; and Professor Marc Hershman, Louisiana. Session 2 (Wednesday, October 13) panelists were Dr. Kent Price, Delaware; Dr. Jack Davidson, Hawaii; Dr. John Armstrong, Michigan; Dr. Sidney Upham, Mississippi; and Dr. William Hargis, Virginia.

Session 2, with the benefit of the output of Session 1, addressed the questions: what is your university's perception of its functional role in supporting your state's coastal zone management needs; can your university carry out this role within the concept of a coastal zone laboratory as envisioned by the Stratton Commission; and, if the answer to this second question is "yes", what is your functional interpretation of a coastal zone laboratory? If your answer to the second question is "no", what must the state or federal government do to make the concept viable?

A summary of the discussion is reflected in the following points:

(1) First, we need to maintain a clear distinction between research and management. The states and federal government have agencies which make management decisions on behalf of the public with respect to marine resources and coastal zone utilization. Universities, through their Sea Grant programs, can conduct research and provide advisory service which is responsive to perceived, or requested, state needs.

(2) A close relationship must exist between university researchers and state decision makers if maximum

benefit is to be derived from Sea Grant programs. The flow of information must be in both directions.

(3) At the present time two problems exist for Sea Grant programs. These are:

a. That State and regional management agencies do not understand what support the Sea Grant program can provide to them, and

b. Sea Grant programs in universities are not fully focused on significant state and regional marine resource problems. This is due in part to the educational objectives of the Sea Grant program, in part to the university structure and reward system which has traditionally fostered narrow disciplinary research programs, and in part to the preconceptions of the Sea Grant Program Office as to the proper role of specific universities in fulfilling their Sea Grant missions.

(4) The functional coastal zone laboratory is now emerging in several forms in several states. To understand how it is emerging it is necessary to recognize that it contains elements of the following three points:

a. First, academic institutions are not able to respond to short term applied research requests except in a very limited sense. (If they did they would sacrifice their value to society as a community of scholars).

b. Second, the Sea Grant program, as now structured, can only adequately serve the coastal zone laboratory function for those problems which match academic program constraints since it typically turns to faculty members to conduct research.

c. Third, the absence of a directable research organization precludes undertaking short term applied research projects.

We must conclude that the Sea Grant program, as now structured, is not sufficiently broad, flexible, or well funded to meet the spectrum of coastal zone research needs of the states. Two possible solutions are: that Sea Grant broaden its scope and gain greater funding, or, that other sources of state or federal funds be made available to accomplish these research needs.

Four recommendations for the Sea Grant Association have emerged:

Recommendation 1 — That the Association establish an ad hoc committee of Sea Grant program directors and state marine resource managers to define clearly how to meet state coastal zone research needs.

Recommendation 2 — That the Association establish an ad hoc committee to review the total experiences of the Land Grant Colleges, and their Association, (not just the

cooperative extensive part) to determine what has worked for agriculture and what has not. In this way we may avoid reinventing several wheels and thus develop more efficiently at all levels of Sea Grant activity.

Recommendation 3 The Association should form an ad hoc committee to explore what activities in state Sea Grant programs could benefit from national or regional coordination and program planning. This would include:

a. The planning and execution of certain parts of their Sea Grant Program as part of a national effort.
b. The planning and execution of certain parts of their Sea Grant Program as part of a regional effort.

Recommendation 4 The Association should form an ad hoc committee to increase the Sea Grant Programs effectivenss and voice in public affairs. Specific activities would include:

a. Commenting on coastal zone legislation and Sea Grant appropriations in Congress.
b. Developing methods, and putting these methods into practive, whereby the public will become increasingly aware and appreciative of what Sea Grant is doing for the nation.

Finally, I want to particularly thank all of our panelists in both sessions as well as participants from the audience. I learned a lot here and I trust that you did too.

Challenges in the Alaska Coastal Zone

David M. Hickok
University of Alaska

Paglan pagga siku sinaa aasii nuna Inupiat. (Greetings from the icy coast and land of the Eskimo people.) I have greeted you in Inupiat Eskimo in order to emphasize to you a little known fact of coastal zone management that is particularly Alaskan -- but the implications of which are national and international.

You are generally familiar with the comparative statistics on the size of the Alaska general coastline and continental shelf in comparison with the rest of the nation. (The general coastline of Alaska is 6,640 miles long, representing 54 percent of the total (12,383 miles) general coastline of the United States. The tidal shoreline of Alaska is much longer and is estimated to be 47,300 miles long representing 53 percent of the total (88,633 miles) of tidal shoreline in the United States. The continental shelves adjacent to Alaska -- the Gulf of Alaska, the Bering Sea, and the Chukchi and Beaufort (Arctic) Sea -- total 830,000 square miles or 74 percent of the total (1,120,000 square miles) United States shelf. Less well known is the fact that along about 40% of the Alaskan general coastline English if spoken at all is a second language. Either Yupik or Inupiat Eskimo dialects prevail in local matters. This is important in considering resource, economic and management practices in the northern coastal zones of the United States. With the settlement of the Alaskan Native Land Claims, management of approximately one fifth or 20% of the entire U.S. general coastline will be tremendously influenced by local political dominance and proprietary interest vested in people of a different culture and value system than any of you possess!

To be sure there is rapid economic and social assimilation occurring between the Eskimo and white societies. To be sure, also, both the State of Alaska and the federal government will own and manage perhaps two thirds of this vast northern coastal zone. Nevertheless, private Native citizens, Eskimo communities, and corporations will possess important and often controlling proprietary interests in the north and west of Alaska, and by virtue of these interests will have a great deal to say on just how the coastal resources of the Arctic are to be developed and managed. To me this is good. This is challenging. It puts in our backyard a responsibility for government, industry and academia to recognize the values of a different culture -- yet one which is equal under the same laws as ours

and which is also economically and politically strong.

I will return to the coastal zone challenge of Native occupation in a moment, but first let me speak more broadly on state attitudes and problems because such understanding is essential to the formulation of coastal zone policy in the north.

Alaska today is the scene of great conflicts over the future of its coastal environment and quality of its inhabitants' lives.

The trans-Alaskan pipeline, the Cannikan nuclear test shot, pending marine mammal legislation, the territorial sea controversy, and the U.S. Champion Plywood timber lease sale have turned the state into America's testing ground for environmental and jurisdictional law. The impending Native land claims settlement and prospective state fiscal self-sufficiency from arctic oil royalties is altering Alaskan's attitudes and expectations about themselves, their fellow Alaskans white or Native, and the state.

At the same time the coast itself is in a period of transition. Legal change through new notions of local borough government, coastal zone planning and management is occurring in order to regulate the effect of both environmental impact and social transformation. Established regimes of international law which could profoundly influence the development of the state's fisheries, petroleum resources, and continental shelf are being reviewed.

These developments argue strongly in favor of stock taking, particularly since both the quality and effect of such change is still uncertain.

The fact is that too much of this law and public policy remains unresolved. Native claims are unsettled. All the great environmental test cases are in process. Coastal zone and/or land planning legislation proceeds slowly through Congress. The Public Land Law Review Commission's report has yet to be implemented for Alaska. And the "Law of the Sea" awaits a 1973 Geneva Conference for recodification.

In addition, knowledge of the Alaska coastal zone in every respect is sparse and frequently scientifically uncoordinated. Our understanding of environmental tolerances is also far from complete.

The public generally, and interest groups particularly, the state and federal government, industry, and overall community as well as Native leaders are extremely cognizant of these limitations in understanding. But whether they are prepared to remedy them is quite another story.

The problem lies in the pipeline controversy and the resonance it strikes with many Alaskans. (The following observations about Alaskan reactions to the pipeline controversy apply as well to the reactions of many Southeastern Alaskans to the effort to set aside the Champion Plywood timber lease sale. Southeasterners must come to grips with that litigation and the pipeline.) To understand their response is to recognize that for Alaskans the pipeline issue is more than the traditional development versus environmental confrontation. Rather it stands as a watershed point in the current generation of Alaskans' grasp of the state's social history.

Perhaps unique among their counterparts in other states, this present Alaskan leadership community (business, labor, political) came to responsibility during territorial and the immediate post statehood days. They personally know the "old" Alaska of decisions from Washington, D.C., dollars from Seattle, construction from the military, and jobs from the federal government.

For many, the state's long lines of communication and distance from the "lower 48" have created a feeling of detachment or removal from the mainstream of American life. Theirs has altogether been a colonial experience which statehood did not really relieve. (This is not to say that the Alaskan colonial experience has been an across-the-board narrowing one. Alaska, for example, presently boasts one of the most highly regarded state supreme courts, has a carefully considered state abortion law, privides a wide range of state social services, and has generally given full support to its educational establishment, to name but a few.)

The discovery of oil, however, first in the Cook Inlet and later spectacularly on the North Slope, provided that state with both apparent self-sufficiency and more importantly the sense that Alaska could now stand on its own. The colonial era seemed at an end.

Given the background, the pipeline litigation came as a great and troubling shock to white Alaska. Its point of origin, Washington, D.C., its effect, the suspension of the post Prudhoe boom and its proponents, "outsiders" and a few Native villagers, all served to remind Alaskans of just how tenuous was their break from the old days, and how unpredictable the new might be.

Rather than accept the delay incident to the litigation as an inevitable result of awakening national environmental sensibilities, these Alaskans moved to a position of pipeline advocacy. To them the only question has been: "Will you speak up for Alaska or are you against the pipeline?" Their approach has proved effective enough to force those Alaskans supporting the litigation to couch their arguments in terms of "the state's best interests." Alaskan conservationists have also split with their national organizations over the reasons for opposing or

modifying the project.

At the same time some pipeline proponents, seemingly against their better judgement, have found themselves supporting a generous Native land claims settlement. The two relate in that oil lease tenure will not be settled until title is confirmed in either the Natives or the state. Yet up to less than a year ago, these same Alaskans failed to take the Native land claims seriously or were disturbed by its obvious grant of power to Alaska's Native peoples. Perhaps this explains why Natives have not been among the pipeline's most enthusiastic boosters.

The combination of a threat to the state's progress and forced support for an otherwise unpalatable social issue was bound to produce a reaction. This would not have been so disturbing were it merely limited to anger with the pipeline's opponents.

But in fact feelings over the pipeline controversy have gone far beyond, focusing instead on any laws which could impede, not so much Alaska's development, but Alaska's autonomy. The pipeline is really seen as a prime example of how "outsiders" can twist law to limit the state's chances of self-determination. And if recent developments are any indication, this attitude now extends widely to many areas of law affecting the environment, coastal and marine resources, and the peoples of Alaska.

For example, the United States recently published charts of Alaskan waters with the boundary of the territorial sea drawn upon them. These charts designated, allegedly for federal enforcement purposes, territorial and contiguous zone waters according to a strict interpretation of U.S. position and established international convention. As published they suggest the U.S. view that certain internal and historic waters which some had considered Alaska's really are international. Once they were published, state officials, fishermen and the interested public all reacted, with great populist feeling, as though Washington was stealing the waters and continental shelf resources of the state behind everyone's back... and who knows, perhaps they are doing just this.

Additionally, feelings were hardly eased by Secretary of State Rogers terming the Governor's concern a "knee jerk reaction."

Another example of unrealistic assault on Alaska's autonomy by the federal government, which does little to improve the climate for federal-state cooperative coastal zone management, involves current marine mammal protective legislation before the Congress.

Scientifically, of course, many of the premises of this legislation are incorrect. More importantly to Alaskans, however, is the unwarranted extension of federal jurisdiction over

resident species of marine mammals guaranteed to Alaska by federal statutes: "The Alaska Statehood Act" and "The Submerged Lands Act." Further, marine mammal management in Alaska can not be faulted by the facts and their utilization by Alaska residents -- particularly the Eskimo -- is of the highest economic and social significance.

Well, it's against this background of attitudes and events that one must consider what has been done by either the State or federal government to implement a coastal zone policy for the north.

One of the first policy steps taken was by the last Alaska legislature which created a new Department of Environmental Conservation for Alaska. The commissioner appointed by Governor Egan is Dr. Max Brewer, former director of the Naval Arctic Research Laboratory at Barrow. Although presently underfunded and understaffed, Dr. Brewer has organized his new department to include coastal management as one of four main divisions.

Policy direction for a coastal zone management effort in Alaska is also under discussion by the Inter-Agency Technical Committee for Alaska. The ITCA is composed of representatives of state, federal, and university organizations interested in coordinating the acquisition of knowledge about Alaska resources and environments. One project involves the preparation of a cooperative interagency Alaska Plan for Coastal Zone Data Aquisition. In this effort too, the fisheries and oil industries are participating and giving good advice on the priority areas where knowledge will be most important in the resolution of user conflict.

Essentially these two situations, together with the dialogue surrounding state-federal relationships on the territorial sea and marine mammal questions and the legislative struggle over Native land claims are the major policy discussions affecting coastal zone management in the north.

In a program sense, however, and reflecting increased awareness of the importance of the coastal zone management concept, several federal agencies have moved to focus their capabilities on coastal zone management problems -- the National Marine Fisheries Service in its Auke Bay Laboratory research program and the coordination of Prince William Sound Tanker transport environmental research; the National Weather Service in ice forecasting; and the Bureau of Land Management together with other federal-state resource agencies in arctic resource planning. In this later context the IBP Tundra Biome program together with Sea Grant researchers can provide important new environmental knowledge to government.

The Sea Grant Program of the University of Alaska is interacting with these problems and events in several ways both at policy and program levels.

In a policy sense our foremost contribution lies in efforts to formulate an interagency plan for coastal zone data acquisition in Alaska. The Sea Grant program has been the initiator of this effort and for the next year I will be serving as chairman of the Inter-Agency Technical Committee for Alaska coordinating this and other interagency resource and environmental data acquisition efforts.

In a program sense -- beyond Sea Grant support for necessary coastal zone research, advisory services and teaching -- our Anchorage-based Center for Coastal Resources is engaged in pioneer efforts uniquely related to current problems of the north:

1) Initiation of an advisory coastal resource and community planning service designed particularly to assist Native communities in the difficult aspects of programming their Native Land Claims selections and capital investments in the period following passage of compensatory legislation now in the Congress. Operating on a pilot basis, and begun at the urging of the Natives themselves, this unique coastal planning and information service may likely become a main mission of the Alaska Sea Grant Program in the years ahead;
2) Preparation for a major conference on the "Environment and the Law." To bring to Alaskans the expert voices of legal authorities on environmental, public land and international marine law -- and to legal authorities something of the resource values and environmental realities of the north with which they are totally unfamiliar;
3) Publication of a series of coastal community environmental atlases. Work on a prototype atlas of the Anchorage, Alaska area has begun in cooperation with the Greater Anchorage Area Borough. Others will feature the physical and biological facts of other coastal communities in Alaska and in addition, where necessary, will be bilingual in presentation. These compendiums of community and adjacent environmental facts will be useful planning and zoning tools; and
4) Preparation of several descriptive and analytical reports on the natural systems and resource problems of the Alaska coastal zone. In this context a particularly important dialogue is taking place between the state government and the Sea Grant Program on the Alaska territorial sea boundary question.

I've tried to give you some background of the coastal zoning questions in Alaska ... attitudes, policies and programs. In closing, I have one major recommendation based on current as well as past experience. The major policy need for Alaska and the arctic is the articulation of a U.S. policy for the arctic and the north by the President of the United States.

Without such a statement of economic, social, scientific and resource goals in the north by the federal government, both federal and state programs will continue to be only loosely oriented to the needs of our society.

Several years ago an initial draft of such a policy was prepared by the Federal Field Committee for Development Planning in Alaska and the National Science Foundation.

It is my understanding that the Office of Management and Budget and the National Science Foundation have resurrected this statement, and it is once again viable.

I sincerely hope so, for my experience in government and in the north tells me that coastal zone management, land use planning, the coordination of research, the transfer of technology to resource users ... indeed everything Sea Grant is deeply concerned about is dependent upon this policy pronouncement.

Kuyanak. (Thank you)

Delaware Coastal Zone Management

Austin Heller, Secretary
Department of Natural Resources and Environmental Control
State of Delaware

This afternoon I feel very much like a student -- even though my "square" haircut and lack of beard belies such academic status. The reason I feel like a student is that Dean Gaither has given me an assignment. And all of you remember that an assignment from the Dean is not to be taken lightly. Furthermore, the Dean has implied that there may be an oral quiz.

Dr. Gaither asked that first I tell you what steps the state of Delaware has taken with respect to developing and implementing a coastal zone management policy. I have in my hand a 44-page report called "Coastal Zone Management for Delaware." This is a report of Governor Peterson's "Task Force on Marine and Coastal Affairs." The committee, or initial Task Force, had nine members. (My modesty almost prevents me from telling you that Dean Gaither and I were on it.) It was appointed early in 1970, had its first meeting on April 28, 1970, and issued the report nearly ten months later, on February 18, 1971. The Task Force, which regards this report as a preliminary one, with the final report probably ready late December, acknowledges much assistance from key individuals in state agencies, at the University of Delaware, and from many people and agencies outside the state, as well.

I'm sure I need not tell you that report did not come to us as a result of inspiration as we sat isolated in an ivory tower. We did much research individually, we had much intra-task force discussion, and very importantly we met with, interviewed and talked to scores of persons and groups with diverse interests and points of view. We explored both in depth and in breadth -- and met with many sectors. We met with developers and with conservationists, we met with mayors and corporate presidents, with engineers and educators, with laymen and professionals. We believe such exploration and probing exposed us to all points of view -- and avoided the danger of "surprises" -- in either direction. Much public interest was aroused, and a feeling of public support for protection of our coastal legacy developed. This is not to say that we did not have strong opposition from certain interests. But obviously, without broad public understanding which engenders support, such programs cannot succeed.

My reference to our "coastal legacy" a moment ago was not just a fine phrase, thrown in for effect. I can think of no state where the preservation of a viable coastal zone environment is more important to its citizens. Delaware is only 96 miles long -- but it has approximately 160 miles of saltwater shoreline. No part of the state is more than 8 miles from tidewater, and the total area of the state is less than 2,000 square miles. We have about 120,000 acres of tidal wetlands -- and Delaware's mean elevation above sea level, at 60 feet, is the lowest of the 50 states. The importance of our wetlands as breeding and nursery places for birds, mammals, fish, and shellfish cannot be over-estimated. Because the coastal zone constitutes such a high percent of Delaware's total area, the use to which it is put has a preponderant influence on the quality of life in the entire state.

Located as it is along the east coast megalopolis -- with high potential industrial sites on deep water, and with shores and beaches accessible to millions of people for recreation -- the pressures for direction and definition of purpose became very great in a relatively short time. Major decisions that were economically sound and environmentally wise were urgently needed. This became the burden of the recommendations of the Task Force.

The Task Force made slightly more than 100 recommendations for the future management of Delaware's coastal zone. Major among these were:

1) A recommendation against approval at this time of any deepwater port facility or offshore island in the Delaware Bay because:
   -- The risks to the environment outweigh any foreseeable economic gains.
   -- The very presence of such a facility would encourage the development of incompatible heavy industry and increased urbanization along the shoreline.
   -- The construction of the facility, with attendant dredging and filling, becomes a form of heavy industry in itself.
   -- The facility would be a potential major risk for additional bay pollution, with accompanying deleterious effects on estuarine life.
2) The Task Force recommended that there be no further intrusion of incompatible heavy industry into the coastal zone. It specifically named steel mills, paper mills and oil refineries, and any other industry that traditionally introduces unacceptable quantities and types of pollutants into the air, land or water and, by its very size and nature, causes massive adverse environmental changes over a wide area.
3) Recommended the encouragement of new industries which are compatible with high environmental standards and

which would enjoy a relatively high ratio of employees in relation to the space occupied and the public services requires.

4) The Task Force recommended the enactment of legislation for adequate land and water use controls for the entire Delaware coastal zone, such controls to include zoning, a system of permits, strengthened subaqueous land laws, cease and desist authority, and required environmental impact statements on all major public and private construction projects.
5) The Task Force recommended that the funding schedule for the acquisition of public lands in the coastal zone be accelerated in order to maintain the desired development pattern, to prevent environmental damage, and to protect the options for coastal zone use for future generations.
6) The Task Force recommended that a focal point for coastal zone management be established in the executive branch of state government.

Although many previous policies regarding the coastal zone had evolved at various levels of state government, the Task Force placed them under one broad umbrella and recommended priorities, policies and management structures.

I believe it is both accurate and conservative to say that the preliminary report was favorably received by the governor, the legislature, and the general public.

I recall your attention to the date of the report -- February 18, 1971. In June, 1971, largely as an outgrowth of the report, the state legislature enacted a coastal zone act. This act defines the coastal zone and prohibits new heavy industrial development, including offshore transfer facilities, within an area roughly comparable to the primary coastal zone. By banning offshore transfer facilities, the state ruled out the use of Delaware Bay as a major deepwater port.

However, a committee has been named by the governor to investigate and report on the ultimate possibilities for a deepwater port to serve this area. This committee is to coordinate its work with the U.S. Department of Commerce.

Principal authority for the implementation and administration of the coastal zone act was placed with the State Planning Office which, with the assistance of the Coastal Zone Industrial Control Board, is charged with the development of the Coastal Zone Management Plan and with promulgation of regulations for permitted industrial uses.

The Coastal Zone Industrial Control Board was organized as the rule-making arm of the State Planning Office. This group also assists in defining heavy industry, and it may pass on specific legislative action.

The state's acquisition of land in the coastal zone has been expedited to the fullest extent possible, with several notable tracts added. (Burton Islands, Land Property).

High priority has been given to the development of public land already in the coastal zone. (Lums pond, e.g.)

Water quality standards have been set at high levels in the coastal zone in order to facilitate water based recreation.

We are regulating the use of pesticides more effectively. We are reviewing our mosquito control programs to assure a high degree of environmental protection.

We are making a great effort to restore and rebuild our depleted shellfisheries industry.

The state has assumed subaqueous land controls.

We have intensified air and water quality monitoring.

We now require environmental impact statements for all new industry in the coastal zone.

Dean Gaither also asked me to comment on how Sea Grant Universities can help the state organization carry out its responsibilities for coastal zone management.

Dr. Gaither, if you will accept a one-word answer on how you can help, then that word is "immeasurably".

While I am convinced that the responsibility for management must rest finally and fully with the designated state agency, the Sea Grant University can render invaluable assistance.

Actually, I see university assistance falling into three types:

In the first case, the university and state agencies would work as research and development teams to tackle such problems as:

1) Effective environmental warning systems.
2) Evaluation of environmental impact of present users of coastal zone, e.g., industry, agriculture, recreation, housing, and transportation.
3) Wetlands evaluation studies.
4) Development of technology for better identification and utilization of marine resources.

The second type of Sea Grant University assistance would be to conduct research, wholly independent of state agencies, but of ultimate interest to them. This would include:

1) Fundamental baseline studies.
2) Training of scientists.
3) Conducting environmental education to develop public awareness of problems.

The third type of assistance would be in an advisory capacity on matters of state conducted research, on planning, on management, and on evaluation projects pertaining to coastal zone resources:

1) Faculty would be available to serve on advisory and regulatory councils.
2) Faculty would be available for regular consultation with state management personnel.

Actually, I foresee that Sea Grant Universities can make the same type of contribution to sound development and scientific management of our nation's marine resources that Land Grant Colleges (Morril Act, 1862) did to development and management of our agricultural resources. This is the critical role of academia.

I think I would be something less than grateful if I did not comment on the splendid cooperative relationship that has developed in about a year between Dean Gaither of the University of Delaware's College of Marine Studies and myself as secretary of Delaware's Department of Natural Resources and Environmental Control. You will recall that we worked together as colleagues on the Governor's Task Force on Marine and Coastal Affairs. Not only did we work together, but the size of the problems and scope of investigations necessitated members of my technical staff working with members of his faculty, and vice versa. Let me say there developed a wonderful working relationship -- a sense of dedication to a common cause. The bridges of communication are open, numerous, and toll-free. There are no communication gap, no petty rivalries, no sniping. Not only do Bill Gaither and I communicate and our staffs communicate, but just as important our respective bosses -- the Governor of Delaware and the President of the University are in close touch with us, and with each other. We are all together, without rivalry or reservation, in the effort to preserve our environment.

Delaware Coastal Zone

Kent Price
University of Delaware

Delaware is the second smallest state in the union. However, it has an extensive coastal zone that is of critical importance to the people of the state, region, and nation. Delaware is contiguous with the west side of Delaware Bay, a typical east coast drowned river estuary. Delaware has 160 miles of salt water shoreline and 120,000 acres of tidal wetlands, which comprise about 8% of the total acreage of the entire state. A recent definition of the coastal zone (both primary and secondary) by the Governor's Task Force on Marine and Coastal Affairs places about two-thirds of the state in the coastal zone.

The Delaware River and Bay system represents a classic example of competitive uses. The Delaware River is one of the most highly industrialized rivers on the North American continent with its ports of Philadelphia and Wilmington. There are seven major refineries in the area. The lower Delaware Bay is the focus of a considerable marine-oriented recreation industry which helped bring more than 140 million tourist dollars into the state last year.

Due in part to the heavy industrialization and consequent degradation of the Delaware River in the vicinity of Philadelphia, there is little remaining of the once viable menhaden, oyster, shad, weakfish and other food fisheries. The oyster fishery has declined from more than 23 million pounds in 1890 to its current level of less than one million pounds. Lewes, Delaware, was one of the largest seafood landing ports in the country in the early 1950's with nearly 400 million pounds of fish landed. Today commercial fisheries landing in Lewes are practically non-existent.

Delaware Bay has many of the physical attributes -- including a 70-foot deep natural channel, natural harbor, and close proximity to major industrial centers -- that are requisite to it becoming one of the major industrial ports in the world. Terminals for deep draft tankers and ore and coal transport have been proposed for the lower bay area which presently has an agricultural and recreation based economy. Clearly the competitive uses of the Delaware Bay are on a collision course that calls for the development and implementation of a coastal zone management policy.

Management agencies and public policy-decision makers at local, state and federal levels require a continuous supply of sound data in order to implement resource management policy. All too often, their decisions are delayed for years because information is not available and must await studies that are conceived and executed within the limitations associated with performance under pressure for immediate results. What is the University of Delaware doing about these problems?

Perhaps the greatest advances made by academic institutions during the past year in regard to the detection and control of pollution lie not in specific techniques but in the development of new approaches to complex environmental problems. It has been recognized that many environmental problems, especially in estuaries such as the Delaware, require a multidisciplinary taskforce approach in order to achieve a satisfactory solution. In response to a growing interest in Delaware Bay and the problems attendant in developing this estuary for multipurpose uses, the University of Delaware created a new College of Marine Studies in 1970.

The College of Marine Studies, a research-oriented graduate school, possesses a faculty representing the traditional categories of physical and chemical oceanography, marine biology and geology, ocean engineering, and marine affairs. Faculty in other colleges of the University provide instruction in their specialties as applied to the marine environment -- making the marine education program broadly interdisciplinary.

The University of Delaware (particularly the College of Marine Studies (CMS) with facilities at Newark and Lewes) is the principal marine environmental research agency in the state. As a part of its Sea Grant Program, CMS, in close cooperation with the Department of Natural Resources and Environmental Control, is in the process of developing a functional concept for a coastal zone laboratory as identified in the Stratton Report.

The first major step will be to understand the coastal development objectives and priorities envisioned for the State of Delaware and Mid-Atlantic region by the Delaware Government, regional developmental bodies, and civic and business leaders. The Delaware Government consists of a bicameral legislature, and administrative and judicial branches. The principal input will probably be derived from the administrative branch consisting of ten departments particularly the Department of Natural Resources and Environmental Control. Additionally significant recommendations will be available from two special bodies which are advisory to the Governor. The Task Force on Marine and Coastal Affairs is preparing a report, as described by Secretary Austin Heller yesterday, to be available before the end of this calendar year on the coastal zone of Delaware, containing detailed information on the present status, trends and problems relating to the coastal zone and recommendations concerning its future.

When the objectives of the legislators and regulators have been identified and assigned priorities, subsequent tasks will extend the prioritization process to include other civic and political components of the Mid-Atlantic region. Policy delphi techniques will be employed in the study to include interrogation by mail and personal interview.

A corollary study will analyze the laboratory functions necessary to support alternative research, monitoring and management requirements for the State of Delaware and Middle Atlantic region based on the development objectives identified. In simple terms these objectives will identify a problem or problems. From problem definition, available management information for that problem can be compared to the information required which will determine the research needed. The research need can be compared to the total research capability of the state and region in order to predict requirements for additional funds, facilities, and manpower.

As a pilot study the College of Marine Studies and the State Department of Natural Resources and Environmental Control have embarked on a cooperative research and management program for FY 73. This effort thus far has involved:

1) A careful survey of marine studies expertise and capability of the University of Delaware and the Department of Natural Resources and Environmental Control;
2) A listing of pertinent environmental management problems in the coastal zone of Delaware Bay;
3) A listing of projects that could be undertaken cooperatively by CMS and NREC to provide the information for management decisions;
4) A refinement of the total list of projects to identify the top seven in order of priority which are:
   a. Development of coastal recreation centers
   b. A predictive physical and hydronumerical model for Delaware Bay
   c. Rehabilitation of the shellfish industry in Delaware Bay
   d. Sports fish habitat management-reef construction
   e. Development of an organization structure for the Delaware coastal zone
   f. A study of financial incentives for coastal zone development
   g. Strategies for engineering development with ecological integrity in a coastal environment
5) Preparation of a joint budget proposal reflecting the proportion of effort to be contributed by each group for each project;
6) Presentation of the project proposals and budget justifications to the Governor and eventually to the Legislature.

Using this approach we feel that the state will get the best information for its research money with little or no redundancy in programs. The success of the effort thus far indicates that it can be expanded as the basis for a coastal

zone laboratory.

My definition for a Coastal Zone Laboratory for Delaware is:

1) A philosophy which embodies maximizing interagency cooperation in selecting marine environmental research objectives and in conducting the research effort in order to insure that the State's marine environmental management needs are met as efficiently and effectively as possible.
2) An entity which insures that appropriate staff, facilities, and funds are programmed to meet the marine environmental research needs of the state.
3) A laboratory organization housed within the University system.

In summary, the University of Delaware has and will attempt to meet coastal zone management needs by: providing a new marine studies program that is effective in studying complex environmental problems and responsive to management's needs; developing an inventory of the State and Region's capability to do marine research; and providing for additional research capability as needed.

Role of the University in Coastal Zone Management

Jack Davidson
University of Hawaii

We have been given two basic questions to discuss. The first is, what does the university or research institute perceive as its functional role in support of the coastal zone management problem? The second is, "can it (the university) carry out this role within the concept of the "Coastal Zone Laboratory" as envisioned by the Stratton Committee?" I am not sure universities as such "perceive." I think some of us in the university system are very aware of coastal zone management problems and perceive a role that the university could and should play. I'd like to rephrase the first question to "what role should universities be prepared to play?" To answer this question, I need to register my perception of the problem.

The coastal zone, representing land-sea interface and contiguous land and water areas, represents probably the most valuable subregion of the nation in terms of concentration of social and economic activity. It is also a fragile environment with ecosystems that are easily damaged and altered. While abusive use of these ecosystems is not new, we now stand at a point where much irreversible damage is in process with the threat that in the destruction of these resources, the quality of human life on the planet can be greatly diminshed. The present management systems governed primarily by vested expectations of profits have been, and will continue to be, incapable of coping with the situation.

Solution of the problem takes on three dimensions, each of which present an equally difficult challenge. The first is to provide the information needed to guide the development of adequate management schemes. Second, to develop adequate management systems and principles. Third, to create a social-political atmosphere which will foster rapid adoption of "good" management.

What is the university's role? Obviously the information needed to permit rapid development of meaningful management schemes to protect coastal ecosystems calls for a massive multi-disciplinary research effort. It is necessary to understand how the ecosystems work, what is happening in them and what will be the ultimate effect on the physical structure and plant and animal life. This must then be translated into terms of human welfare and enjoyment both now and in the future.

To reduce even a portion of these problems to manageable terms will require innovative framework and approaches. Although much meaningful research is carried on in federal laboratories, the universities represent the repositories for the nation's fundamental research resources and the source of new ideas and approaches.

The several federal research agencies that now have research responsibilities relating to coastal zone management are limited in pioneering efforts by the nature of their ongoing commitments. Philosophically, they represent the vested use interests and there is a tendency for the problems generated in these uses to absorb all their attention and resources. Then too, federal research institutes, laboratories, etc., are often well equipped to research aspects of the physical environment but rarely ever are equipped to explore the social science (human) issues. (In fact, I would suggest that the U.S. Department of Agriculture alone had the capacity to meet a significant portion of its social sciences research needs, and this capacity is biased heavily toward economics and concentrated mainly in Washington and not in local or regional laboritories and research units.)

To approach the second tier of problems -- namely that of developing adequate management schemes -- an even larger and more imaginative social science commitment is required. Again the main, fundamental research input must come from the university. However, the present trend of state governments to acquire well trained planning staffs opens the door for close cooperation between academic and government institutions in seeking to define appropriate management mechanisms.

The third level of problems -- that of implementing effective management in face of the inertia, apathy, and vested interest resistance -- is advisory and educational in nature and may present the greatest overall challenge.

I would like to present an example from the University of Hawaii Sea Grant Program to illustrate how the university can serve at each of these levels. In the State of Hawaii, we have become seriously concerned with pollution of our coastal waters. With money provided by the Sea Grant Program we undertook a year of services planning on this issue. The result is multi-directional, multidisciplinary project to render the necessary information and assistance in developing and implementing management schemes. The eight specific objectives are to:

1) Identify the origin and measure the amounts of such quality factors as nutrients, pesticides, toxic metals, degradable organic matter, and sediments which enter coastal waters in typical situations of land use, e.g., undeveloped, urban, industrial, general agricultural, and sugar cane culture.

2) Determine the fate of the foregoing influent quality factors by measuring their concentration and amount in coastal waters, sediments, and biota of selected coastal environments such as Kahana, Kaneohe, Mamala, and Waialua bays on Oahu and the north and south coasts of Kauai.
3) Monitor the changes in water quality and in associated ecosystems which follow changes in sewage discharges at opportune locations such as, Sand Island and Kaneohe Bay, and in sugar mill waste on the Kauai Coast.
4) Evaluate the adequacy of coastal water quality standards and criteria as presently conceived, to insure the desired quality of ecological environments is such water.
5) Develop scientific data and parameters on which to base coastal water quality protection measures and systems in future urban or agricultural land development in Hawaii.
6) Recommend the changes in policy, institutional arrangements, water quality parameters, and practical measures necessary to protect coastal waters.
7) Assess the economic and social effects and costs of changes associated with the measures recommended in Objective 6 (above).
8) Maintain an informational and advisory program designed to keep citizens, lawmakers, public officials, students and members of the professional and lay communities informed of the project findings and of the implications of the recommendations they support.

From these objectives, it is evident that the necessary work involves experimental, investigative, interpretative, and educational activities and techniques. The purpose of the experimental aspects is to provide currently needed supporting information, not otherwise available, to obtain meaningful institutional, economic, and social interpretations through which the project is to achieve practical significance to the community.

Fourteen scientists from different disciplines met almost weekly for ten months to establish the priorities and to develop methodology for the project. This was donated time and effort. Sea Grant monies were used to bring experts in various aspects of pollution to meet with the group, to review their progress and to share their particular expertise. The result is a model, the implementation of which can be expected to yield major dividends in terms of reliable and useable knowledge, It will, however, require continuing strong focus to overall goals, concerned participation and careful management and coordination.

This leads to the second major question: Can the university carry out this role within the concept of the "coastal zone laboratory?" I say yes but with strong reservations.

The Stratton Committee recommended:

> "that 'coastal zone laboratories' be established in association with appropriate academic institutions to engage in scientific investigations of estuarine and coastal processes and to be prepared to advise the states in managing the estuaries and coastal zones" (Our Nation and the Sea, U.S. Gov't. Printing Office, Jan. 1968).

Certainly federal help and funding will be required if coastal zone problems are to be reduced to manageable dimensions within a meaningful time frame. It is also clear that, while there is ample reason to talk in general terms of a coastal zone problem, coastal environments vary so tremendously in terms of structure, uses and problems as to require consideration as separate entities. A coastal zone laboratory at the university would be in a good position to take advantage of the already established scientific resource base of the area.

My concern with the Stratton Committee recommendation arises first from the apparent preoccupation with the physical and biological sciences. The problems of use and abuse of the coastal zone are all people-oriented or people-generated. Second, I am concerned with the apparent lack of thought concerning how to carry out the interdisciplinary aspects of such a laboratory.

Development of the coastal zone in a positive sense hinges very strongly on the social initiative. We have had encouraging signs of a mounting social awareness in which new variables have come into focus including concern about the environment, increasing concern with aesthetic values, etc. There are also signs that society will not only encourage but even demand development of the capacity to anticipate conflicting uses, not simply wait for them to arise. The coastal zone laboratory concept should, therefore, be expanded to encompass a social science institute to supplement the work of the biological and physical scientists. There must also be focus and direction to the laboratory's activities and a framework developed for active interchange between the scientific disciplines and those responsible for policy and decision in the coastal zone management. The views of the latter must be put in proper perspective if the help of the body politic is to be enlisted in implementing meaningful management systems.

The direction and focus of the national program could be developed as follows: develop broad federal guidelines with a charge to select and focus scientific resources on high priority needs in terms of immediate problems and anticipatory uses; and require formation of local planning and steering committee comprised of university personnel, representatives of state and local government and the body politic, and relevant federal personnel. This committee would be responsible

for establishment of priorities, review of progress and recommendations for change and redirection of resources.

The focus of local efforts might be generated as follows:

1) List all the major potential problems of the coastal zone.
2) Estimate the probable biological, physical and social impact of these problems.
3) List the probable approaches to improved knowledge and/or effectiveness.
4) Roughly appraise the costs and returns of these courses of action and the relevant time frame for each.
5) Develop social acceptance of action programs in coastal zone management.
6) Aim the proper mixture of research and extension at the spots of highest payoff (where payoff includes the implementation of action based on project results.)

There appears to be a need for a stronger concept of management than is normally recognized as desirable by the academic establishment. Complete investigative license often seems the best of all possible worlds to the academic researcher and occasionally produces tremendous payoffs. However the risk is high and there is 'gut' feeling that the time frame for action may be such as to render this approach too risky for society to long condone. This is not to imply that the industry R & D approach is the answer. The scientist must have the necessary freedom and elbow room to exercise his imagination and talent.

Strong focus and control of funding to achieve this focus by a competent program director seems to be the answer. If the laboratory has a staff, it should be a small one and the scientists employed or otherwise supported would be attracted from the academic departments, by their interest in the goals of the unit, the personal challenge offered, and the prospects for meaningful scientific and social contribution. They should be encouraged to remain with the program only so long as their interest and potential contribution remains high.

With increased funding and added legislative flexibility the concepts developed by the Stratton Committee and in this paper could be accommodated in the Sea Grant Program. The Sea Grant provision for advisory services would then serve the logical role of communicating research results to users and enhancing the feedback process, and hence the focus, on relevant issues.

Michigan Sea Grant Program and Coastal Zone Management in Michigan

John Armstrong
University of Michigan

Michigan's coastline has been so prominent in the history of the state that it is gratifying to see within the past three years that a positive and definitive state position is evolving concerning its coasts.

With over 38,000 square miles of the Great Lakes inside its boundaries and with frontage upon 3,200 miles of shoreline, Michigan has a considerable share of the Great Lakes -- 41 percent of the entire Great Lakes area and more than 65 percent of that which lies within the United States. The shorelands of the state are, and will continue to be, one of the state's greatest natural resources. At the present time about 100 Michigan cities obtain their water supply from the Great Lakes. No point in the state is more than 85 miles from one of the four bordering lakes or their connecting waters. Thousands of miles of fine beaches, millions of fish that are caught yearly and unexcelled boating are only a few of the recreational advantages offered by the lakes. Michigan alone has 38 state parks along the shores of the Great Lakes.

Michigan's shoreline is exceeded in length only by that of Alaska and Hawaii, and it is interesting to note that the shoreline of the Great Lakes resembles, at one place or another, most of the nation's seacoasts. The marshes of Saginaw Bay and Lake Erie are reminiscent of Chesapeake Bay. The bleak, rock coasts of Lake Superior are similar to those of Maine or Oregon. On the west coast, Michigan's sand beaches more than rival those of Florida, Texas and Southern California (and the water is fresh).

Some features of the lakes' shoreline are unique. Sleeping Bear, Grand Sable, and other giant dunes are among the largest in the world. Lake Superior's pictured rocks were a national scenic attraction when the only way to see them was by canoe.

Shoreland management in Michigan can somewhat arbitrarily be placed in three general categories: control and use of Great Lakes bottomlands; erosion; and protection of environmental resources.

The Michigan Coastal and Shorelands Management Project, a cooperative project with the Michigan Water Resources Commission,

is one of twenty-five Sea Grant Projects dealing with Great Lakes problems. But it is one of the most important since it deals very directly with a pressing, immediate problem in the state.

The major element of this project centers around the implementation of Michigan's newly enacted Shorelines Protection and Management Act (Act 245). Specifically, its implementation in a particular area of the state -- Grand Traverse Bay in Northwest Lower Michigan -- before its implementation over the entire shorelands area.

Shoreland Protection and Management Act of 1970 (Act 245)

As its name implies, this act represents a two-stage attempt at shoreland management:

First phase In the first stage of implementation, the State Department of Natural Resources and the Water Resources Commission are to identify high-risk erosion areas and natural fish and wildlife habitat areas. Once these are identified, local units of government will be informed of those areas lying within their jurisdiction and will receive suggestions on methods of preventing further property damage due to erosion and of protecting fish and wildlife habitat areas. The local governmental units then have three years in which to establish zoning and other regulatory devices to control erosion and manage habitat areas. Their activities are subject to the approval of the Water Resources Commission, who will establish the necessary controls directly if local groups fail to act within the three year period.

Working with the Water Resources Commission, Michigan's Sea Grant Program has helped to construct a basic resource inventory of Grand Traverse Bay, and to develop recommendations for appropriate regulatory mechanisms. A Joint Water Resources Commission-Sea Grant publication is being completed which will be sent to each local unit of government. It will identify critical areas, make some initial regulatory suggestions, and then suggest further actions which, on the local level, can lead to a comprehensive shorelands management system rather than one of piecemeal regulation.

Second phase Within 18 months, the Water Resources Commission is required to submit a comprehensive plan for the management of Michigan's Great Lakes shorelands, including recommendations for required legislation. Sea Grant has been working with the commission on this phase by generating management concepts to be included in the report as well as public information programs to convey an understanding of the need for such a management system.

Traverse Bay Shorelands Project

Sea Grant has developed the concept of a Shorelands Review Board to explore the possibility of establishing a comprehensive regional approach to shorelands planning and management through local initiative and action.

The purpose of such a board would be to:

1) Act in the interest of Traverse Bay as a total, natural system in contrast to existing developing interests that may or may not reflect the valuable attributes of the shoreland system as a whole.
2) Serve as a meeting ground for fractionalized and often conflicting political bodies, plans, values and interests.
3) Act as a unified local voice in relation to state, regional or federal interests.
4) Act as a source of information on planning, design, and ecological concepts and aid the local units in preserving their natural shore while allowing human use by reviewing permit and variance requests submitted to various local governmental units.

Using Michigan Public Act 200 (1957), a group of concerned citizens has now formed a shorelands coordinating committee with the assistance of the Michigan Sea Grant Program. They are now finalizing official support agreements, and insuring representation of all government and planning groups on the bay -- including 12 townships, 5 municipalities, 3 counties, and 5 planning agencies. This is very significant for the university. We have actually stepped out of academia and created a positive change in the community -- a small but real step forward.

As the Coastal and Shorelands Management Project has progressed, it has emerged as a combination of research and public information. Acting in conjunction with Michigan Sea Grant Advisory Services, this project provides information and suggestions to local, regional, and state groups seeking methods of managing various shorelands problems, whether these are predominantly land or water oriented or actually at the land-water interface. Information obtained from project research and field experience is applied to the specific problem.

A listing of some of the current subprojects which this project is dealing with indicates the scope and direction of this on-going research program:

1) Syntheses and analysis of innovative coastal management techniques in the United States through a review of recent management programs throughout the United States. This will be published shortly as a Michigan Sea Grant Report.
2) Development of use-impact matrices for use by local units of government to identify potentially adverse impacts of shoreland activities.

3) Identification of shoreland components which lead to unique shoreland configurations and which must be preserved if the shoreland is to remain a unique and viable resource. This research includes functional systems of land use classification and an inventory of shoreland resources through our Sea Grant remote sensing project.
4) Design political, legal and institutional methods of regulating and managing various parts of the shoreland area, as well as potential comprehensive management techniques -- including the preparation of additional model legislation for shorelands management -- since we feel Act 245 must be strengthened and expanded.
5) An identification and analysis of the concept of "public interest" as it relates to the shorelands of Michigan, in view of the variation in perception depending upon regional, economic, political and temporal factors.
6) The development of shorelands use concepts which will minimize impact while allowing human utilization of shoreland areas. Currently underway are a series of "self-help" booklets clearly stating some of these principles, which will be distributed to the general public.
7) Management information systems: a study of alternative inventory systems which might allow for the identification and solution of multiple, complex user-resource and user-user conflicts.

The "Public Interest" and the Coastal Zone

At this point I would like to take the time to discuss a problem which our Coastal and Shoreland Management project has had to deal with, and, indeed, one which I feel pertains to the Sea Grant Program in general and to shorelands management in particular.

Today it is generally accepted by those concerned with coastal or shorelands management that the basic problem is one of a fragile, complex resource under increasing pressures from conflicting, and often disruptive, human demands. But as reflected in recent federal and state coastal zone legislation, there is no clear acceptance of what the desired solution of this problem is, or how a solution can be effected. The very concept of management is today a meaningless term, used to describe everything from the most questionable exploitation and destruction of resources to the total protection of these resources.

Under the original legislative mandate (PL 89-688), Sea Grant is supported by public funds and is directed to generate information on our nation's marine and aquatic resources and related land areas so as to better serve the "public interest." Considering the diversified and conflicting definitions of

what the public interest is in relation to shoreland areas, it is not at all clear how Sea Grant programs can best serve it. There is certainly a strong emphasis on the federal level for the development of information which can facilitate the increased utilization of shoreland and deep-water areas, and much Sea Grant work has been directed twoards obtaining and disseminating such information.

As an example, the University of Michigan has received numerous requests for information which would aid commercial or sport fisheries, industrial-commercial activities, or residential-recreational interests. It is expected that such requests will increase as more information becomes available through our various projects.

But since the start of the Coastal and Shorelands Management Project, Michigan Sea Grant has also received requests from public officials, planners, businessmen, private residents and environmental protection groups for methods of protecting the natural characteristics of the shore; and preventing pollution, crowding, destruction of natural biota and a loss of the 'flavor' of shoreland areas. To supply information which allows for the increased utilization of shoreland areas is often in direct conflict with attempts to preserve such areas as viable natural systems. Since the maintenance of a 'neutral' stand on natural resources policy is paramount to ignoring this conflict, a clear definition of policy becomes necessary.

The University of Michigan Coastal and Shorelands Management Project feels that it is in the 'public interest' to preserve the unique, complex natural subsystem represented by the land-water interface of the Great Lakes in a viable condition. The most desirable contribution of Sea Grant within the Great Lakes is not to facilitate unchecked exploitation of these fragile and unique resources, but rather to help manage them in a way that will match current demands with the right of future generations to enjoy at least some of the same amenities we now enjoy. If preserved as a viable natural system, the Great Lakes can provide more present and future flexibility, economic gain and social benefit than if short-term development interests are totally accomodated. Thus the whole focus of this project has become the development of methods for reducing or eliminating adverse impacts of human activities with the Great Lakes, and generally for preserving the natural system in the face of human demand.

Operation-oriented government agencies on all levels are forced to 'be practical' and to accommodate public demands. Sea Grant, at least by design, may not face such short-term political constraints and can provide a real and much needed service to such agencies by: diminishing potentially destructive demands through public information programs, based on research and analysis; and by providing agencies with information, and with information-handling systems, so that they have a more objective method of dealing with multiple, subjective

demands.

Some of the following conclusions have been tentatively arrived at by the University of Michigan Shorelands Management Project.

1) There are several perhaps irreconcilable conflicting interests in the shoreland areas of the Great Lakes.
   - The regional interest does not necessarily match that of the nation or of individual states.
   - The state is often in conflict with sub-regional interests and with specific localities, individual counties, townships, or municipalities.
   - Within a township or municipality there are often strong conflicting perceptions of the 'proper' use of shoreland areas.
   - Aiding an industry in extracting lake-bottom resources serves one segment of the public interest but always detracts from one or more other segments, such as the interests of fishermen or property owners.
2) Past and present shoreland management decisions, whether formally institutionalized or not, have all had the same impact upon shoreland areas in every state of the nation -- the incremental destruction of the natural system. Each generation may only accommodate some of the demands for shorelands access (use), but the cumulative effect is to replace the fragile natural system with an often unmanageable non-system of human activities.
3) Working with the Michigan Department of Water Resources on the implementation of Act 245 which requires, among other things, the preparation of a comprehensive shorelands management plan, it becomes clear that Michigan faces a major decision.
   - There is no human activity which is absolutely nonharmful to the shorelands system, particularly when one starts dealing with density factors.
   - Considering the growing population and the number of people wishing to use shoreland areas -- which is growing at a much higher rate than the population -- the shoreland is currently facing an unprecedented pressure which can be expected to rapidly increase over the next 30 years.
   - Of equal importance is the fact that increasingly human shoreland activities are becoming potentially more disruptive through new uses or more intensive uses.

Within the field of public reaction, the major shorelands concern in the past was to provide beach areas and public docks. Now public shorelands recreation must find ways of accommodating all-terrain vehicles, high-powered boats, launch areas, parking lots, marinas, snowmobiles, heavy weight camping vans, beach and dune buggies, individual submersibles, skin-divers, surfers, glider planes, inexpensive shoreland housing, scenic

roads, mass-recreational parks, airports, etc.

New technology in industry also adds problems of never-before-seen dimensions. Thus atomic energy, nationally supported as the future source of energy, will add to the pressures, as will increased interests in aquaculture. More and more, businesses are locating according to scenic amenities rather than in major urban centers. And urban conditions are such that increasing numbers wish to live in rural, often shoreland, areas not just seasonally but year-round.

It is becoming clear that even though some people, both in and out of government, refuse to accept or fail to realize it, the types and intensities of user demands for shorelands resources is going to increase and diversify. In many areas such as Michigan, it is not unreasonable to propose that these pressures have not really even begun and that the present situation is not a reasonable target of comprehensive management system. One must project potential demand, and design the management system to be able to deal with much greater pressure -- environmental, economic, political -- and much greater complexity than currently exists.

It is also becoming clear that no single shorelands user demand can be fully met. This is the dilemma which Michigan, as well as every shoreland state, faces. To date, there has been only a minimum acknowledgement of the existence of this problem much less an attempt to deal with it. It still seems that the public interest can best be served by allowing everybody to do everything.

Some state agencies, such as Michigan's Department of Natural Resources, are charged with managing the natural resources. This is usually construed as preserving them at a viable, continuing level, but with some noticeable exceptions as in the case of oil and natural gas. But other state agencies, other governmental units (federal level) and the State of Michigan as a whole are charged with meeting public demand: user demand in shoreland areas. It can be rather well argued that, in the wording of Sea Grant legislative mandate, Sea Grant was and is designed to accommodate user demand in shoreland areas, and that to do anything which will detract from this is to violate the mandate: the public trust.

In this context one can continue to support a basic conservation philosophy and remain true to the directed objectives of the Sea Grant program by stating that:

> No matter how politically desirable it may be to accommodate all public demands in the shoreland area, such is not possible. Furthermore, there are many clear-cut examples to illustrate that it can be politically preferable to know how to reduce or eliminate environmental degradation rather than blindly accomodate all or specific demands.

Thus it is in the public interest to lessen the conflict and impact of multiple use of the coastal (shorelands) zone. Greater efficiency, greater flexibility, greater economic return and critical global conditions, necessary for human survival, can thus be preserved, and many more interests can be accommodated.

It is socially irresponsible to promise everything to everyone within the coastal zone, as its potential is not that great, and, increasingly, it is politically hazardous to do so.

Coastal Zone Laboratory

The University of Michigan Coastal Zone Project is seeking a basic understanding of the natural systems which are represented, in whole or in part, at the land-water interface. It is also attempting to analyze the dynamics of our socio-cultural and techno-economic system to understand the character of past, present,and potential future demands upon this resource zone. From this understanding, based on the parameters that describe the Great Lakes, the intention is to continue developing management alternatives, institututional arrangements and public information projects to allow for the continued and increased use of this resource while protecting it from destruction.

Such protection may not always be politically feasible, but without detailed, comprehensive information about the system and potential management devices, such protection is not possible.

With regard to the Coastal Zone Laboratory concept, it is our feeling that the approach, as generally understood, would be of assistance in the types of efforts we are undertaking in Michigan.

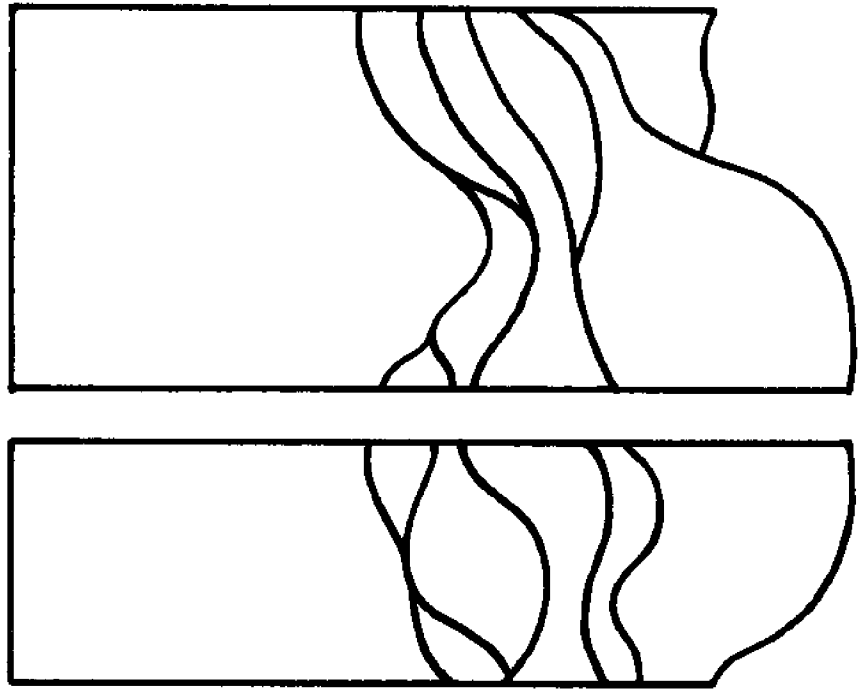
Feasibility plans to establish a Coastal Zone Laboratory in Michigan are already underway -- Sea Grant legislation already can provide for this.

The major features of a laboratory are straightforward:

1) it would provide a centralized research organization for coastal and shorelands research to augment the development and administration of shorelands management and administration of shorelands management and protection programs by the Water Resources Commission;
2) it would provide a means by which many university research personnel from various institutions could be assembled; and
3) it could provide a more efficient clearinghouse for research funds from various agencies concerned with Great Lakes shorelands and near-shore waters (e.g., Environmental Protection agency, Atomic Energy Commission, etc.). It would also seek industrial support.

Its structure has not been formalized in final form; a quasi-public lab or institute management, as part of the Michigan Sea Grant Program in cooperation with the Water Resources Commission, would involve both state and university personnel perhaps on an appointment basis.

The Coastal Zone Laboratory concept can be carried out within the basic objectives of the Michigan Sea Grant Program -- identification of both long and short term resource management problems in the Great Lakes; research to deal with understanding of identified problems; and application of developed methodology towards problem solution in cooperation with the various agencies and groups responsible for resource management.



LEGAL-ECONOMIC ASPECTS OF FISHERIES

Legal-Economic Aspects of Fisheries Session Summary

H. Gary Knight, Session Chairman
Louisiana State University Law Center

The panel on "Legal-Economic Aspects of Fisheries" met Wednesday, October 13, 1971. In addition to the chairman, the panel consisted of Professor William T. Burke, Professor of Law at the University of Washington Law School; Dr. Francis T. Christy, Jr., Research Associate with Resources for the Future Inc. in Washington, D.C.; and Mr. Bernard H. Oxman, Assistant Legal Adviser for Ocean Affairs in the Department of State. Following a brief introductory statement by the chairman, papers were delivered by Messrs. Burke, Christy, and Oxman, and an open question, answer, and discussion period including audience participation followed.

The chairman observed that although the sites of the greater portion of international fishery operations are the high seas beyond the limits of national jurisdiction, nonetheless the effects of fishery operations in coastal states are profound, for it is there that the fishermen live, their equipment is purchased, their product processed and distributed, and they otherwise interact with the coastal community. Accordingly, it is altogether appropriate that the National Sea Grant Program be involved with the sometimes difficult scientific, technological, legal, economic, political, and social questions involved in international fisheries management. The problem of international fisheries management has taken on added urgency in the last year as a result of the call by the United Nations General Assembly for a Third United Nations Conference on the Law of the Sea to be held during 1973. Preparatory work for that conference is being undertaken by the United Nations Seabed Committee and the subject of fisheries management is one of the key items on the agenda.

The panelists and members of the audience raised and discussed a wide range of problems concerning management of the living resources of the high seas. Accordingly, in this report there will only be identified the issues discussed without reference to the substance of that discussion, save with regard to suggestions concerning the role which Sea Grant support recipients might play in conducting research aimed towards solving some of these problems.

Among the issues considered at the meeting were the following:

(1) Legal and economic aspects of the conservation of the living resources of the high seas. This topic involves such issues as the goal of maximizing productivity of the living resources of the high seas; the object of maintaining such productivity through the establishment of maximum sustained yields and other controls on the harvest; the conduct of scientific research necessary to make the requisite determinations for effectuation of conservation systems; the problem whether economic efficiency should be part of any fisheries management criteria; and the role of regional and international organizations in promulgating and enforcing rules designed to conserve these resources.

(2) The legal and economic aspects of the allocation of fisheries resources. This subject involves the issue of which states are entitled to what resources (or revenues derived from the exploitation of fishery resources) as a result of fishery activities. Included are problems of conflicts between distant water fishing fleets and the interests of coastal states in fishery resources off their coasts; the so-called "abstention principle" in which economic investment in the maintenance of a fishery stock is urged as justification for exclusion of other states; the problem of new entrants, particularly from the developing countries, into existing fisheries; the obsolesence of the doctrine of "freedom of the high seas" and the need for allocation systems based on property concepts, including the licensing of the privilege of fishing on the high seas or portions thereof; the meaning of "common heritage of mankind" and its possible reference to the sharing of fishery resources or revenues derived therefrom among states not actually engaged in the fishing effort; the possibility of affording to coastal states certain preferential rights in the stocks off their coasts; the problem of peaceful conflict resolution in the case of controversies which cannot be resolved by the parties to the conflict; and the question of "political acceptability" versus efficiency of the system in reaching agreement on an international fisheries management regime.

(3) Article III. "Article III" is the popular title given to the United States' proposal for international fisheries management submitted to the July-August, 1971, meeting of the United Nations Seabed Committee. In its substantive provisions the proposal calls for coastal state preferences on the basis of their ability to exploit stocks in adjacent waters but without prejudice to existing fishing rights possessed by distant water fishing fleets. The pros and cons of Article III were discussed at length by the panelists, both in their formal presentations and in the discussion which followed. As noted above, however, this report

is restricted to identification of issues, and resort to the actual papers and the transcript of the discussion which followed (all of which are included in these Proceedings) will be necessary for exposure to the various substantive positions taken.

(4) The question of decision-making procedures in the United States government on fisheries and other law of the sea matters. This subject involves (1) the role and importance of defense interests in formulating United States ocean policy; and (2) the imposition of secrecy upon intra-governmental deliberations on law of the sea policy for reasons of (a) military security, and (b) maintenance of a negotiating position. A conflict exists in the latter situation, for regardless of the validity vel non of the two security objectives mentioned above, there unquestionably also exists substantial value to be derived from the use of nongovernmental experts on the United States delegation to the international law of the sea conferences.

Throughout the discussion, the substantive issues were related to the possible role of recipients of support from the Office of Sea Grant Programs with a view toward assisting in the solution of some of these difficult issues. Among the suggestions made with respect to the continuing role of Sea Grant in fisheries research were the following:

(1) Continuation of support for research on scientific and technical aspects of fishery exploitation.

(2) Continuation of support of advisory service programs to transmit the results of such research to the appropriate parties.

(3) Initiation of support for research on the nature of institutional barriers to effective national and international fisheries policies, and possible remedies therefore.

(4) Initiation of support for analysis of fishery industry interests and methods of operation from the standpoint of the individual fisherman, as an incident to examining over-all national fisheries policy.

(5) Continuation and expansion of support providing inputs to national policy and decision-makers concerned with United States policy on international fisheries management. Professor Burke emphasized the importance of regional studies on an interdisciplinary basis (such as the NORFISH project at the University of Washington) in formulating inputs for the national policy making apparatus.

(6) Suggestion that Sea Grant recipients review "A Preliminary Report on International Fisheries Management Research," (National Academy of Sciences, Report on the Working Group on International Fisheries Management of the Committee on International Marine Science Affairs Policy (IMSAP) (May, 1971) which contains numerous suggestions for research in the field of fisheries management.

Fisheries Issues in Law of the Sea Negotiations

William Burke
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The following remarks are addressed to somewhat disparate subjects: U.S. Tactics and Procedures in Negotiating LOS Issues; the Objectives of International Fisheries Management and Article III, the U.S. Fisheries Proposal; and Sea Grant's Role in Fisheries Management.

U.S. Tactics and Procedures in Negotiating LOS Issues

A main purpose of this session as I understand it is to discuss the substantive provisions of the proposals tabled by the United States at the latest session of the Enlarged Seabed Committee of the United Nations which meeting was part of continuing preparations for a general law of the sea conference tentatively scheduled for 1973. Before addressing this topic, however, it may be desirable to call attention to the unusual methods being employed by the U.S. in formulating its policies and conducting negotiations. It may be that some of you are not familiar with or aware of the tactics now prevailing in these respects.

For reasons that are still obscure, the U.S. suddenly, beginning apparently sometime last spring after the March, 1971 meeting of the Seabed Committee, ceased meaningful consultation with private groups interested in the issues now debated in the Seabed Committee. Prior to this time various advisory groups -- some long established, others created ad hoc to deal with and consider some new policy problems -- were consulted in terms of prospective positions the U.S. might assume in future meetings. Usually these groups were consulted on the basis of written statements. After March, however, this procedure terminated and so far as is known to me, advisory groups were no longer apprised in any way whatsoever of the positions the U.S. might advocate in Geneva. I made this statement after participating in three different advisory group meetings in that interval. (One in May, two in June.)

After the Executive Branch dropped the water curtain over its views in this fashion, it should perhaps be no great surprise that it was decided that the U.S. delegation to the July-August Seabed Committee meeting would be com-

posed solely of U.S. government officials. This was a complete reversal of prior practice in which it was routine to name as advisors and delegation members persons who were chosen as representatives of various interest groups whose livelihoods or professions would be affected by the outcome of the negotiations or who were knowledgeable about the issues.

The real question is what difference it makes that the interested public (or the general public) are no longer consulted nor permitted to participate as delegate-advisors in negotiations. One answer to this is political, namely that treaties negotiated in such a manner could conceivably face obstacles to ratification by constitutional processes. This possibility is well known, of course, to U.S. officials and one can only conclude that they have a very considerable confidence that treaties can be negotiated which are broadly acceptable to politically powerful groups in the U.S. Perhaps it is felt that there are no politically powerful groups interested in these matters, although this seems doubtful.

Another answer is that the procedures being followed may, because they so completely isolate U.S. policies from critical appraisal, lead to less than desirable solutions in the negotiations. Mr. Christy has delivered himself of some extremely pertinent comments in this respect, which will soon be available in the proceedings of the 6th annual meeting of the Law of the Sea Institute. While I agree wholly with the views he there expressed, he was criticizing the fact that the public had no access to U.S. proposals while I am now noting that secrecy has gone even further than that. Recent practice has shut out the advice and criticism even of outside advisory groups which were established for the very purpose of commenting on prospective U.S. positions in law of the sea negotiations.

I do not expect the U.S. to have difficulty in obtaining ratification of LOS treaties insofar as interested user groups are concerned. For reasons that have nothing directly to do with oil or fisheries, it is not unlikely that both the oil industry and most of the fish harvesting industry will be generally satisfied with treaties on these subjects. The reason for this is that it suits U.S. military interests, which are the priority interest of the U.S., to negotiate for extended coastal authority over both oil production and exploitation as part of the price to be paid for securing rights of transit. Both the oil and most of the fisheries people believe such extended authority is favorable to their interests.

However, if the provisions of Article III were actually negotiated it would still be possible for there to be some difficulty in obtaining Senate consent to ratification. The reason for this is that these provisions, if they are to be made effective in any sense, will completely transform the fishery regulation system traditionally employed in the U.S. That system places fishery regulation in the hands of the

individual states with the federal government playing no role in this respect with the exception of its role in international fisheries. Article III, which is almost completely unworkable in any event, would be absolutely impracticable unless the federal government were to take over fishery management in the U.S. or play a dominant role in this function other than by directly assuming the function. While every informed observer believes that this is a change long overdue and devoutly to be wished, the fact remains that unless the way is carefully prepared there might be some determined opposition to the change. Such opposition must perforce oppose ratification of the treaty.

Beyond this possibility of a federal-state conflict over who should manage fisheries, there is the additional extremely practical consideration that federal management and enforcement would very probably require very large increases in the federal budget for this purpose. As virtually everybody knows this would require a complete reversal of federal budgetary policy which for a number of years has been to reduce federal expenditures for fisheries. In this connection it deserves notice that Article III in its present form has no provisions for extracting license or user fees from foreign fishing, a provision which would perhaps alleviate the financial implications of the Article. This is one of several reasons for believing that Article III is not really a serious proposal.

Objectives of International Fisheries Management and Article III, the U.S. Fisheries Proposal

The major impression one gets on reading Article III of the U.S. proposal is that it is above all a negotiating document and that it suggests the positions to be accommodated without explicitly stating a preference for how to do this. Paragraph 2 provides for an allocation of part (or all) of the allowable catch to the coastal state but also provides that the share traditionally taken by noncoastal states cannot be allocated. It is then stated that an appropriate text on traditional fishing must be negotiated between coastal and distant water states. The textual provision suggests one alternative, that traditional catches must be left as is, and since this is most unfavorable to coastal states I assume it is the intent to alter that position, through negotiations, in favor of the coastal state in return for concessions on other matters.

The real problem here is what the effects on fisheries management goals are as a result of providing for strong preferences or exclusive rights to coastal states. This might be considered in terms of effects on distribution of benefits, increased production of protein, improvements in net yield from fishery exploitation, and maintenance of physical yields of living marine resources. These latter are widely accepted goals of fisheries managment.

Wider Distribution of Benefits

To the extent Article III provides for a preferred position for coastal states in exploitation of adjacent or other fish stocks or species it seeks to enlarge the number of states who realize benefits from exploitation. But, as is obvious, the method chosen here differs substantially from that advocated by the U.S. for non-living resources. For these latter resources the coastal state would get only a portion of the benefits of exploitation from resources beyond the limit of national jurisdiction and the region to which this preference applied would itself be delimited. For fisheries it is apparently anticipated that for adjacent stocks the coastal state gets, actually or potentially, all the catch that can be taken although the U.S. proposal does not specify exactly how the division between coastal and distant water catch is to be made. The only limit to the coastal preference is its capacity to exploit.

It must be reasonably obvious that these proposals suffer serious deficiencies, although some of these are probably unavoidable under current conditions.

One glaring difficulty is that the U.S. draft would allocate stocks solely to coastal states treating each of these formally the same. The standard for allocation is simply that the state borders on the ocean and for various reasons commercially valuable fish happen to congregate "near" there. It does not matter at all, in this approach, whether the coastal state has need for the resources or for the benefits of their exploitation. In this view the richest countries are treated exactly as the poorest. Countries with large numbers of protein-deficient residents, off whose coasts fish occur but sparsely, are given a wholly theoretical preference while countries but sparsely populated by humans are given an allocation of, potentially, all of a rich adjacent fishery. It does not matter, either, that the "capacity" of the coastal state to take from a fishery derives not from its own resources or capital or whether the benefits of the allocation go to that state at all.

The U.S. proposal for allocation of living marine resources contrasts very substantially with the U.S. view on non-living resources. In the U.S. seabed proposal, the coastal state has a high degree of exclusive authority, but it does not realize all the benefits of the resources found in the trusteeship zone. The international community would get a share of the revenues from the resources produced in the trusteeship zone. Under the U.S. proposal for the seabed it is not sufficient that some coastal states might want to take all of the adjacent non-living resources. It is not immediately obvious that living and non-living resources are different for allocation purposes and one wonders what and whose purposes are served by maintaining a distinction in the situations.

Increased Production of Protein

The question is whether adoption of the U.S. proposal would tend to increase production or reduce it. At least for a temporary, perhaps short, period the likelihood is that production will be reduced. The reasons for this assertion is that coastal states are more likely to overestimate their capacity to exploit fish and thus to demand allocations that are unrealistic. The effect of this, especially of course if the allocation is 100% of the available catch but also even if it is less, will be to reduce the level of foreign exploitation. I believe this series of events is very possible if proposals were accepted which give coastal states an initial unilateral decision on who gets what share of fisheries, as does the U.S. proposal.

I am aware that paragraph 7 of Article III sets out a disputes settlement procedure that can be employed in the event there is a dispute over the coastal allocation. The special commission established in accord with this paragraph may decide that the coastal allocation cannot be applied pending settlement of the dispute. It seems to me rather unlikely that a decision to suspend an allocation would be made unless the coastal state's demand was outrageous. However, if it were not suspended but the special commission found against the coastal state I would imagine subsequently disputed allocations might well be suspended.

However one important practical point is whether distant water states would themselves bother to contest an allocation they believed to be excessive in relation to the currently effective capacity of the coastal state. If the coastal demand were not too high, whatever that means, the distant water state might well choose to avoid the dispute. If, at the same time, it respects the coastal decision the consequence may well be a reduction in the distant water catch. It would not be surprising, therefore, to see a temporary reduction of distant water fishing of 10-25% over a period of several years. Since most of the increases recently in total global production have come from the activities of distant water fleets it could well be that diminished production by such fleets will be reflected in a drop in total production.

One other effect of providing for coastal preference might be to diminish investment in distant water fleets. Since, as just stated, it is these fleets that have increased productivity recently, such discouragement to investment could, and I think probably will, reduce the rate of increase in world fish production. It seems to me that it will be very difficult to prove that this effect has occurred, given the dynamics of world fishing.

If distant water fleets are discouraged by allocations of stocks adjacent (whatever this means) to coastal states it may be that future activities will turn to the high seas pelagic stocks which are not, in the U.S. proposal, subject to a coastal

allocation but would be subject to international management. Whether or not such a spur to investment in these stocks is desirable seems questionable. FAO data estimates large pelagic stocks have a potential yield approximately double the present catch (4.3 million tons as against 2 million in 1968). However most of this is skipjack tuna, the other tuna species being nearly fully exploited. Given the continued expansion in the catching capacity of the world tuna fleet it is not clear that this is a fertile activity for still additional investment arising from deterrence to investment in nearshore pelagic and demersal stocks.

Improved Net Yield from Fishery Exploitation

In strict terms Article III has nothing in it which is aimed directly at improving net yields. There are no provisions for licenses or user fees from which the coastal state might derive revenue while providing for limiting entry into the fishery.

However, in allocating catch of a stock to the coastal state the latter would be in a position to limit entry of its own fishermen for taking the amount allocated. Non-coastal states and the coastal states would still have to get together to agree on limiting entry of their fishermen to take the amount left unallocated. In this sense the U.S. proposal is seriously deficient since a major purpose of fishery management is not only to make provisions for allocation of benefits among nations but to increase the size of the benefit to be shared.

I would imagine that provisions for allocation to a coastal state might provide a motive for non-coastal fishermen to arrange for limited entry to a fishery. The reason is simply that unless they do limit entry their costs will increase greatly. If a coastal state receives an allocation of 75,000 out of 100,000 tons, a foreign fleet of 50 boats would now be exerting effort to catch only 25,000 instead of a larger proportion of 100,000 tons. If the boats do not have attractive alternative possibilities it would make a lot of sense to reduce the number of vessels exploiting the remaining stock. However whether or not this situation would frequently arise is unknown. Since most fisheries involve multiple stocks it may be that it is better to maintain the size of a fleet rather than reduce it because one of the stocks is subject to a coastal allocation.

Maintenance of Physical Yields of Living Marine Resources

Article III seeks to get at the problem of conservation, in the sense of avoiding impairment of the productivity of stocks, by providing for a single management entity in those circumstances where one is feasible and by drastically reducing the requirements for data that are needed to support conservation measures.

Paragraph 1 provides that regulation shall be by international organizations established or to be established for such purpose. Since regulation by such bodies is already possible, paragraph 1 does not materially add to the existing situation which is mainly characterized by a large number of regulatory bodies to whom member states refuse to concede meaningful power to regulate. However paragraph 3 provides, inter alia, that the coastal states may unilaterally institute conservation or allocation measures if the states concerned are unable to establish an international organization as called for in paragraph 1. The measures and principles to be applied (by an IO or by a coastal state) are set out in paragraph 2.

There can be little doubt that Article III would make a material contribution to regulation by providing for a specified entity to exercise regulatory authority. Furthermore it is to be noted that the proposal manages to achieve this without finally defining the resources which would be subject to the regulatory body (whether it is international or a coastal state). All that appears on this subject is that allocations to a coastal state (and presumably coastal conservation measures) shall not apply to "a highly migratory oceanic stock" which would be identified in an appendix. Since the term "adjacent" is also not specifically defined the extent of coastal control by area and by stocks is left "flexible".

Article III appears to place great emphasis on international management and this is commendable. The provision for ultimate coastal control could very well provide the needed spur for conclusion of realistic and fair international arrangements. It is to be hoped that paragraph 7's dispute settlement procedures will operate successfully to encourage the coastal state to act reasonably in negotiations for the establishment (or revision) of an international organization. If Article 7 did not so operate the effects on either fishery production or the costs of harvesting could turn out to be drastic, at least temporarily.

Even if a fishery regulatory scheme did not provide for international regulation as the initial and preferred option, it is doubtful if such a method can be wholly escaped. Provision for the unilateral competence of the coastal state will not suffice to cope with stocks which either exist in, or migrate laterally through, waters adjacent to more than one state. There is no doubt whatsoever that this situation occurs and when it does there will be a need either for an international organization or at least agreement between the states concerned on how to conserve and to allocate stocks.

Provision for conservation and allocation control by coastal states is, naturally, not without attendant problems. The main difficulty that I see is that many coastal states do not have the scientific competence upon which to base a regulatory system nor do they now possess the wherewithal to create or buy such competence. In such circumstances there is bound to be a good deal of suspicion of assertions by a coastal state regard-

ing "allowable catch", "maximum sustainable yield", and measures proposed by the coastal state based on these quantities. Of course this condition is likely to make distant water states more amenable to reasonable bargaining for a solution. It will also help to promote cooperation by such states in research activities, in exchange of reliable data and statistics, and even, perhaps, in provision of various forms of assistance to developing coastal states. Perhaps some institutional arrangements will be devised to cope with the imbalance in science and technology relating to fishing as well as other ocean problems. Certainly if the "common heritage" concept, now applied to non-living marine resources, were extended to include fisheries there would be a source of financial support for improvements of this kind.

In one sense the problem of maldistribution of scientific capabilities is somewhat alleviated by the provision in paragraph 2A that "the allowable catch shall be determined, on the basis of the best evidence available, at a level which is designed to maintain the maximum sustainable yield or restore it as soon as practicable, taking into account relevant environmental and economic factors." While this statement is not a triumph of legal draftsmanship, it does appear to lessen substantially, if not eliminate, any cumbersome problems of proof in establishing what the MSY may be or what the allowable catch might be. Very plainly the "best available evidence" may consist of very sparse statistics or sketchy scientific inquiries yet these would be satisfactory, apparently, as the basis for coastal or international organization decisions on conservation and allocation. Whatever else this provision might accomplish it would surely meet the demands of those who believe there is an urgent need to speed up the management process in the face of rapid movement and increases in fish catching ability.

The difficulty with this approach is that it appears to throw out any standards or criteria and leaves the coastal state virtually complete discretion. It is true, again, that a compulsory review procedure is established by paragraph 7 but it is hard to see how this works as a protection against arbitrary coastal action when no standards are provided for assessing that action.

One general point in assessment of these proposals relates not directly to fisheries but to the paramount interests of the United States as they apparently are conceived by U.S. government officials presently. The proposals tabled by the U.S. for fisheries are inspired not primarily by U.S. interest in fisheries, which is hardly of any great shakes insofar as the U.S. harvesting sector is concerned, but by military considerations. This is not unique -- the U.S. proposals for the seabed beyond the limits of national jurisdiction are also heavily influenced by military concerns. The effect of such weighting the U.S. interests, so far as fisheries are concerned, is to produce a fisheries proposal that does not mention a

fisheries limit or fisheries zone but attempts nonetheless to provide favorable treatment for coastal fisheries.

The difficulty with this ordering of priorities with the U.S. is that it may lead to less desirable arrangements for fisheries than if the U.S. really were interested in the matter. The arrangements the U.S. wants for fisheries are those which contribute to our military security problem. Since these could be inconsistent with acceptable goals of fisheries management, it is unfortunate that the U.S. position is as it is.

Roles for Sea Grant Institutions in Improving International Fisheries Management

It seems to me probable that the major contribution reasonably to be expected from Sea Grant institutions are in the advisory and research fields, the former being employed to disseminate the results of the latter. Many types of research are pertinent for fisheries management and it is not possible here to give time to discussion of them. A major input that would prove extremely beneficial would be the undertaking of studies of important regional fisheries using a very broad contextual, or systems, approach that would require the contributions of persons from a variety of disciplinary backgrounds. It is very clear that the level of effort needed to mount and to maintain such inquiries is not trivial. The project at the University of Washington which studies the fisheries of the North Pacific is an extremely ambitious effort and one that potentially involves the full-time work of an appreciable number of faculty and graduate students. A Sea Grant institution or a group of such institutions and other agencies could be an ideal mechanism for conducting regional studies of the scope and intensity required. Universities, other public agencies as well as private groups can band together to provide the considerable variety of skills that are essential for adequate investigation of such complex social, political, and scientific problems as are presented by international fisheries.

One major reason for suggesting regional studies is that this requires emphasis on relatively specific situations. Because of the more specific focus, the investigator may be able to escape the uncertainty which attaches to the current and anticipated LOS negotiations. It is very difficult to forecast the outcome of those negotiations for fisheries all over the world or on a very general basis. However it may well be feasible to investigate particular regional settings where patterns of supply, demand, fishing effort, organizational effort, and other factors can be projected against an array of more or less likely alternatives. In addition, it seems more likely than not that after LOS-73, if it reaches agreement on fisheries issues, states will continue to need to negotiate disagreements over fisheries matters in regional contexts.

It is likely that many institutions and individuals are not situated so as to conduct formally organized joint studies. There are a large number of useful projects to be pursued that are worthwhile as separate inquiries. Dr. Christy has written a paper outlining a number of these. In addition a report of a working group of the Committee on International Marine Science Affairs Policy (IMSAP) suggests a number of others. This report, to which Dr. Christy's paper and others are appended, is available by writing Richard Vetter, Executive Secretary, Ocean Affairs Board, National Academy of Sciences, 2101 Constitution Avenue, Washington, D.C. 20418.

These brief remarks have concerned international problems of fisheries management which, it is fair to say, are at a crisis state. There are also national problems that bear on global ones. I do not believe it is an exaggeration to say that the most critical problems plaguing fisheries in the United States come not from scientific and technological deficiencies but from institutional and regulatory barriers that obstruct efficiency and fail to ameliorate conflict. Accordingly as valuable as Sea Grant programs are in developing improved yields or better predictive capacities based on scientific investigation and improved gear or processing equipment based on technological advance, it is very likely that the most startling benefits for fisheries would arise from removal of the institutional and regulatory barriers that raise costs, deter fisheries development and pander to political prejudices. I believe this statement is really very conservative--in the case of the Pacific Northwest it has been demonstrated that on the most conservative estimate about $ 35 million per year are squandered through legislated inefficiency in harvesting salmon. Removal of this single institutional barrier would produce a social surplus several times larger annually than the entire present federal Sea Grant budget. This situation may be unusually extreme but on different levels similar institutional constraints hamper marine fisheries in other states. Research advisory work that assists in remedying this situation would be a material contribution by the National Sea Grant program.

Fishery Problems and the U.S. Draft Article

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I would like to make three main points. The first is that the principle of the freedom of the seas for fisheries is no longer a viable principle. The second is that the world community is now compelled to face up to the problems of distributing the sea's wealth in fisheries. And the third is that the problems are extremely complex and will require considerable attention by social scientists if they are to be resolved with a minimum of damaging conflict. Some brief comments on each of these points will be made in order to provide a background for an assessment of the recent United States "Draft Article on Fisheries."[1]

The Freedom of Fishing

For the past three hundred years, one of the basic principles of the freedom of the seas has been the freedom of fishing. This means that beyond the limits of national jurisdiction, there is free and open access to all fishery stocks by the fishermen of all nations. No individual state or groups of states has a right to exclude the fishermen of other states or to require payment for the privilege of fishing.

The condition of free and open access can be maintained without damage to society provided that the use of the resource by one unit does not diminish the value of use to other units. There have been, and still are, a number of natural resources for which these conditions hold true. The air we breathe, sunshine, the view of the Rocky Mountains, are natural resources that can generally be used by two or more persons or units with no decrease in value. In earlier times, the same conditions held true for the common grazing lands of the West and for the water in rivers, streams, and lakes. But the demand for the flow of services from these resources increased beyond the supply; users interfered with each other; and society's values were diminished.

The case of the western range lands is instructive. In 1870, it was reported that "all the flocks and herds in the world could find ample pasturage in these unoccupied plains and the mountain slopes beyond; and the time is not far distant when the largest flocks and herds in the world will be found here, where the grass grows and ripens untouched from

year to year."[2] Such remarks about inexhaustibility are not dissimilar to past assertions about the inexhaustibility of the sea's fisheries.

Since the bounty of the range was believed to be limitless, it was assumed that use by one cattleman would not diminish use by others, and there was, therefore, no need to acquire exclusive rights or to impede free and open access. At that time, the only characteristic of private ownership that existed was that of the brands on the cattle.

It was not many years, however, before depletion of the range became apparent and conflicts between users of the range became significant. This increased the incentives for the acquisition of exclusive rights. Simultaneously, the technical costs of acquiring such rights were greatly reduced by the development of barbed wire. "Companies with headquarters in eastern cities, and even in England, fenced in as much as they wanted and some had the effrontery to claim in court that a man had a right to as much land as he could fence."[3] But the land was in the public domain, to be used for the benefit of citizens of the United States. In 1885, Congress passed an act making enclosure (unilateral appropriation) a punishable offense, thereby reinforcing the condition of free and open access. This "meant that there was virtually no control over the land and the first comer was entitled to the grass. No one was responsible in a large way for overgrazing and the resulting destruction of the forage."[4]

The cattlemen were more immediately concerned about the excessive competition among themselves and with other users than they were about the depletion of the range. It might be said that, to the cattlemen, the distribution of wealth was more important than efficient production of wealth. This, consequently, led to collusive and extra-legal devices for acquiring de facto exclusive rights. In 1904, a Public Lands Commission appointed to study the problem stated that "at present the public lands are theoretically open commons, free to all citizens; but as a matter of fact a large proportion has been parceled out by more or less definite compacts or agreements among the various interests." The compacts and agreements were not very stable, however, and the growing demands and growing incentives for exclusive rights led to the conflicts known as the "range wars".

Attempts to establish entry limitations and user fees were opposed by the cattlemen for various reasons.

> It is claimed by some stockmen that they cannot afford to pay a fee, that it would mean bankruptcy. It is feared by some that under any system of control the large owners and corporations would secure a monopoly in the use of pasture land, and the young men starting in the business of stock raising would have no opportunity to build up under a lease system.

> Other stockmen hold the view that since they have fought out their controversies and arrived at mutual agreement as to the use of the range, it would be foolish to open the whole question for new adjustment. It is held that, although range conditions are not entirely satisfactory, it is better to continue the present system than to take any chance on the application of new methods.[5]

However, the mood of Congress with respect to the public domain was such, that in 1934, the Taylor Grazing Act was adopted. This removed the condition of free and open access and established a leasing system under the authority of the Federal government. This provided for a distribution of the wealth among both the owners of the resource -- the general public -- and the users of the resource in contrast to the cattlemen's proposal which would have granted the users full property rights and all of the wealth.

The history of common property grazing lands bears many similarities to the developments taking place in fisheries. It has often been claimed in the past that the fish of the high seas were so abundant that all could win and none could lose in their enjoyment. This argument has been advanced in order to support the principle of the freedom of the seas and to protect the maritime powers from impediments to their free use of the seas for other purposes. The argument, however, was of dubious validity even during the period in which the principle of the freedom of the seas was being formed. Scarcity of herring in the North Seas has been known for centuries. And as early as the 1600's in the Northwest Atlantic, Captain John Smith asserted that "New found land doth yearely fraught neere 800 sayle of ships with a sillie leane poore John and codfish; which at least yearely amounts to 3 or 400,000 pound -- yet all is so overlaide with fishers as the fishing decayeth and many are constrained to return with a small fraught."[6]

Since the days of John Smith and, more spectacularly since the days of the Second World War, the economic scarcity of fish has become much more severe and much more pervasive. The myth of abundance is no longer credible. From the Second World War until 1968, the world catch of fish increased at about the rate of 6-7% per year. The catch in 1969 was less than that of the previous year. While the 1970 catch is likely to be larger, the past rate of increase cannot be maintained into the future. Recently made projections indicate that the rate of increase will only be about 2-4% per year until 1985, and may even level off after that.[7] But even though the supply of fish is limited, the demand will continue to grow and the consequences will become increasingly severe.

One of these consequences will be the increased amount of depletion. There are dozens of stocks of fish that are already being fished beyond the point of maximum sustainable yield. And several more will be added to the roster in the near future and at an increasing pace. One observer has stated that "many

fisheries scientists and administrators do not seem to realize even now that the days are gone in which years can be taken in studying and taking action on a particular fisheries problem, for the time is gone in which problems could take years to develop. With modern vessels, gear, and techniques, it is increasingly easy to create a new problem overnight, and problems of fisheries management must be dealt with speedily."[8]

Depletion is the consequence of growing demand applied to limited supplies under the conditions of free and open access. Since the resources are available to all at no direct cost, no individual fishermen will voluntarily restrain his effort in the interests of future returns. Anything he leaves in the sea for tomorrow will be taken by others today.

Conservation regulations can (and sometimes do) prevent depletion. But most such regulations have, at least ostensibly, attempted to avoid affecting the distribution of wealth -- in the language of negotiators, have attempted to be "non-discriminatory". That is, instead of closing off free and open access, they make all users subject to the same restraints -- such as using certain sized mesh in nets or by stopping fishing when total catch reaches a certain point. In conservation terms, such regulations have occasionally been successful. But in economic terms, they have all been disastrous.

The economic consequence of maintaining free and open access is a great waste in the uses of capital and labor. In most natural resource situations the resource is owned by a single individual or economic unit, and the right of access is exclusive to the owner. In these situations, capital and labor are invested only to the point where marginal revenues equal marginal costs -- the point where there is the greatest difference between total revenues and total costs. But in the case of fisheries, where there are no controls over the amount of capital and labor, any difference between the total revenues from the stock and the total costs of the fishermen will be an excess profit shared by the fishermen. The excess profit inevitably attracts more fishermen until the point is reached where total costs equal total revenues and all excess profit has dissipated. In short, more fishermen are employed than are necessary to produce a certain amount of catch.[9]

In the Pacific salmon fishery of the U.S. and Canada, it has been estimated that the same annual catch (and total revenue) could be taken with about $50 million less capital and labor than are currently employed each year.[10] For the U.S. Georges Bank haddock fishery, an estimate made several years ago (prior to the utilization of that stock by the Soviets), stated that "the point of maximum profit would be at a level 50% or less of the recent average (amount of effort)."[11] In a recent publication, the FAO stated that "it has been estimated that the total effort on some of the major stocks of cod and haddock in the northeast Atlantic has increased so far

that substantially the same or possibly an even slightly greater catch could be taken with one-half to two thirds of the present level of fishing."[12]

There is no way in which such waste can be prevented except by removing the condition of free and open access. Either one or the other or both conditions of access must be changed. That is, economic waste can be prevented by keeping access open to all comers provided they pay an appropriate fee for the privilege of fishing. The size of the fee, ideally, would be such that only the most efficient number of vessels would be used and the difference between their total costs and the total revenues to the stock would be at the maximum. In this situation, this difference -- the economic rent -- would be appropriated by the collector of the fees. The fishermen that remained in the fishery would be no worse off than before, but there would be fewer of them.

Economic waste can also be prevented by keeping access free but by limiting the number of fishermen. This could be done by requiring licenses and limiting the number of licenses to the appropriate amount of effort. This system has been adopted by the Japanese for their distant-water fishermen and by New York City for its taxicabs. In this case, the profit accrues to the holders of the licenses and can be realized if they are able to sell their privileges. A combination of the two techniques is now being employed by the Canadians for the salmon fisheries in British Columbia.

For both economic and conservation reasons, the removal of free and open access is greatly to be desired. Economic rationality in fisheries cannot be obtained unless this occurs. But, as indicated above, the removal of free and open access can only occur by directly distributing the wealth of the seas in fisheries. If access is open but no longer free, then the wealth is taken by the collector of the fees who may either keep it or distribute it to others. If access is free, but limited by license, then the wealth is distributed among the licenses. The adoption of an economically rational system makes wealth distribution inevitable.

Developments Forcing Wealth Distribution

But even if the arguments for economic rationality did not exist, some form of distribution of the sea's wealth in fisheries is still inevitable. It simply cannot be avoided. In view of the shortness of time, I can only outline the arguments leading to this conclusion and make reference to materials providing fuller treatment.

1) The effect of growing demand on limited supplies is to increase the value of the supplies. It has been estimated that, by 1985, world catch will increase by less than 40% while gross revenues will increase by more than 100%.[13] The value of an exclusive right to a stock will also increase greatly

and provide an increased incentive for acquiring a share in the wealth.

2) There is an increasing number of fishery arrangements whose viability depends upon their ability to exclude newcomers, or, in essence, to distribute wealth among those with a history of participation in the fishery. National quota and other distributive arrangements, such as those for Antarctic whales, North Pacific fur seals, the salmon abstention agreement, Soviet-Japanese salmon and king crab agreements, cannot successfully accommodate new entry by non-member fishing states. These arrangements are similar to the "more or less definite compacts and agreements among the various interests" in the western grazing lands and they may have the same degree of instability.

3) With diminishing opportunities for increased catches and with growing impediments to new entry, the value of the option to fish at some time in the future has been greatly decreased. In the past, some non-fishing or small fishing nations may have been satisfied with the principle of the freedom of the seas as long as they could anticipate deriving some value from it in the future. But this option to fish, which can be considered an item of wealth, has become greatly devalued and may lead nations to demand a more direct participation.

4) There has been a rapid and dramatic increase in the amount and extent of distant-water fishing effort. Large, foreign fleets of technologically advanced vessels have suddenly appeared off the shores of many coastal states (both developed and developing). By far the most significant effort is that of the USSR, which owns more than 50% of all fishing vessels over 100 gross tons in size.[14] The sudden appearance of such vessels (Soviet or not) understandably causes coastal states to become concerned about the wealth off their shores.

5) Such fleets have the capacity to sweep a fishery ground and deplete a stock in a single season. They are also highly mobile so that once having depleted a stock, they can move off to other distant water areas with little difficulty, whereas the local coastal fisherman, with small, specialized craft have little or no alternative but continue harvesting the depleted stock.

6) There is a considerable amount of instability in fisheries arrangements due to the continuing increases in excess capacity. A "domino" effect might take place at any moment. If, for example, nations reached an agreement for the Lofoten Islands and Barents Sea that displaced fishing effort, the displaced effort would quickly shift to the west and south. In self defense, Iceland would probably extend its limits, thereby displacing more effort, and shifting it to the Northwest Atlantic. This might force either national quotas or unilateral extensions of jurisdiction, but would, in either case, force more vessels out. The repercussions could even be felt in the South Atlantic if the vessels are sufficiently mobile. Something on this order is now actually occurring with respect to tuna.

The tuna situation was greatly exacerbated by the adoption of a form of conservation reguation that was known to have very damaging economic consequences. Its adoption was due to the unwillingness of the fishery scientists and diplomats to face up to the problem of distributing wealth by the allocation of national quotas or by the imposition of economic controls. It was also due to their short-sighted approach to fishery problems and their inability (or unwillingness) to anticipate the consequences, or to learn from the lesson of the North Pacific halibut arrangement.[15]

In 1967, the Inter-American Tropical Tuna Commission established a total quota on the catch of yellowfin tuna in the region. Under this arrangement, each fisherman has an incentive to build a larger and faster vessel in order to get a greater share of the catch for himself before the total quota is reached and the season closes. In the tuna situation, the incentive has clearly been at work. Almost half of the current U.S. high seas tuna fleet (in terms of gross tonnage) was built since the establishment of the quota -- 3,809 tons in 1967, 6,032 tons in 1968, 9,185 tons in 1969, and 10,427 tons in 1970.[16] It is reported that an additional 21 vessels with a capacity of about 24,000 tons are now under construction in the U.S., and about 32,000 tons elsewhere in the world.[17]

The global repercussions from this artificial stimulus to over-capitalization derive from the fact that the large number of vessels is able to catch the total quota in a short amount of time. Prior to the control, the season was about nine months. It now takes only about 3-4 months to reach the quota and will take less as more vessels are added. Since the vessels are large and highly mobile, they naturally turn to other areas of the world after the close of the eastern tropical Pacific fishery. The domino effect has already been felt in the Atlantic and may soon reach the western Pacific and Indian Oceans.

7) Outside of fisheries, developments have recently taken place that indicate the oceans to be a source of great mineral wealth. Since some of the sources of this mineral wealth -- the manganese nodules -- lie well beyond any conceivable jurisdiction of coastal states, the question of ownership of that wealth has been clearly and forcefully raised. States without the technologic or economic capacity to exploit these resources feel that they should share in the benefits. This has produced the concept that the oceans are the "common heritage" of mankind. It might be noted that the germs of this concept can be found in the arguments advanced by the most vocal advocates of the principle of the freedom of the seas. These advocates, in seeking to protect the interests of the maritime powers, have claimed that the freedom of the seas has served all peoples of the world in the production of mutual benefits. It is not surprising that the non-maritime states, having been taught this lesson, should now attempt to realize their benefits in more explicit terms.

8) A final development of importance can be found in the increasing strength of the developing states and in their growing demands to share more fully in the world's wealth.

All of these developments, most of which have taken place since the 2nd UN Conference on the Law of the Sea in 1960, will come into focus in the next few years, during the preparations for, and the holding of, the 3rd UN Conference on the Law of the Sea. They make it impossible to avoid facing up to the task of distributing the sea's wealth in fisheries.

Who Gets What?

In a certain sense, the question of distribution of wealth is not one that lends itself to analysis. That is, there are no rational, objective criteria by which one can determine who should get what from the sea. The process of distribution is essentially a process of negotiation -- the function of diplomats willing to trade off certain items of value in order to achieve others. But social scientists can --and should -- provide a great deal of information and analysis that will facilitate the tasks of the diplomats and help to reach more viable arrangements and better decisions.

Research of this kind is essential not only to the process of distribution but also to many aspects of fisheries management and fisheries science. It is wasteful, for example, to invest scarce public funds in the development of new techniques for fishing a stock that is already depleted or a stock that may soon come under the jurisdiction of another coastal state. It is wasteful to plan a scientific program that requires access to the waters of a coastal state that may prohibit such access. Different kinds of scientific research may be required for different kinds of international arrangements such as national quotas or license schemes. In short, knowledge of distribution problems and alternative management techniques is an extremely important element in making choices about the best use of scarce public funds for research.

Although there are many kinds of problems, only three will be described here -- chosen because of their relevance to the U.S. Draft Article. These three deal with the meaning of wealth, the means for its distribution, and the criteria for distribution.

The Meaning of Wealth

Reference has already been made to one measure of wealth -- the amount of economic rent that could be captured by an economically rational scheme of management. In the world of the fictional economic man, this (or some similar measure of economic contribution) would be the best possible. The value of the fishery stock would be clear; efficient allocation of capi-

tal and labor to different stocks would be feasible; and distribution of wealth would be facilitated by using a common denominator -- money.

But it doesn't take much thought to expose the weaknesses of the fiction; weaknesses that are crippling but not fatal. One of the weaknesses lies in the difficulty of determining where the monetary value should be placed. One might be the yield from the stock. Another might be the stock itself or, perhaps, the ecosystem inhabited by the stock. These bases for wealth are beset by their own set of difficulties -- as is indicated by the lengthy and abstruse arguments over yield functions and population dynamics. Monetary value might be placed through means of license fees upon some measure of effort, such as the length, power, or tonnage of vessel or size of net or number of pots. These measures also have their difficulties, not the least of which are the impediments that they create for technological innovation.

But even knowing where to place the value does not resolve the difficulties, for there is still the question of the amount of value. This raises problems because the same fish stock might be taken by fishermen from nations with vastly different wage/price structures. The same fish might produce a high net economic revenue to one nation and a low one to another.

An even more upsetting weakness is that the fiction ignores non-economic man. There are many values, other than monetary ones, that nations seek from fisheries. Chief among these is the use of fisheries to provide opportunities for employment. This is particularly upsetting to an economist because employment opportunities tend to be maximized when access is free a and open, and they are minimized under economically rational management. Nevertheless the values are real and politically potent, even though not readily susceptible to measurement. Other non-monetary values might be mentioned, but it is sufficient to point out that they exist and that they represent items of wealth.

Determining the meaning of wealth is obviously difficult. There is tremendous room, however, for improving our estimates and perceptions of wealth. It is critically important to know, far better than we do now, what it is that we will be trading off in the coming negotiations; and this is a task for economists and other social scientists. Parenthetically, I might express the hope that similar analyses of values might be undertaken for the military interests in the freedom of transit. It is asserted that the military values are so great they are not negotiable. But the assertion rings hollow, for the analyses (if any) have never been produced and the values are, by no means, clear. Unless and until the military values are clearly demonstrated to be great and long-lasting, I, for one, will remain skeptical about the wisdom of trading off fisheries and other items of wealth in order to achieve the freedom of transit.

The Means for Distribution of Wealth

Another set of problems lies in determining the best means for the distribution of wealth. Several different alternatives are possible. One would be to distribute wealth on the basis of some spatial dimension, such as distance from shore or depth of water. Distance is a conventional means and it is relatively easy to define (once one arrives at a uniform concept of islands and archipelagoes). But fish are notoriously disrespectful of such boundaries. Depth appears to have some biological rationale since many species, particularly the demersal and sedentary ones, are limited in depths to which they penetrate. But because of vertical migrations and other factors, the limits may be well beyond the edge of the continental shelf. For certain species, such as tuna and whales, neither distance nor depth has much relevance.

It may be possible to distribute wealth on the basis of the resource, irrespective of its location. This, in essence, is what the U.S. and Canada have attempted to do by making the Japanese abstain from taking salmon east of the 175° West Meridian. It is an attempt to incorporate (and appropriate) the entire resource. Another approach using the resource is that of national quotas, a modification of which is found in the U.S. Draft Article. This requires a satisfactory estimate of the annual sustainable yield. Neither of these tasks is easy.

A third means for dividing wealth that is conceivable, although not yet attempted internationally, is through the distribution of effort. Under this technique, licenses to fish would be distributed. This could be done through some form of "grandfather" technique, permitting all those currently fishing to continue doing so and then letting attrition take place on some uniform scale for all parties. The technical difficulties of defining what would be licensed and how to achieve uniform attrition are probably so great that such a system could not be adopted.

The final means that should be mentioned is that of distributing wealth by distributing economic rents. This is, by far, the most sensible from an economic point of view. It too has its difficulties -- the major one being the adoption of a system that permits economic rent to be captured. But if this can be achieved, rent offers the simplest and most direct means for distribution. In addition, and this may be the critical determinant, this is the only practical means by which the non-fishing states can share in the distribution of fisheries wealth. National quotas or licenses could be alloted to non-fishing states, and they could either develop the necessary capital and labor to use them or they could sell them. But this would be neither efficient nor politically realistic. If the interests of the non-fishing states must be accommodated, then some system for capturing economic revenues will have to be adopted. Indeed, it would be eminently desirable to adopt such a system in any case, for it would be the most effective and

viable over the long run. Monetary management of fisheries has received some attention in the past, but there is still a great need for further research.

The Criteria for Distribution

Many criteria for the distribution of wealth have been suggested, usually in support of a nation's claim to a share of the wealth. The criteria are poorly defined and their use tends to be subjective in nature. It is difficult to question their validity, but possible to question their value as guides for decision-making.

1) "Proximity" is the most important criterion and, up to a point, carries the greatest weight. A stock that lies close to a coastal state clearly "should" be considered as belonging to that state. However, there is no satisfactory definition of the extent of proximity.

2) A second criterion that has often been advanced is that of "need" or "dependence". It is stated that if a nation is dependent upon fisheries as a source of protein, income, or employment opportunities, then it "should" acquire a share of the wealth. It is even more difficult to define need than distance. What percentage of income or protein should be derived from fisheries in order to qualify a state as dependent? In addition, to which resources should the criterion apply? If need is an acceptable criterion, why should it not apply to resources far distant from its shores as well as to those that are close?

3) A third criterion, most recently advanced by certain Latin American states, might be called that of "natural prolongation" (after the criterion suggested by the International Court of Justice for the sea-bed). In this case, the argument is that the natural environment off the coast is an indivisible part of the terrestrial environment and thus, "should" belong to the coastal state. In Latin America, it is the Humboldt Current and the deep upwellings that form the character of both the land and the adjacent sea. In other areas, the continental shelf might be considered a natural prolongation, so that, for example, Georges Bank haddock "should" belong to the United States rather than Canada.

4) An often used criterion is that of "historic rights". One of the problems with this is the definition of the number of years that constitutes history. This is a source of controversy in the discussions of national quotas in the North Atlantic. The Soviets, who are catching increasing shares of the total yield, would like to define "history" in terms of the present and future, while those states with decreasing shares would like to choose a base period some years back.

5) A criterion similar to that of natural prolongation is one that refers to the "management" ability of the coastal state. It is argued that, because of environment and proximity, a coastal state is better equipped to manage and conserve near-by stocks and therefore, "should" acquire the stocks.

This is one of the criteria advanced by the U.S. and Canada in their claims to exclusive rights to the Pacific salmon. However, one can question the validity of this criterion in this instance since salmon are so poorly managed. For example, in the last 25 years, the total catch of Alaska salmon has declined by a third while the total number of fishermen has doubled.

6) Another criterion is "exploitability." This was also used by the U.S. and Canada with respect to salmon -- the argument being that because the stocks were being "fully utilized" and managed, they "should" belong to the host state. A more recent version of this criterion is found in the U.S. Draft Article. This refers to potential utilization rather than past. "The percentage of the allowable catch of a stock in any area of the high seas adjacent to a coastal State that can be harvested by that State shall be allocated annually to it." Comments on this criterion will be made later.

7) Finally, I should like to mention the criterion of "common heritage". To quote the Representative of Singapore at the August meetings of the Sea-Bed Committee: "It is the view of my delegation that every State, whether coastal or landlocked, should be entitled to a fair share in the seabed and in the resources of the sea, be it living or mineral. The marine environment of this earth constitutes an 'indivisable whole' in which every member of the international community is entitled to an equal share." Unlike the others, this criterion has yet to find application.

Knowing man's ingenuity, it is likely that other criteria will be brought forth from time to time. Which criteria one chooses will depend upon what one wants to gain. From a relatively objective point of view, the most that can be said is that the criteria should be simple to use, clear-cut in definition, and widely acceptable.

The Importance of Common Heritage

I have referred several times to common heritage, and have done so because the accommodation of this concept may be necessary and because such accommodation would create particularly difficult problems for the management and distribution of the sea's wealth in fisheries. In the absence of common heritage interests, the struggle would remain between the interests of the coastal states and the distant-water states. These could continue bumbling along their rocky path, ignoring economic factors and trading off special privileges and rights in a primitive kind of bartering, until the card house collapses.

The United States, for example, is foremost among those avoiding the market mechanism for making decisions on fisheries. We have negotiated several ad hoc, bilateral agreements with the Soviets, Poles, and Japanese. These constitute an intricate web of trade-offs, providing port calls to the Soviets, for example, in exchange for their abstention from fishing a

particular region 100 miles or so from shore during a particular season of the year. These agreements are workable, in the short run, and they provide employment opportunities for enforcement services and diplomats. But no one knows what is being traded off and the arrangements are not very durable.

Nevertheless, such techniques are likely to continue unless it becomes necessary to buy out the non-fishing states with their demands for common heritage shares or until present techniques fail completely. As stated above, the only way in which this can be done is by putting fisheries on a market basis. This would require explicit evaluation of fisheries or fishing rights in monetary terms. It would require some means for extracting economic revenues from the fishermen. And it would require the creation of some kind of regional or international authorities to collect and disburse the revenues. From the point of view of economic efficiency, such measures would be highly desirable. From the point of view of common heritage interests, they may be necessary.

The case for common heritage is weak with respect to coastal state stocks and becomes stronger with respect to high seas stocks. If, for example, some system of national quotas is adopted for North Atlantic cod and haddock, the system would have to allow for potential new entrants. It is proposed that a certain proportion of the total annual yield be set aside for this purpose. Depending upon the portion set aside, it might accommodate one, two, or possibly three new states. But the accommodation of a fourth state could only be achieved if the participating states were willing to give up a portion of their share.[18] Since this would be extremely difficult, the system might collapse.

This might be avoided by extracting some revenues from those who receive national quotas and using the revenues to meet, through some means or other, the interests of the non-fishing states. The revenues might be distributed directly to the states, might go to a development fund, or be devoted to some acceptable common goal. In order to succeed, the revenues would have to be used in such a fashion that the potential new entrant feels that it is better off by respecting the agreement than by entering the fishery and breaking the agreement.

Aside from this particular kind of situation (admittedly tenuous), the meeting of common heritage interests may be forced by the strength of these states at the next Law of the Sea Conference. The representative of Austria, at the last Sea-bed meeting, pointed out that "there are twenty-four member states of the United Nations which do not have coastlines; twenty-five, with the expected admission of Bhutan during the twenty-sixth General Assembly . . . In addition to these twenty-five countries, there are about another twenty countries which are shelf-locked and share the general interests and objectives of land-locked countries."[19] In addition, there may be several coastal states with insignificant fishing interests that may want

to join the land-locked states. Since there will be about 130 or so states at the Law of the Sea Conference, the ones with predominantly common heritage interests could make up a blocking third, if they were to hang together.

The U.S. Draft Article

Having presented some of the problems and background associated with the distribution of the sea's wealth in fisheries, I now turn to a few comments on the U.S. Draft Article on Fisheries. The comments need only be brief, because it would appear that the Article has been proposed more as a basis for bargaining than as a real solution. In fact, when examined, it can best be labeled as a "non-solution" because it advances no viable principles and because it essentially leaves distribution up to the same bilateral and multilateral negotiations that have taken place in the past.

The most important paragraphs dealing with distribution are contradictory. Paragraph 2C states that "the percentage of the allowable catch of a stock in any area of the high seas adjacent to a coastal State that can be harvested by that State shall be allocated annually to it." Paragraph 2E(1) states that "the percentage of the allowable catch of a stock traditionally taken by the fishermen of other States shall not be allocated to the coastal State." The first so-called principle advances the criterion of exploitability and the second, the principle of historic rights.

In referring to this contradiction, the head of the U.S. Delegation stated that "it is the view of the United States Government that an appropriate text on the question of traditional fishing rights is a matter especially suitable for negotiation bewween coastal and distant-water fishing States most concerned."

In essence, this Draft Article seeks to preserve the status quo, providing no useful guide for future decisions. It is not particularly fruitful to comment on specific items in the Draft, because they are not likely to endure. But some comments can be made on the intentions that are implicit in the Draft.

First, the Draft avoids any reference to limits, except by use of the word, "adjacent." The reason for this comes clear in the text of the statement made by the head of the delegation. "We believe the Subcommittee should avoid the extremes of absolute freedom of fishing beyond 12 miles, and of absolute and exclusive coastal State control over fisheries in a fixed zone beyond 12 miles. We are particularly concerned about the implications of the latter for navigation and overflight, in view of the historical tendency to assert more and more types of control within fixed zones of special purpose jurisdiction."

This clearly indicates the dominance of military interests. But it is hard to see how the open-ended proposal could have any effect but a temporary one on the extension of fisheries jurisdiction. The U.S. has already proposed exclusive jurisdiction over sedentary fisheries out to the edge of the continental margin.[20] The application of the exploitability criterion to fish of the superjacent waters could lead to equally (or more) extensive limits for particular stocks. Through our ad hoc, bilateral agreements with the Soviets and others, we have already claimed a form of exclusive right to certain stocks more than 100 miles from our shores. As demand increases and technology reduces the costs of exploitation, our ability (and interest) in exploiting more and more stocks will become greater. It is not difficult to see that the eventual outcome will be exclusive fishery jurisdiction over all stocks out to limits that may be quite extensive, perhaps even beyond 200 miles or the edge of the shelf.

It may be that the exploitability criterion is proposed as a temporizing measure. This assumes that within a few years, the U.S. defense interests will be less concerned about extensive limits than they are at present. The future development of ULMS -- the Underwater Long-range Missile System -- will reduce, in part, the desirability of defense interests in operating in the superjacent waters close to the shores of foreign states. The adoption of the exploitability criterion for fisheries may postpone eventual extension of exclusive fisheries jurisdiction until ULMS comes into operation. Or it may be that the proposal is simply an opening, bargaining position. At some future time, we will be able to accept wide limits of jurisdiction in exchange for freedom of transit. But whatever the case, this element of the proposal is intended to protect U.S. defense interests.

Second, the Draft makes no provision for the entry of new states into old fisheries. In fact, it would appear to exclude such entry, in that it states that provision 2E(1) "does not apply to any new fishing or expansion of existing fishing by other States that occurs after this Convention enters into force for the coastal State." This appears to be an attempt not only to preserve but also to enforce the <u>status quo</u>, and to exclude the new fishing states.

Third, there is a marked contradiction between the U.S. treatment of fisheries and the U.S. treatment of sea-bed minerals. The Sea-bed Convention would give coastal states both the right to exclude foreigners and the right to extract revenues from exploiters. Whereas for fisheries, the opposite holds true. According to Mr. Stevenson, "we do not consider it wise to give any state the right to prevent or encumber fishing for portions of stocks that state cannot harvest itself". The purported rationale for this is that it could reduce the production of protein, or make protein more costly to society. This is not necessarily true. But if this were to be the case, the argument might be advanced that there should also be free and open access to the mineral resources that are not being

exploited by the coastal state.

Fourth, the Draft Article makes no reference whatsoever to common heritage interests. This might be construed as a desire to maintain the status quo; as an implicit recognition of the difficulty of meeting common heritage interests; or as an attempt to keep something back that can be traded off at a later date. It is, however, a bit peculiar to find that the worthy sentiments for common heritage expressed in the Draft Convention on the Sea-Bed are totally absent from the Draft Article on Fisheries.

A fifth and final comment is that the Draft assiduously avoids any reference to the possibility of using economic controls. The only reference to economic factors is the meaningless statement in paragraph 2A that "the allowable catch shall be determined, on the basis of the best evidence available, at a level which is designed to maintain the maximum sustainable yield or restore it as soon as practicable, taking into account relevant environmental and economic factors." It is interesting that the State Department should ignore the possible use of taxes and licenses at the same time that the Department of Commerce is actively exploring such devices for domestic fisheries. The Director of the U.S. National Marine Fisheries Services, at a highly significant but little noted recent congressional hearing, made a very forceful presentation in favor of establishing institutions that would permit market mechanisms to become effective for fisheries.[21] The Draft Article, however, would continue the primitive bartering technique and would be likely to impede, rather than facilitate, the employment of economically rational controls.

Summary

By way of summation, it can be pointed out that the U.S. Draft Article on fisheries has little, if any, relevance to the developments that are taking place and to the problems that are emerging in the real world of fisheries. Sadly, this can be explained, in part, by the severe constraint dictated by the U.S. military interests in the sea. But even with this constraint -- assuming for the moment that it is desirable -- a much better draft could have been prepared.

This, then, raises the question as to why the Draft is not better than it is. The answer, I think, lies in two failures. The first of these is the failure of the U.S. Government to open up its process of analysis to the concerned public. Both Mr. Burke and I have commented on this in some detail.[22] The arguments need not be repeated here except to say that by proceeding in secret, the Government is needlessly cutting itself off from ideas, interests, and knowledge.

The other failure is mine and that of the scholars like myself who have been unable to stimulate the social science

research that is necessary to deal with these difficult and important problems. I hope, in making this presentation, that you will be able to help us overcome this failure.

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16. Derived from "American High Seas Tuna Fleet," National Fisherman Yearbook Issue 1971, Vol. 51, No. 13, April 1971.

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18. The system might provide for new entry through the purchase of shares. While this would be desirable, it would still constitute a distribution of wealth on the basis of historic rights, rather on the basis of common heritage. New states might question why they should pay for what others have received for free.

19. "Enlarged Committee on the Peaceful Use of the Sea-Bed and Ocean Floor, Sub-Committee I, Statement made by A. Prohaska, Representative of Austria, on 29 July 1971."

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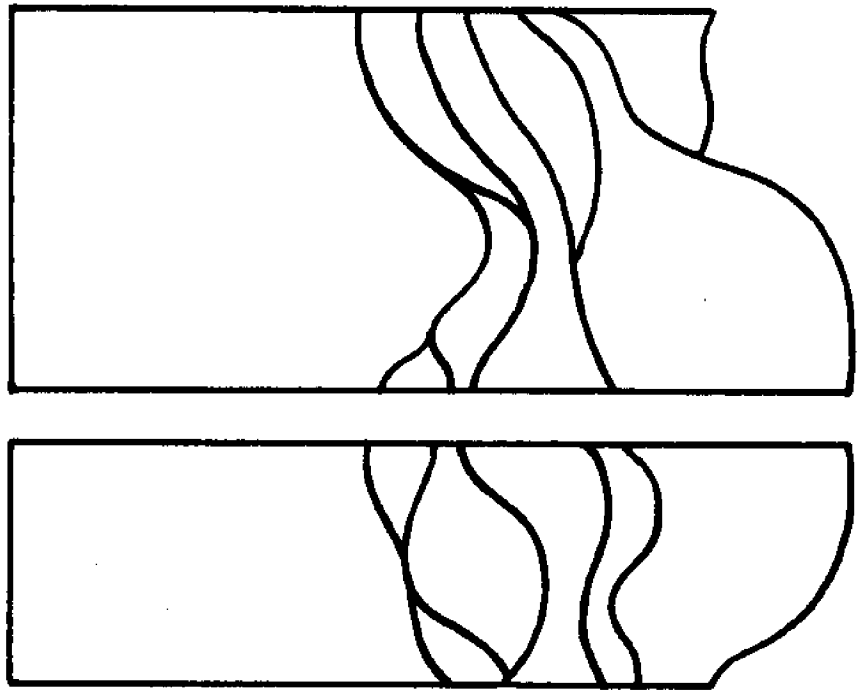

OCEAN ENGINEERING

Ocean Engineering Session Summary

J. A. Duffie, Session Chairman
University of Wisconsin-Madison

The Ocean Engineering workshop anticipated spending about two hours on discussions. The interest in the subject was such that the session lasted closer to five hours. It was introduced by four panelists: G. Savage, University of New Hampshire; J.B. Herbich, Texas A & M University; J.P. Breslin, Stevens Institute of Technology; and L. Slotta, Oregon State University. Subsequent discussion involved representatives of other universities having Sea Grant activities.

This summary can be prefaced by saying that while there may have been a variation of degree of satisfaction with which we viewed the position of Ocean Engineering in the Sea Grant Program, there probably was preponderant feeling that Ocean Engineering was not accomplishing what it should in this Program. We tried throughout the discussion to examine the role of Ocean Engineering as a part of what we understand to be Sea Grant.

We started on the premises that Sea Grant is a problem-oriented program, and that research, education and advisory services in Ocean Engineering must be set in this problem context, and thus also in an appropriate institutional contest (i.e., in an appropriate relationship to other, non-engineering facets of the program in a particular university). If we see Sea Grant as a problem-oriented program, Ocean Engineering in our view becomes an integral and often critical part of Sea Grant.

> As an aside, we might refer to aquaculture as a "problem." Ocean Engineering, in the sense of Sea Grant, is a "nonproblem." It is not a problem of the region or nation that we serve; it is a problem primarily to those of us in engineering colleges who have some responsibility to develop these kinds of activities.

We recognized two kinds of Ocean Engineers. While people refer to these by various terms, the ones I seized on were: those whose primary interests were in analysis or phenomena, who dissect the elements of a problem to understand the phenomena involved; and the synthesizers or the process-oriented people who assemble possible alternative solutions to problems and proceed to evaluate them. It appears that it is the latter kind of engineer that has the larger role to play in the Sea Grant Program as we see it. In Sea Grant, it appears that the Ocean Engineer's most important contribution will be to use the in-

tegrative aspects of engineering--the engineer's knowledge (what he has himself and what he gets from his colleagues in other parts of the university), knowledge of oceanography, the natural sciences, economics, mathematics, to devise and evaluate alternative solutions to problems.

There was considerable feeling in this meeting that we should not minimize the importance of engineering analysis or engineering science--that this is a necessary part of the longer term solutions to some of the kinds of problems that Sea Grant institutions are concerned with. If we can't support some of the more analytical phases of Ocean Engineering under Sea Grant, we face the risk of not funding programs which will, in the long run, be important to Sea Grant.

Those present felt rather strongly that there is need for greater participation by Ocean Engineers in Sea Grant if this is to be a problem-oriented research program. We discussed at considerable length the problems and challenges in trying to accomplish this. Many of these discussions have been heard before; they relate to: university emphasis and rewards for science rather than application; organizational problems in universities; our relations with colleagues in other parts of the university; the availability of other funding that affects the willingness of our colleagues to participate in these activities; and many others.

The observation was made that Sea Grant Program coordinators and advisory committees to the coordinators should work closely with deans of colleges of engineering and other appropriate administrative officers in the universities to develop engineering participation in Sea Grant Programs particularly in the light of the development of other related activities such as Coastal Zone Laboratories which may in effect funnel off some of the people who could be participating in Sea Grant. So we saw Ocean Engineering as a vital part of Sea Grant, and we saw the efforts to develop it into a viable part as one of the most important activities in which we should be engaged.

Ocean Engineering is perhaps unique in its responsibility to industry and government in its need to keep its focus on what is called the "real world" problems. There was some disagreement as to how easy this was--to work with industry in particular--with some reporting considerable frustrations in trying to extract information from industrial organizations. Others reported an easy flow of people and information back and forth between industry and university. There were several specific suggestions made on engineering programs which would be appropriate for consideration as part of Sea Grant activities: co-op programs with industry (in which our students would move back and forth between university and industry); industrial sabbaticals for faculty (some of our young faculty do not have much industrial experience); a cooperative research with industry (particularly if industry would help to fund some of these activities). These activities would be particularly important

in those problems areas where industry will be the vehicle by which the solutions to the problems may be achieved.

There were rather strong feelings that Ocean Engineering's role is sufficiently unique and different in Sea Grant that the group wanted a mechanism for getting together again, without waiting for another year and a half for the next Association meeting. Those present this morning were unanimous in recommending to the Association that there be formed an ad hoc Ocean Engineering committee of the Association to serve as a vehicle for further consideration of these problems, and specifically to assume responsibility for planning a plenary session on Ocean Engineering at the next Association meeting, on the basis that the relation of Ocean Engineering to Sea Grant is a subject that should be of interest to tall those concerned with Sea Grant.

(Conference Sessions on Ocean Engineering were primarily unrecorded open discussion sessions. As a result, only one ocean engineering paper is included in these proceedings.)

Ocean Engineering

John Herbich
Texas A&M University

"Ocean Engineering" : A Viable Field In Itself?

Only the oceans can meet the increasing demands for protein, power generation, minerals and fresh water. Anyone of these requirements would require a major and accelerated effort and each will require engineering in the ocean or ocean engineering.

In an earlier presentation[1] it was concluded that a considerable amount of ocean engineering activity falls within the purview of existing branches of engineering; however several identifiable areas of engineering will not fall within any of the traditional engineering areas unless they are modified considerably to meet the demands of the new environment. (Figure 1).

Demands for engineering talent in ocean environment require outputs different from those that are known, and we have been confronted with an area of engineering practice that has its own characteristics and which demands new recognition. It is believed that the profession has now recognized that a new species of engineer, an ocean engineer, has appeared on the scene.[2] Although the term ocean engineering has been coined in the United States, it has also been accepted overseas[3]. The importance of ocean engineering was recognized by engineers and scientists as may be evidenced by formation of new societies, or of new conferences. In the United States, the Marine Technology Society, the Offshore Technology Conference, Civil Engineering in the Ocean Conferences, World Dredging Conferences, Underwater Technology Conferences were all formed and organized within the last 5 to 7 years to join the Coastal Engineering Conferences which started almost three decades ago. In the United Kingdom the Society of Underwater Technology was formed and several international meetings in Ocean Technology have been held during the past four years.

The "Marine Resources and Engineering Development Act" of 1966 outlined a national policy for intensified study of the sea for the benefit of all. Research and education programs existed prior to 1966, but have no doubt been accelerated by the sea grant program and by the general interest in development of ocean resources. As Professor Bishop writes:

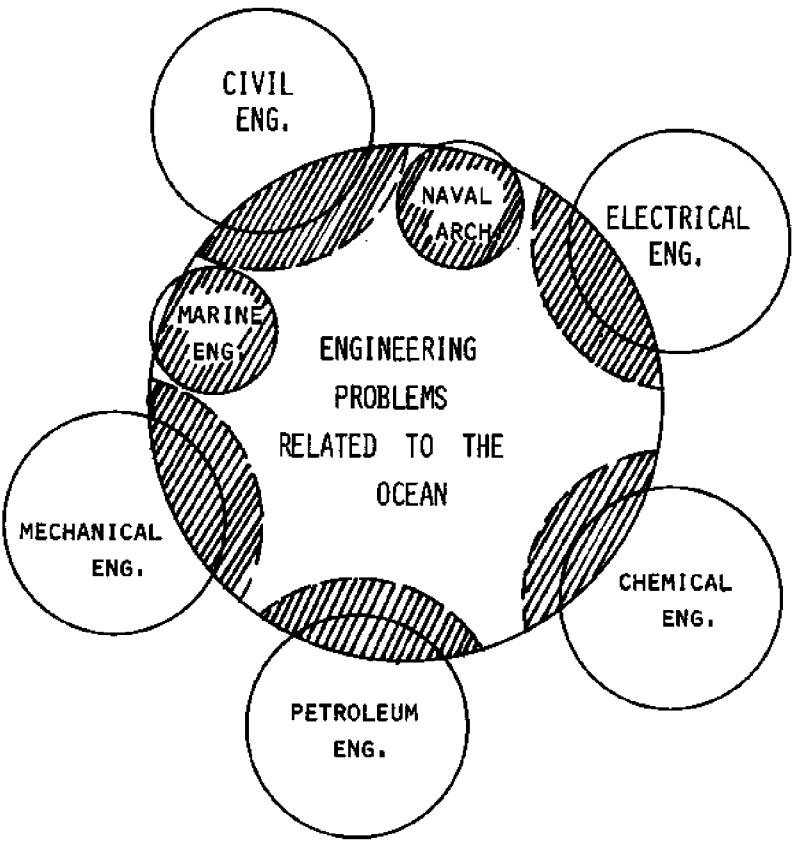

FIGURE 1 REPRESENTATION OF PROBABLE FURTHER EXPANSION OF EXISTING ENGINEERING DISCIPLINES INTO OCEAN ENGINEERING PROBLEMS.

"American industry has entered the field of ocean engineering with a vengeance and American firms are not noted for their altruism" (3)

Let us consider, as an example, an offshore platform design. An engineer can design the structural members of the platform based on information regarding the wave forces given to him by a physical oceanographer; however, in order to interpret the information given to him, he should know something about the wave hindcasting methods, the significant, or 1/10 maximum waves concept, also he should know about the probability of a 50 year storm occuring the following year, or during the next five years, etc. He ought to know something about corrosion in the ocean, etc. In other words, the engineer who anticipates working in the ocean environment ought to know something about this hostile environment and be trained as an ocean engineer.

A recent survey[2] pointed out that a large percentage (54%) of those working in ocean engineering possessed a graduate degree. The major fields of study of the respondents are shown in Figure 2, and the subfields of ocean engineering in which they are currently working are shown in Figure 3, while the product of their work is shown in Figure 4.

How Does Ocean Engineering Relate to Other Aspects of the Sea Grant Research and Educational Activities?

The objectives of the Sea Grant Program cover activities in research, educational and extension areas. Ocean Engineering may be a part of all the above areas. Research in ocean engineering will certainly play an important part in development of marine resources; ocean engineering educational programs which will prepare and provide the necessary manpower and ocean engineers can also assist in all extension activities. In a Sea Grant College all activities should include ocean engineering as part of an overall program. In other colleges and universities ocean engineering could be included in whatever marine activities are underway.

What Kinds of Research Activities are Included in Your Ocean Engineering Program?

Types of research needed in ocean engineering were listed in the Proceedings of the Third Sea Grant Conference.[4] Some fourteen categories were listed and included the following:

a. Wave action in the coastal zone
b. Shore processes
c. Tides and surges
d. Inlet studies
e. Estuary studies
f. Structure design
g. Effects of actions by man

h. Submerged structures, underwater habitats, underwater pipelines
i. Perfecting of improvement methods
j. Oil spill containment and recovery of oil
k. Knowledge about the interaction of humans with the ocean environment
l. Knowledge about the transfer and communication characteristics of the ocean
m. Knowledge about operational, instrumentation, and other hardware capabilities within the ocean and,
n. Knowledge about the behavior of materials within ocean environment.

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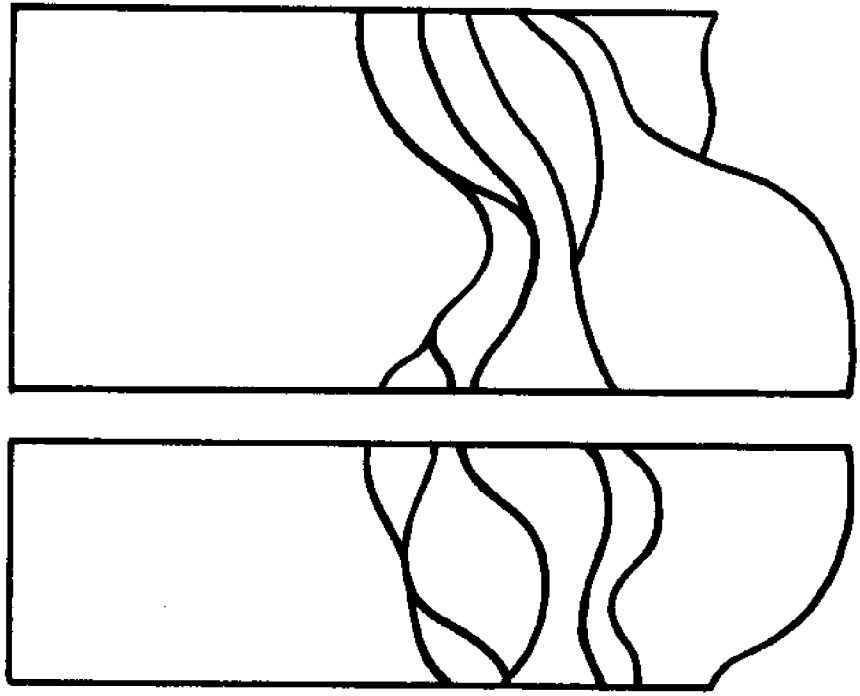


EDUCATION

Education Session Summary

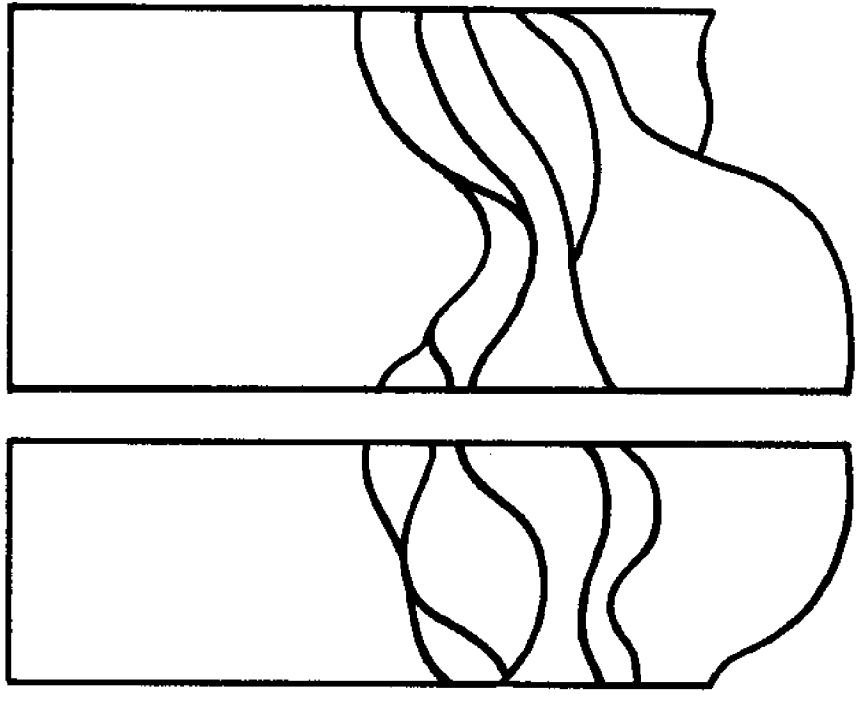
Nelson Marshall, Session Chairman
University of Rhode Island

To open this session three very brief presentations were offered, representing educational interests and concerns of three Sea Grant groups. The chairman, Professor Nelson Marshall of the University of Rhode Island, discussed educational efforts, such as the Master of Marine Affairs program, graduate study in Ocean Engineering, the two year program Fisheries and Marine Technology, the doctorate in Marine Resource Economics and an interdisciplinary estuary-coastal zone course at his University, all bearing on the Sea Grant effort. Professor Donald S. Squires, the Director of the Marine Sciences Research Center at the State University of New York, discussed a program to assess the need in his state for vocational-educational offerings in the marine fields that might be incorporated, either under Sea Grant auspices or other auspices with the State University system. Professor Stanley R. Murphy, the Director of the Division of Marine Research at the University of Washington, discussed programs whereby two year colleges within his state are cooperating in the Sea Grant effort, offering technical programs appropriate to community college efforts and not within the usual range of coverage at the University.

The discussion which followed included recitations from many of the groups present as to their unique Sea Grant offerings. Several asked for a clarification as to what the Sea Grant Program itself will sponsor in the way of educational efforts. Arthur G. Alexiou, Program Director of the National Sea Grant Program Office, pointed out that support to education is derived through the support of research and other endeavors, including funds for graduate assistantships. He pointed out that Sea Grant also gives some direct support for educational programs where the offerings are truly unique to the Sea Grant mission and such worthy programs would not otherwise be supported. His estimate of the amount of funds that are directly designated in support of curricula was about ten percent of the total.

At the conclusion of the meeting the chairman, noting the spontaneous interest in the subject of education, said he would recommend to the business meeting of the Association that effective on-going provisions be made for considering educational matters. We should avoid a repetition of the present situation

which, for lack of an effective committee or planning group, education had been neglected in the program of annual meeting and was not covered until those concerned more or less spontaneously rose to the occasion and offered a program. The suggestion further takes cognizance of the need for a focus on educational interests in the work of the Association.



BUSINESS SESSION

Second Annual Business Meeting

Dr. Herbert Frolander, director of the Sea Grant Program at Oregon State University, was elected Association president for 1972, succeeding Dr. John A. Knauss, provost for marine affairs at the University of Rhode Island. Dr. Robert A. Ragotzkie, director of the University of Wisconsin's Sea Grant Program, was elected president-elect.

Two new members of the executive board were elected. They are Dr. Stanley R. Murphy of the University of Washington and Dr. William J. Hargis Jr. of the Virginia Institute of Marine Science. At a separate executive board meeting Dr. Knauss was appointed secretary-treasurer of the Association for 1972.

Reports were received from session chairmen (these are included as session summaries in these proceedings) and financial and membership reports were distributed. It was announced that the executive board had accepted the invitation of Texas A & M University to host the 1972 conference and annual meeting.

THE ASSOCIATION OF SEA GRANT PROGRAM INSTITUTIONS

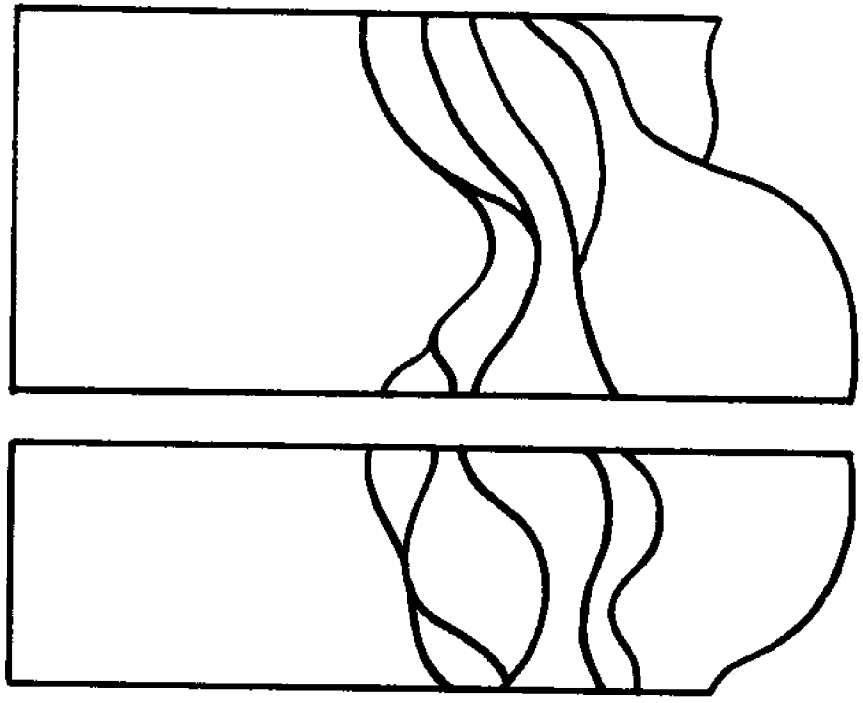
The Association of Sea Grant Program Institutions was formed on November 19, 1970 in Washington, D.C. as an organization of colleges, universities and other institutions concerned with the broad objectives of the National Sea Grant Program.

There are presently 48 members, including 14 members with major institutional grants for diverse programs in marine research, education and public service, 30 regular members who are degree-granting institutions and 4 associate members. Four of the group were recently named Sea Grant Colleges by the Secretary of Commerce. This special designation to denote excellence in marine programs was awarded to the University of Washington, The University of Rhode Island, Texas A & M University and Oregon State University.

The Association's objectives are:

1. To further the optimal development, use and conservation of marine and coastal resources (including those of the Great Lakes), and to encourage increased accomplishment and initiative in related areas.
2. To increase the effectiveness of member institutions in their work on marine and coastal resources (including those of the Great Lakes).
3. To stimulate cooperation and unity of effort among members.

The Association publishes a monthly newsletter for its members and co-sponsors the annual National Sea Grant Conference. This year, for the first time, the Association sponsored a National Sea Grant Award at the Wisconsin conference (Lauren Donaldson was this year's recipient, see Special Addresses). This award goes to an individual who has made an outstanding contribution to mankind's utilization of the oceans and carries with it a stipend of $500.



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