Proceedings of the

TWENTY-SEVENTH ANNUAL

Gulf and Caribbean Fisheries Institute

and the

SEVENTEENTH ANNUAL

International Game Fish Research Conference

MIAMI BEACH, FLORIDA • NOVEMBER, 1974

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MIAMI, FLORIDA OCTOBER, 1975

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Edited by JAMES B. HIGMAN

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Library of Congress Catalog Card Number: 52-33783

Gulf and Caribbean Fisheries Institute

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Announcement

The Gulf and Caribbean Fisheries Institute was organized in 1948. There are two classes of membership, one for industry and one for scientists. Inflationary costs have compelled the Institute to increase its membership and registration fees. Formal action to raise these fees was taken at the annual Executive Committee meeting November 29, 1972. Members of the fishing industry and associated businesses will pay a minimum membership fee of $50.00 per year. Technical members will pay $10.00 per year. In addition, a registration fee of $35.00 will be required for attendance at the Institute.

The membership year of the Gulf and Caribbean Fisheries Institute begins on November 1 and ends October 31st of the following calendar year. Membership cards are issued to this effect. Members are entitled to attend the annual meeting and to receive the published *Proceedings* of the Gulf and Caribbean Fisheries Institute.

Membership and registration fees together with funds from the University of Miami's Rosenstiel School of Marine and Atmospheric Science support the Gulf and Caribbean Fisheries Institute.

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EXECUTIVE DIRECTOR
GULF & CARIBBEAN FISHERIES INSTITUTE
4600 RICKENBACKER CAUSEWAY
MIAMI, FLORIDA 33149

MONDAY—AM—NOVEMBER 11, 1974

Chairman –E. S. Corlett III, *President,*
Metropolitan Miami Fishing Tournament, Miami, Florida

Our Changing International Fisheries

JOHN NORTON MOORE, *Chairman*
National Security Council
Interagency Task Force
on the Law of the Sea
Department of State
Washington, D.C.

It is an honor and a pleasure to participate in this joint conference of the Gulf and Caribbean Fisheries Institute and the International Game Fish Research Conference. I particularly welcome the opportunity at this time when through the Third United Nations Conference on the Law of the Sea we stand on the threshold of a promising new era in fisheries management. Yet paradoxically, our nation now faces the most important oceans policy decision in our history. Is United States oceans policy to be pursued through cooperative efforts at international agreement? Or is it to be pursued through unilateral national measures risking an irreversible pattern of conflicting national claims? How we answer this question will determine the future of international fisheries and indeed of the oceans themselves.

All of us are familiar with the symptoms of the present inadequate international system of fisheries management: overexploitation of certain coastal and salmon stocks, disputes concerning fishing rights affecting highly migratory species, and many other problems. The principal causes of these problems are uncertainty in present oceans law and an outmoded jurisdictional basis for managing international fisheries.

The crippling defect in the present pattern of international fisheries jurisdiction is that management jurisdiction does not generally coincide with the range of the stocks. As such, any effort at sound management and conservation confronts the classic "common pool problem" similar to that experienced in the early days of the east Texas oil fields. That is, in the absence of agreement, it is not in the interest of any producer acting alone to conserve the resource. The solution to this common pool problem in fisheries is broadly based international agreement providing coastal nations with management jurisdiction over coastal and anadromous species with highly migratory species managed by regional or international organizations.

For the first time in the history of oceans law it is realistic to expect such a broadly based agreement reordering fisheries jurisdiction and ending the uncertainties in oceans law. After lengthy preparatory work in the United Nations Seabed Committee, the Third United Nations Conference on the Law of the Sea has recently completed its first substantive session held in Caracas, Venezuela, from June 20 to August 29. If other issues are satisfactorily resolved the Conference offers every promise of providing the jurisdictional framework within which we can solve the coastal fisheries problems as well as the special requirements of salmon, highly migratory species and sport fishermen. The strong trend in the Conference is for acceptance of a 200-mile economic zone providing coastal states with jurisdiction over coastal fisheries in a 200-mile area off their coast. There is also considerable support for host state control of salmon throughout their migratory range and growing support for special provisions on international and regional management of highly migratory species such as tuna. In this connection the United States Delegation has indicated that we can accept and indeed would welcome the 200-mile economic zone as part of a satisfactory overall treaty which also protects our other oceans interests, including unimpeded transit of straits used for international navigation.

It is also realistic to expect a broadly based oceans treaty in the near future. The General Assembly Resolution which established the Law of the Sea Conference provided that any subsequent session or sessions necessary after the Caracas session would be held no later than 1975.

Whether agreement is reached in 1975 or 1976, it is, of course, also important that we prevent further depletion of the coastal and salmon stocks off our coast before the new Law of the Sea Treaty comes into force. We are taking several important steps to meet this need.

First, we are actively pursuing bilateral and limited multilateral approaches for the protection of our stocks. Progress has been significant in recent months, and we intend to continue to vigorously pursue improved protection bilaterally and within regional fisheries commissions.

Second, we have proposed that the fisheries as well as certain other provisions of the new Law of the Sea Treaty should be applied on a provisional basis. That is, they should be applied after signature of the new treaty but before waiting for the process of ratification to bring the treaty into full legal effect. Provisional application is a recognized concept of international law and our proposal was favorably received.

Third, we have announced a significant new measure to provide increased protection for certain of the stocks off our coast. That is, new enforcement procedures for the protection of living resources of the United States continental shelf. These new enforcement procedures will provide substantial increased protection to our valuable living resources. We believe that they are entirely justified by existing international law and that jurisdiction over the living resources of the continental shelf carries with it the right to require other states to enter into agreements for the protection of such resources if they are taken during fishing for non-shelf stocks as well as if the taking of such shelf resources is intentional.

Along these lines, we are also carefully reviewing the availability of means to make possible increased Coast Guard enforcement efforts to protect our living resources in particularly vulnerable areas.

An expanded enforcement effort by the Coast Guard would also help ensure compliance with existing regulations and will assist in the transition from the present limited fisheries jurisdiction to the broader jurisdiction which is the likely outcome of a successful Law of the Sea Conference.

Paradoxically, at a time when the chances for concluding a comprehensive oceans treaty seem brightest, pressures for unilateral action are mounting. A major debate has been taking place in Congress during the last few months concerning S. 1988, a bill to unilaterally extend the fisheries contiguous zone of the United States from the present 12 miles to 200 miles.

Despite the interim problem in protection of our coastal and anadromous stocks, the Executive Branch is strongly opposed to the enactment of such legislation. It would not satisfactorily resolve our fisheries problems, would at most merely anticipate a result likely to emerge in a matter of months from a successful Law of the Sea Conference, and would be seriously harmful to United States oceans and foreign relations interests in at least five principal ways.

First, unilateral action extending national jurisdiction in the oceans is harmful to overall United States oceans interests and as such we have consistently protested any extension of fishery or other jurisdiction beyond recognized limits. A unilateral extension of jurisdiction for one purpose will not always be met by a similar extension but rather may encourage broader claims which could have serious implications, for example, with respect to our energy needs in transportation of hydrocarbons, our defense and national security interests in the unimpeded movement of vessels and aircraft on the world's oceans, or our interest in the protection of marine scientific research rights in the oceans. Because of our broad range of oceans interest and our leadership role in the world, an example of unilateral action by the United States would have a particularly severe impact upon the international community which could quickly lead to a crazy quilt of uncontrolled national claims. Indeed it was the threat of just such a result with its open-ended invitation to conflicts and pressures on vital U.S. interests that led to a decision in two prior administrations at the highest level of government that U.S. oceans interests and the stability of the world community would best be served by a broadly supported international agreement. This administration strongly agrees with that judgment. Soundings from our embassies and at the Caracas session of the Law of the Sea Conference indicate that the possibility of unilateral claims by others is not merely an abstract concern should this legislation pass.

Second, such legislation could be seriously damaging to important foreign policy objectives of the United States. Unilateral extension of our fisheries jurisdiction could place the nation in a confrontation with the Soviet Union, Japan and other distant water fishing nations fishing off our coasts. These nations strongly maintain the right to fish in high seas areas and are unlikely to acquiesce in unilateral claims, particularly during the course of sensitive law of the sea negotiations in which they have substantial interests at stake. The implications for detente and our relations with Japan are evident. In fact, both the Soviet Union and Japan

have already expressed serious concern over this legislation to our principal negotiators at the Law of the Sea Conference.

Similarly, unilateral extension of our fisheries jurisdiction coupled with reliance on the Fishermen's Protective Act to protect threatened distant water fishing interests of the United States seem certain to assure continuation of disputes with Ecuador and Peru as well as to generate new disputes with other coastal states off whose coasts our nationals fish.

It is strongly in the national interest to encourage cooperative solutions to oceans problems rather than a pattern of competing national claims. A widely agreed comprehensive Law of the Sea Treaty will promote development of ocean uses and will reduce the chances of ocean disputes leading to conflict among nations. If these interests seem too theoretical, we might recall the recent "Cod War" between the United Kingdom and Iceland which resulted from a more modest Icelandic claim of a 50-mile fisheries contiguous zone.

Third, a unilateral extension of our fisheries jurisdiction from 12 to 200 miles would not be compatible with existing international law, and particularly with the Convention on the High Seas to which the United States and 45 other nations are party. The International Court of Justice held only last month in two cases arising from the "Cod War" that the 50-mile unilateral extension of fisheries jurisdiction by Iceland was not consistent with the rights of the United Kingdom and the Federal Republic of Germany.

What would we do if this bill were to become law and another country brings us before the International Court of Justice? Would we invoke our reservation and maintain that issues relating to the use of the seas up to 200-miles from our coast, or even hundreds of miles beyond this in the case of salmon, are exclusively within our domestic jurisdiction? Or would we respond on the merits and risk losing what we are certain to get from a widely accepted Law of the Sea Treaty?

Violation of our international legal obligations by encroaching on existing high seas freedoms can be seriously detrimental to a variety of oceans interests dependent on maintenance of shared community freedoms in the high seas. The appropriate way to change these obligations in order to deal with new circumstances is by agreement. It is particularly inappropriate to argue that a unilateral act contrary to these obligations is required by such circumstances when a widely supported agreement that resolves the problem is nearing completion. Violation of our international legal obligations can have the most serious short and long run costs to the nation.

Fourth, a unilateral extension of our fisheries jurisdiction would pose serious risks for our fisheries interests. Protection of our coastal and anadromous stocks can only be achieved with the agreement of the states participating in the harvesting of those stocks. Unilateral action not only fails to achieve such agreement but it may also endanger existing fishery agreements and efforts to resolve the problem on a more lasting basis with such countries. Similarly, protection of our interests in fishing for highly migratory species such as tuna or coastal species such as shrimp where U.S. nationals may fish off the coasts of other nations can only be achieved through cooperative solutions. This is particularly true for our important distant water fishing interests in the Gulf and Caribbean area. In short, we

cannot expect to achieve acquiescence from states fishing off our coast, and we will harden the positions of other countries off whose coasts we fish. The resolution of old disputes will be made more difficult and their costs to our fishermen and our government will continue. At the same time we will face new disputes off our own coast and elsewhere.

Legislation unilaterally extending United States fisheries jurisdiction would provide others with an opportunity to make unilateral claims damaging to our distant water fishing interests despite any exceptions for highly migratory species or provisions for full utilization written into the legislation. If the United States can make a unilateral claim eliminating the freedom to fish on the high seas, it is difficult to assert that other nations are bound by the exceptions and provisions contained in our own legislation. Moreover, even by its terms pending bills such as S. 1988 would include highly migratory species in the extension of coastal state jurisdiction where such species "are not managed pursuant to bilateral or multilateral fishery agreements." We should keep in mind that the principal countries with which we have disputes concerning jurisdiction over highly migratory species are not now parties to agreements relating to the management of such stocks.

A unilateral extension of fisheries jurisdiction by the United States could also make it more difficult to achieve meaningful guarantees such as those we are advocating at the Law of the Sea Conference binding on all nations for the conservation of the living resources of the oceans. Moreover, it could make more difficult acceptance of a rational basis for fisheries management: that is, jurisdiction over coastal and anadromous species in the coastal nation and jurisdiction over highly migratory species in a regional or international organization. Similarly, it could make more difficult general acceptance of a concept of maximum sustainable yield permitting consideration of economic factors in order to take meaningful account of the needs of sports fisheries. As such, legislation such as S. 1988, although intended to protect our fish stocks, could paradoxically have the opposite effect not only on stocks off our coast but on fish stocks the world over.

Finally, passage at this time of legislation unilaterally extending the fisheries contiguous zone of the United States would seriously undercut the effort of all nations to achieve a comprehensive oceans law treaty. Our nation has urged particular care and restraint in avoiding new oceans claims during the course of the Third United Nations Conference on the Law of the Sea. A pattern of escalating unilateral claims during the Conference could destroy the delicate fabric of this most promising and difficult negotiation. It could also undermine the essential political compromise by which all nations would agree on a single package treaty. And by unilaterally taking action which we have said must be dependent on a satisfactory overall compromise, it could undermine other United States oceans interests such as protection of vital navigational freedoms, or economic interests such as a regime for deep seabed mining which will promote secure access to the minerals of the deep seabed area.

The nation is faced with a fundamental choice. Are we to pursue cooperative efforts at a solution to our oceans problems even when the going is rough and the

pace slower than we would like? Or are we to pursue unilateral policies destined to lead to escalating conflict in the oceans?

The overall oceans interests of our nation, our foreign relations interests, compliance with our international legal obligations, our fisheries interests themselves and our interest in concluding a timely and successful Law of the Sea Treaty all strongly require that we firmly set our course toward cooperative solutions. As Secretary of State Henry Kissinger has highlighted, the world is "delicately poised" on the verge of a new historic era. We can go forward to a recognition of our global interdependence and usher in one of the great periods of human creativity. Or we can turn our backs on difficult cooperative solutions and have a world of conflict and disarray. The choice is real, immediate and inescapably ours.

A Fisherman's View of the Law of the Sea

JACOB J. DYKSTRA, *President*
Point Judith Fisherman's Cooperative Association, Inc.
Narragansett, Rhode Island

Two hundred miles is a major Law of the Sea issue for fish people. But whether or not the United States will have a 200-mile economic zone doesn't seem to be the question now. Ambassador Stevenson has said in recent Congressional oversight hearings that over 100 (of a possible 138) countries at the Third United Nations Law of the Sea Conference support an economic zone extending to a maximum limit of 200 nautical miles. He also said he would like to see implemented the provisions of the Magnuson/Studds bill; his concern was only for the timing of that implementation. Furthermore, the articles on the economic zone and the continental shelf which the U.S. submitted to the Conference this August afford more protection to coastal fishermen and distant water fishermen than the Magnuson/Studds bill does. Therefore it would seem that now U.S. policy clearly supports both a 200-mile economic zone and protection for its salmon and its distant water shrimp and tuna fishermen.

The Conference recessed in Caracas with little more than broad agreement on a few of the issues that are before the Conference and a meeting date to recommend to the General Assembly for its approval.

John Norton Moore is very optimistic that the Conference will produce a treaty by the end of 1975. Ambassador Stevenson seems somewhat less so. But I am pessimistic and I am not alone in this in the U.S. delegation. Nor is this pessimism limited to fish people.

Although there is broad—that is, not specific—agreement on a 12-mile territorial sea and a maximum 200-nautical-mile economic zone, the details of the coastal state's rights and responsibilities in the economic zone remain unresolved. For example, there is what Ambassador Stevenson calls the "very strong territorial element" in the proposal for the economic zone which several African states put forward near the end of the Caracas session. This proposal is especially unsettling for the U.S. because, earlier in the summer session, a number of the same states indicated they would welcome a new U.S. proposal on the coastal state's rights and responsibilities in the economic zone as a step toward moving the negotiations forward.

Too, the U.S. draft articles on the economic zone and the continental shelf are far more conservative than are other proposals which have a chance of selling during this Conference. And, as you know, the territorial sea, the economic zone, and fisheries are only three of the 25 complicated and interrelated major issues with which the Conference is dealing.

This is one reason for my pessimism.

A second reason is the Conference schedule as it now stands: 8 weeks in Geneva, only 6½ months after nothing more than "broad agreement" in Caracas, and up to 3 weeks back in Caracas "to tie up the loose ends"—whatever those might be at that point. I haven't looked closely at the extremely complex voting procedure because it is so difficult to sort out and I don't really believe we're going to get around to using it immediately. Far from it. Near the end of Caracas, one State Department type commented to me that even if things moved rapidly and we were to be in a position to vote in Geneva, to begin to vote and follow the procedure the Conference has accepted—and it is a reasonable procedure to protect all the interests involved—would take at least 6 weeks. That, on the present schedule, gives 2 weeks in Geneva for serious negotiating. Ambassador Stevenson has said, "governments must begin serious negotiation the first day at Geneva; and to prepare for that, they must during the intersessional period appraise the alternatives, meet informally to explore possible accommodations that go beyond stated positions, and supply their delegates with instructions that permit a successful negotiation."

Even if we add the 3 weeks maximum which now seems scheduled for Caracas, that means only 5 weeks for Conference negotiating. From my experience, I'd say it takes these guys at least 2 weeks just to shake hands.

The UN General Assembly is now scheduled to deal with the Conference's recommendation for the 8-week Geneva session and the 3-week Caracas session either this week or by the end of the month, after it considers the Palestinian question. Although last year's General Assembly resolution on the Conference "contemplated"—in Ambassador Stevenson's phrase—a comprehensive treaty by the end of 1975, there is now a paragraph in draft at the UN which would allow the Conference to "take the necessary steps to conclude the work of the Conference." This might mean a second 8-week session, perhaps in Caracas; it might also mean additional substantive sessions in 1976. If the General Assembly were to accept this, the Conference could have the authority to extend itself beyond the end of 1975.

Thus, the General Assembly may vote to increase the amount of time the Conference can have and the dollars it can spend, either in 1975 or beyond. But if it does, we'll encounter problems with nations which refuse to negotiate until the very last session (this problem also weakens the idea of particularly productive intersessional bargaining). We'll also have to deal with nations which, for a wide variety of reasons among them, appear not to want a treaty, as well as with those nations that are beginning to suggest privately that this may be a futile exercise at this time—even if no treaty in 1975 means no treaty for many years to come.

Assuming, therefore, that the end of 1975 (as I recall, until Ambassador Stevenson and Mr. Moore testified before Congress in oversight hearings, the end of summer 1975 was the season for an LOS treaty) will not see the comprehensive treaty the U.S. now seeks, what are the alternatives?

I see three.

First, the Conference will not take any real action, whereupon a lot of states will take unilateral action, followed, perhaps, eventually, by regional multilateral agreements.

Or second, the Conference, in an effort to produce something concrete, will sign a limited treaty, saying only that there will be a 12-mile territorial sea and a 200-mile economic zone, without spelling out the rights and responsibilities involved in that zone. For obvious reasons, this might appeal to several of the developing coastal states, but for the U.S. it could have severe limitations. For example, if distant water tuna and shrimp don't have as a part of a treaty, full utilization and compulsory dispute settlement, that might well justify the distant water people's fears of gloom, despair, and destruction that preceded and now follow the U.S. move to a 200-mile economic zone position.

Or third, the Conference might actually settle down, do the necessary serious negotiating, and make the progress necessary to build up momentum to carry it to a more comprehensive treaty in 1976—despite several nations' unilateral actions—if there is not a treaty by the end of 1975.

I'm inclined to think we'll see the first alternative.

Shrimp and the 200-Mile Issue

ROBERT G. MAUERMANN, *Executive Director*
Texas Shrimp Association and
Shrimp Association of the Americas
Brownsville, Texas

All of us who are concerned with our fishery resources, whether our interests are commercial or recreational, want the same thing—an optimum sustainable yield, although some of us may march to the sound of a different drummer. Many of my colleagues in the Northeast and the Pacific Northwest are sincerely convinced that U.S. fishermen can best be served by an extension of our fishery zone to 200 miles from our shores and that the passage of legislation by the U.S. Congress providing for such action would eliminate the competition from foreign fishing fleets. I will agree that foreign fishing fleets combined with our own are overfishing several important species in what has historically been America's most important fishing areas in both the North Pacific and the North Atlantic. I disagree, however, that the passage of legislation proclaiming U.S. fisheries jurisdiction over a 200-mile area in what is now considered international waters is the solution for several reasons.

First, such a law would be enforceable only if the world's major fishing nations agreed to recognize such a radical departure from the principle of freedom of the seas. Foreign fishermen are not likely to recognize the U.S. claim to an extended fisheries zone into what is now accepted as international waters by the major powers of the world anymore than we have recognized similar claims by several of the Latin American countries.

More importantly, the unilateral extension of our fisheries zone to 200 miles provides no protection, or at least very little, to the salmon or the tunas, both of which range the ocean far beyond the 200-mile zone. The only solution to the maintenance of optimum sustainable yields of these species is through enforceable international agreements. It is my hope, and I should think the hope of fishermen all over the world, that the Law of the Sea Conference will ultimately provide such agreements.

The original U.S. position at the Law of the Sea Conference was based on a species management concept which did not include an extended economic zone. Since the meeting began, however, the official U.S. position, as outlined by Ambassador Stevenson in his address to the Conference on July 11, 1974, indicated that our government would agree to an extended economic zone to 200 miles provided that such a package included provision for the management of anadromous species and the migrating oceanic species, and further, Mr. Stevenson contemplates that it will be the coastal states' duty to permit foreign fishing under a reasonable license and under coastal state regulations to the extent that a fisheries resource is not fully utilized by the coastal state.

There are two points in this position statement which are of great concern to the distant water shrimp fishermen. First, who is to decide whether or not a fishery resource is fully utilized? Biologists studying shrimp populations have been un-

able to agree on this issue in the Gulf of Mexico, although research in this area has covered an expanse of many years. Secondly, the Ambassador's statement does not mention historic fishing rights and yet that is what much of the sound and fury is all about. The 200-mile advocates who are pushing for unilateral U.S. action are trying by this legislation to protect their historic rights to the fishery resources off our coast in waters which have been considered as international by the world community. The U.S. shrimp industry feels that such unilateral action by the U.S. would jeopardize the historic fishing rights of distant water shrimp fishermen who are largely responsible for the development of this fishery throughout Latin America.

In this connection it is important for us to recognize that 18% of the shrimp landed in Gulf ports in 1973 were caught by distant water shrimp fishermen operating off the coast of several Latin American countries. These landings amounted to 37 million pounds worth over 40 million dollars. Therefore, it becomes immediately apparent that the shrimp fishing industry stands to gain nothing from an extended American fisheries jurisdiction. In fact, unilateral action by the U.S. will undoubtedly trigger similar action by Mexico. Legislation now pending in the Congress of the U.S. has already strengthened Mexico's position on the 200-mile issue. I fully expect that our neighbor to the south will unilaterally declare a 200-mile Patrimonial Sea in both the Gulf of Mexico and the Pacific within a matter of days, if the U.S. Congress passes 200-mile legislation.

We do not quarrel with the basic concept of granting coastal states preferential rights over coastal species. We do, however, object to the ultimate elimination of a very important segment of the Gulf shrimp industry by the stroke of a pen. We are willing to cooperate with the Latin American countries in the management of this resource and we are willing to pay our fair share of the management costs in the form of licenses. We feel that our Law of the Sea position should include language that addresses the issue of historic fishing rights.

An extension of fisheries jurisdiction by the Republic of Mexico and other Latin American countries without some consideration for American fishing rights off their coasts would result in the return to American shrimping areas in the Gulf of Mexico off our own coast of a great number of fishing vessels, possibly as many as 600. This increased pressure would certainly further reduce the annual landings per vessel and create further financial problems to vessel owners. The Gulf shrimp industry is already caught in an economic crunch far greater than any it has known in the past because of the enormous increases in the cost of fuel and other production costs.

The U.S. shrimp industry, America's most valuable fishery, could survive through bilateral or multilateral treaties with its neighbors to the south. Such arrangements, however, are of no help to the salmon or tuna fishermen. If America's three most valuable commercial fisheries are to remain viable a combination of enforceable international conventions and regional agreements are going to be necessary, and these can be negotiated only by a Law of the Sea Conference.

A Sportfisherman's View of the Law of the Sea

HENRY LYMAN, *Publisher,*
Salt Water Sportsman
Boston, Massachusetts

Mister Dooley long ago made the wise statement: "The Constitution follows the flag, but the Supreme Court follows the election returns." In brief, the people of the United States still have a say in the operations of their federal government.

The State Department is no exception to this rule. When the Law of the Sea Conference was first in the blueprint stage, State had no plans whatsoever to include anything about marine fisheries. First drafts of State Department proposals did not even admit that there was such a thing as fisheries. Both sport and commercial fishermen began to scream—and their screams had effect. When the LOS Conference opened, State actually did a complete about-face, although the Department will deny in a hundred different ways that its policy had changed at all.

This turnabout was refreshing—and I welcome the State Department into the 18th century. It now admits there are fish in the ocean and that there are international problems concerning these fish and the harvesting of them. However, State still is operating in the past. For example, it sticks to the concept of maximum sustainable yield even though biologists, economists, sport and commercial fishermen all have agreed that optimum sustainable yield or maximum economic yield are far better concepts for the solution of marine fisheries problems.

Unfortunately most of those discussing these problems at the LOS Conference were attorneys or had legal training. The lawyers of this world have maneuvered themselves into an enviable position. Businessmen find it necessary to hire lawyers in order to keep themselves out of jail. The converse is not true: lawyers do not find it necessary to hire businessmen. This is unfortunate, for the legal profession could learn much from the business world, of which, incidentally, I am a representative.

In many of their deliberations at the LOS Conference, the legal types operated on a "Momma-Knows-Best" approach. They seemed to forget that they were supposed to represent the United States as a whole, not just the armed services or those involved with non-commercial efforts. The commercial fishing industry in this country is big business. Many do not realize that the recreational marine fishing industry is also big business amounting to hundreds of millions of dollars annually.

Recreational fishermen are strongly in favor of the 200-mile fisheries limit concept. They are in favor of it right now, not 5 or 10 years hence when the resources have been decimated by both foreign fishing fleets and even some of our own fishermen. I do not exclude sport fishermen from those who may be over-

exploiting marine resources. Anglers are not scared of restrictions in their efforts as long as these restrictions work towards good management and are applied equally to all.

Left in the hands of those who seek time-consuming legal and diplomatic maneuvering, a 200-mile fisheries limit will take years to implement. The Studds-Magnuson Bill now before Congress is the quick and obvious solution. It would impose a 200-mile fisheries limit until such time as there could be an international agreement on the whole problem. It would not sacrifice the fisheries resources while lawyers and diplomats quibbled over the fine print.

The State Department, as is its custom, is running scared on this whole question. It seems to forget that unilateral action by this country in establishing the Truman Doctrine concerning the continental shelf was accepted by two LOS Conferences without a terrible upheaval in international relations. Also it seems to forget that our unilateral actions in establishing the present 12-mile fisheries limit did not have the retaliatory reactions among other coastal nations that were prophesied. Some followed the U.S. lead and others went further.

However, those that went further did so long after the 12-mile fisheries limit had been established. The wave of nationalism throughout the world is still in the process of cresting. Whether or not this country acts unilaterally, other countries will do so anyway. By taking a firm stand now to bring proper management to our coastal fisheries, we can save the resource before it is too late and also can show other nations that we mean business. That this system works is clearly illustrated by the recent threat by the United States to withdraw from ICNAF. When other nations learned of this firm stand, they hastened to negotiate.

State Department people are not all devils incarnate. They simply live in a world which is a good deal different from that in which businessmen like myself live. By applying continued pressure on the Department and upon all those connected with it, you and I can eventually change State's attitude, just as we forced it to admit that there were fish in the oceans of interest to American industry. The interim measure to assure conservation and management of the fisheries resources until the third, fourth or fifth session of the LOS Conference comes up with an answer is passage of the Studds-Magnuson Bill. Remember Mr. Dooley's words and keep that pressure on our government representatives.

MONDAY—PM—NOVEMBER 11, 1974

Chairman – James A. Timmerman, Jr., *Deputy Executive Director, South Carolina Wildlife and Marine Resources Department, Columbia, South Carolina*

The National Ocean Policy Study

DAVID H. WALLACE
Associate Administrator for Marine Resources NOAA
U.S. Department of Commerce
Rockville, Maryland

I am honored and delighted to have the opportunity to address you today as this symposium discusses developing national policies that can have significant effects on the future course of our fisheries. I firmly believe that symposia such as this one which you have organized are essential to the formulation of policies within our system of government. Consequently, I am looking forward to learning not only what our panelists have to say today, but also what you in the audience, with your extensive experience and interests, comment on during the discussions. It is important that all of you are heard in the development of such important matters.

I would like to discuss two things with you: First, the National Ocean Policy Study initiated by the Senate to undertake a comprehensive analysis of national ocean policy and the federal ocean programs, and second, other efforts to formulate fisheries policies and plans at the national level.

In the past decade, as we are all well aware, ocean affairs have been acquiring greater visibility and consideration as we address national problems. This resulted in a declaration of national policy for the oceans in the Marine Resources and Engineering Act of 1965, followed by the Stratton Commission report with its plan for national action, and more recently by such important legislation addressing critical national problems as the Coastal Zone Management Act and the Marine Research, Protection and Sanctuaries Act. Now, new situations are arising and new opportunites and problems are presenting themselves. Among the major areas which require reexamination is fisheries.

The National Ocean Policy Study, authorized by Senate Resolution 222, is the U.S. Senate initiative to focus high level legislative and executive attention on ocean affairs. It was sponsored by Senator Magnuson from the State of Washington and co-sponsored by the chairmen of all the Senate standing committees.

Its unanimous adoption by the Senate in February of this year surely demonstrates the strong intent of the Congress to address the ocean issues facing our nation today.

The chairman of the study is Senator Ernest F. Hollings of South Carolina, who has long been a leading advocate of a strong national ocean effort. A small staff from the Senate Commerce Committee staff supports the study of its activities. They provide direction to the study and utilize the specialized services and talents of other areas of the Congress, such as the General Accounting Office, the Library of Congress and the new Office of Technology Assessment. They also request assistance from the National Advisory Committee for the Oceans and Atmosphere (NACOA) and from the executive branch, through the Interagency Committee on Marine Science and Engineering (ICMSE) for broad issues, as well as through the federal agencies directly. To perform this broad response function ICMSE has in turn established a Select Committee for the Ocean Policy Study (SCOPS), on which I am the Department of Commerce member. In this way, the combined capabilities of the legislative and executive branches are being brought to bear on the important ocean issues.

Among the principal areas of interest of the National Ocean Policy Study to date have been the coastal zone, and its proper management with emphasis on the environmental effects of offshore oil and gas development, and the federal governmental organization and programs in ocean affairs.

The study has been especially active in the first of these. It has asked the Library of Congress to compile a summary of scientific information on marine pollution. It also has held a number of hearings on the issue raised by the development of oil and gas extraction from the continental shelf. These hearings have been held in Washington, in New England, and in California. A group representing the study visited the North Sea oil producing areas to learn of problems being experienced from such offshore development and how they are being addressed. More activity is planned on this general topic. Closely associated problems under consideration involve the onshore impact of outer continental shelf resource development, the building of deep water ports and the siting and building of nuclear power plants. Studies relating to these matters are being conducted by the Office of Technology Assessment, particularly for the area off New York and New Jersey.

As for government organization, one only has to attend a meeting in Washington these days on a major marine problem to realize that marine affairs encompass a wide variety of activities and agencies in the federal establishment. It is only fitting then that the National Ocean Policy Study has as one of its principal goals the development of recommendations of alternative government organizations to improve efficiency of operations. To this end, it has asked the General Accounting Office to study the federal agency structure and budgets in marine affairs.

Responding to statements by collectors and users of oceanographic data that the amount, accuracy, and compatibility of such data are questionable, the chairman of the study has turned to ICMES to conduct studies on ocean data resources and ocean instrumentation. Both of these studies were conducted by NOAA

with assistance from other agencies; the first has been delivered to the Senate and the second has been completed and is undergoing review.

The National Ocean Policy Study also has announced plans to hold hearings on fisheries problems, including the proposed 200-mile zone of extended jurisdiction and management of the ocean's living resources. The Library of Congress is conducting a study on the economic value of ocean resources including fisheries, and the General Accounting Office is considering the questions of availability and markets for under-utilized fish stocks. Studies on other matters are under way, or are planned: science and technology, recreation, education, transportation, ocean mining, and pollution.

A concerted effort is going to be required by both the legislative and executive branches if we are to formulate the issues and programs required to develop and implement a meaningful national ocean policy in these areas. However, the development of such policy will not be limited to the efforts of the National Ocean Policy Study alone. There are also other activities in ocean affairs which are helping to move ocean affairs forward rapidly. Of special relevance to this meeting is the National Fisheries Plan, which is to be the subject of the remainder of your session.

A comprehensive National Fisheries Plan has been a dream of many people for decades, as many of you here are aware. Since the formation of NOAA, attempts to begin a national plan developed from several sources at about the same time.

About 3 years ago, NOAA developed a national fisheries policy which enunciated a statement of principles and laid out the skeleton of a program we felt should be the responsibility of the federal government—especially NOAA—in relation to fisheries. These goals and objectives were discussed and modified by the Marine Fisheries Advisory Committee (MAFAC) and were approved by the Secretary of Commerce.

The National Fisheries Plan, now being prepared by NOAA's National Marine Fisheries Service was suggested by the President's National Committee on Ocean and Atmosphere in its reports to the President and Congress in 1972 and 1973. The Committee strongly recommended the development of a national fisheries plan by the Secretaries of Commerce and of the Interior and proposed a set of conditions for working out such a course of action. This included conservation of the fisheries resources by regulation and uniform national and international enforcement, economic regulation of the industry with due regard to historic rights and social consequences, and increased protection for our coastal and high seas fishermen.

The Secretary of Commerce responded positively to the Committee's recommendations and directed the National Marine Fisheries Service to develop a National Fisheries Plan. As many of you know, NMFS requested assistance in this undertaking from states, industry, and universities; in fact, all those who are concerned with fisheries. Jack Gehringer will discuss the status of the plan in his presentation.

In forwarding the NACOA report of June 1974, the Secretary of Commerce also informed the Congress that a cabinet-level committee of the Domestic Coun-

cil is being established under his chairmanship to consider a broad range of domestic ocean policy issues. The principal function of this committee will be to develop policy recommendations and also to work closely with the Senate Ocean Policy Study group as it develops legislative recommendations. This committee is still in its formative stages.

As you know, in December 1973, Congress, in a parallel effort passed Senate Concurrent Resolution 11, introduced by Senator James Eastland and 41 other U.S. Senators. It was designed to assist the nation's commercial and sport marine fishing industries. This resolution set up a mechanism to use the state fisheries compact commissions, working with all segments of these industries and state conservation agencies, to develop plans which are then to be reviewed, discussed, revised, and refined with NOAA. It pointed out that this approach should not take the form of patchwork programs or sectional one-shot solutions but must reach a broad spectrum of Americans engaged in fishing and related activities, to secure their advice and guidance. As a prelude to this activity the concurrent resolution set forth a strong statement of the Congress' intention to support U.S. fisheries and recognizes the key responsibilities of the states for conservation and management within U.S. territorial waters. The commissions have completed their plans to undertake the inquiries proposed by this resolution and many of you will undoubtedly be contacted as they proceed in the next phase of their work.

Some people have said that these two approaches to fishery plans are competitive and inevitably will be duplicatory. I do not share this view. It seems to me to be abundantly clear that it is the intent to the sponsors of this Resolution that the knowledge and experience of the commercial fishing industry, the states, and the federal government be brought to bear on the multi-faceted fisheries problems. Furthermore, the fisheries commissions are appropriate mechanisms to use in exploring with industry their concerns, problems, and needs. NMFS and the commissions have been actively pursuing means whereby the efforts of both can be utilized most effectively and be mutually supportive.

To assure a common approach to the basic issues, I would like to suggest, as I did shortly after passage of the Senate Concurrent Resolution No. 11, that the national fisheries policy developed by NOAA and approved by our Marine Fisheries Advisory Committee serve as the starting point for both plans. The general mission statement and goals for the NMFS national fisheries plan which evolved from discussions with many people, including regional staffs, representatives of conservation agencies, the fishing industry, universities, recreational fishing interests, and others, is consistent with the principles set forth in the National Fisheries Policy. Thus, I would hope that the three commissions consider this same approach.

Last spring when I addressed the Gulf States Marine Fisheries Commission, some of you here heard me indicate my optimism about the future of fisheries in the United States. This optimism was not merely wishful thinking; it was based on important developments that had occurred and which continue to occur. I have already mentioned the Eastland Resolution and the National Ocean Policy Study which indicate the concern and support of the Congress. Early next year

the Law of the Sea Conference will again convene. From this conference we hope to see emerge a convention that will give coastal nations complete jurisdiction of their coastal fisheries resources out to 200-miles. This would give the federal government authority to regulate coastal fisheries beyond the territorial sea, to serve our national needs for food and recreation. Indeed, I look upon the opportunity available to us under extended fisheries jurisdiction as the most significant event that will have affected U.S. fisheries in the entire history of our nation.

My optimism also continues to be bolstered by increased high-level interest in fisheries by this administration as, for example, the establishment within the Domestic Council of a cabinet-level committee to consider domestic ocean policy issues, one of which must certainly be our U.S. fisheries under extended jurisdiction concepts. Such indications and commitments of high-level support are desperately needed if our U.S. fisheries are to reach their full potential. I am convinced that we will continue to get this kind of support. Thus, our U.S. fisheries are fast approaching an important crossroads. The direction we take and the plans we develop will truly set the course of events for many decades to come. This is, indeed, a time of challenge and opportunity for fisheries.

The National Fisheries Plan— A NOAA Overview

WILLIAM W. BEHRENS, JR.
Vice Admiral, U.S. Navy, Ret.
Naval Deputy, NOAA
U.S. Department of Commerce
Washington, D.C.

The multitude of problems plaguing our fisheries have been recognized for many years and numerous attempts have been made to resolve them. But these attempts have usually focused on individual problems and have tried to treat them in isolation. At best, such efforts have provided piecemeal remedies for the ills of specific interest groups. At worst, they have created new problems as diverse as conflicting state regulations and as critical as the depletion of some fishery resources.

Now, hopefully, we are beginning to see the development of more balanced and comprehensive approaches in which individual problems are being considered within the context of the overall problem of fishery rehabilitation. These approaches are aimed at establishing broad new policies to address the common problems of fishermen and to reconcile apparent conflicts between harvesting and conservation interests, between supporters of opposing views on national and international regulatory jurisdictions, and even between commercial and sports fishermen.

Over 5 years ago, the Stratton Commission recommended a number of administrative, legislative, and international measures to rehabilitate our fisheries without depleting the resource. Most of these recommendations have not been implemented, and the basic problems they were intended to correct remain with us.

Now, as we discussed this morning, international issues of fishery jurisdiction and conservation are being tackled in the LOS conferences, and Senate Resolution 1988 which we also discussed earlier is pertinent. If the conferences produce agreement on extending jurisdiction to 200 miles, coastal nations will be faced with new obligations to protect and manage the fishery resources in these zones. In the United States today, fishery management in the territorial sea is the responsibility of the states, but we have no mechanism for managing fisheries in the existing 9-mile contiguous zone beyond the 3-mile limit. Fulfilling new obligations for fishery management to a 200-mile limit will, thus, be a truly awesome task. On the other side of the coin, however, extended jurisdiction will give us the opportunity to improve the resource base and the economic viability of a large segment of the U.S. fishing industry.

Recent events in another international body will also have an effect on U.S. fisheries. The International Commission for the Northwest Atlantic Fisheries, in 1973, adopted U.S. proposals to reduce annual catches of certain stocks to allow them to recover. This action will, in the long run, increase the harvest of

these stocks and, in the meantime, will benefit the American fishermen by reducing the foreign take of species of great demand in the U.S. market.

On the domestic front, we are now establishing the basis for genuinely national fishery policies rather than the purely federal or local plans we have had. The Senate's National Ocean Policy Study under Commerce Committee Chairman Senator Magnuson is directed by Senator Hollings, the able Chairman of the Study Group. Among the goals of this Study is the establishment of policies for the "full utilization and conservation of living resources" and recommending solutions to problems in marine fisheries management and rehabilitation. The results of the Study, we have been promised, will be used in formulating new legislation.

At the present time, there is no really effective state management of migratory fish stocks. Senator Eastland has introduced a resolution to support state efforts directed to the conservation and scientific management of fishery resources. He proposes that this be accomplished with strong participation by three major regional fisheries commissions, the Atlantic States Marine Fisheries Commission, the Gulf States Marine Fisheries Commission, and the Pacific Marine Fisheries Commission. This thrust could contribute instrumentally to the formation of cooperative regional programs for the management of common fishery resources.

The National Fisheries Plan, the subject of this symposium, was proposed by NACOA in 1972. NACOA's purpose was to establish a national strategy for rehabilitating U.S. fisheries by assuring continued resource productivity and a proper U.S. share of the harvest, while accommodating the needs of both recreational and commercial fisheries. Currently, the U.S. fishing industry satisfies only 40% of this country's demand for food fish. NACOA suggested that the National Fisheries Plan establish a target goal for increasing the share supplied by the domestic industry. In 1973, after NACOA had clarified its proposal, the Secretary of Commerce requested NOAA to begin work on the Plan. In developing the Plan NOAA is working closely with the Department of Interior, the states, and industry groups.

The National Fisheries Plan *

JACK W. GEHRINGER, *Deputy Director,*
National Marine Fisheries Service
Washington, D.C.

Admiral Behrens has outlined for you several developing circumstances of fisheries in the United States, and indeed in the world, which make the development of a national plan not just a good idea, but a necessity for our fisheries at this time.

I will first describe for you the general nature of the National Fisheries Plan, and then discuss how it is being developed to provide for the involvement of many people needed to ensure its general acceptance.

First, it will be a broad plan designed to cover actions needed by all concerned with fisheries. This includes federal and state governments, the recreational and commercial industries, universities, conservation and recreational groups, and supporting industries. It will not simply be a plan for federal action, since action by the federal government or any other single party can achieve only a limited amount by itself. Since it will cover all interests, not just federal, it will be developed in cooperation with states and others.

Second, although described as a National Plan, it will cover only marine commercial and recreational fisheries and some aspects of inland commercial fisheries, such as catfish. It will not include inland recreational or Great Lakes fisheries, for which plans for some parts are being developed by the U.S. Department of the Interior in cooperation with the concerned states.

Third, no plan could possibly encompass all actions needed in fisheries. The National Plan will cover only the broad policy and strategy needed to restore and maintain our fisheries at their full potential. It will not replace more specific programs, such as the State-Federal or the NOAA aquaculture programs, but will relate these to other ongoing programs and propose new programs which together can attack the problems facing U.S. fisheries.

Fourth, it will develop all the economic and social evaluations of the options that available data permit to enable sound selection of options for inclusion in the plan. It is being developed on a tight timetable for completion and approval of a draft plan by July 1975. At this moment, it is on schedule.

The plan is being developed under the guidance of an internal policy committee chaired by the National Marine Fisheries Service (NMFS) Director, Robert Schoning, and with the advice of a committee drawn from members of the Marine Fisheries Advisory Committee and NACOA. The work is being done by a small full time staff and five senior NMFS staff members assigned as full time task leaders.

The mission and goals of the National Fisheries Plan were developed with considerable assistance of many people in and out of government. They address the continuing contributions of fisheries to the people of the United States and directions of the future of fisheries to increase this contribution to national and local interests.

*The title of the National Fisheries Plan has changed to National Plan for Marine Fisheries in June 1975.

The *mission* is to optimize the economic, social, and aesthetic value of fisheries to the nation consistent with maintaining fisheries resources for the future.

Four goals were selected: (1) restore and maintain fisheries stocks of interest to the U.S.; (2) develop and maintain a healthy commercial and recreational fishing industry; (3) improve the contribution of marine resources to recreation and other social benefits; (4) increase the supply of desirable, wholesome, competitively priced fishery products to the consumer.

The National Fisheries Plan is giving careful consideration to the needs of recreational fishermen as well as commercial fishermen, and several National Plan issues directly address improving marine recreational opportunities.

Some issues deal directly with marine recreation, others with several of the broad aspects of management which concern both recreational and commercial fisheries. One such important issue is that of allocation. Our country's needs for both recreation and food are growing. We believe that fish can contribute to both needs; but in many cases, we lack a satisfactory procedure for deciding how limited fisheries resources can be allocated in the fairest manner between these different national needs. This is one of the issues being explored in the Plan.

Based on comments of our regional staff on material submitted to them in April this year, a draft National Fisheries Plan outline was developed to provide a basis for an extensive review by many entities. This document was distributed to national fisheries and conservation organizations, state agencies, and our own regions in September for comprehensive review and comment by late January 1975. The outline consists of (1) a description of the principal problems and potentials of U.S. fisheries; (2) a series of papers covering what we believe are the major issues in fisheries today, together with a series of options for addressing the issues; and (3) a series of summaries showing briefly how these issues might apply to a number of major U.S. fisheries or species.

Series of meetings are being held across the country to obtain in-depth views and comments by state and local fishing interests. A pattern for many of the meetings was set up at a workshop held in July by Dr. John Harville of the Pacific Marine Fisheries Commission. The workshop was attended by about 35 people from states and federal governments, Sea Grant universities, and others, who spent long hours laying the basis for future meetings on the west coast.

While the comments, opinions, and suggestions are being developed across the country, we will begin to refine the options to be considered, writing them up in more detail, and developing the cost, benefit, social, environmental, priority, and other assessments which will form the basis for selection. The result will be an array of optional courses of action in different areas of fisheries. Each proposed course of action will show the estimated costs, benefits, and other consequences of such action. From these, a selection will be made to pick those options which show the most promise of success in achieving the program goals. Those selected will be written into the draft Plan by May 1975. This draft Plan will undergo a thorough national review before implementation.

The Plan will no doubt call for changes in NMFS role and programs. In addition, we see both the present draft outline form which is now completed, and the final form which will follow next year, as providing a useful basis for grass-

roots inquiries to be held by the Marine Fisheries Commissions under the Eastland Resolution. These two activities are quite separate, representing initiatives of the executive and legislative branches, but they are both directed to the same concerns, and ultimately will contribute in complementary ways to the future of our fisheries. A third initiative you have heard discussed today is the Ocean Policy Study, which we believe will also bring powerful forces to bear on our fisheries problems.

The reconciliation of the many fisheries interests in our country is no easy one, and we do not believe the National Fisheries Plan can provide instant or total solutions. We do believe that with the help of all fisheries interests across our country it can provide a rational basis for a greatly improved future for our depleted fisheries resources, our recreational and commercial fishermen and industries, and the millions in our country who enjoy eating fish. We see it providing a considered basis for helping to shape national policy and recommendations for legislation, to enable fisheries to move ahead. We see it leading to opportunities for more fruitful and effective state-federal cooperation in fisheries to take seriously needed action and we see program changes to provide a much sounder nationally (not federally) planned attack upon the fisheries problems of today.

The development of a National Fisheries Plan is an immense undertaking and NOAA is putting a major effort into the project. With the goodwill and help of many concerned people in this room and elsewhere, the plan can succeed, and the benefits to our recreation, our food supply and our industries can be great.

Conservationist and the National Fisheries Plan

FRANK E. CARLTON
President, NCMC, Inc.
Savannah, Georgia

Historically the Bureau of Commercial Fisheries and subsequently the National Marine Fisheries Service have functioned predominantly as a biological and research arm of the commercial fisheries industries of the United States. Fundamental contributing factors can be generalized in two large categories: (1) those characteristics of the commercial fisheries industry and the relationship and function of national government in the development and support of industry, (2) and those inherent characteristics of sportfishing which mitigated (constituency) organizational efforts as well as the tardy appreciation of the economic costs of insufficient conservation practices. A detrimental quality shared by both groups of factors can be described in terms of their short-sightedness and preoccupation with immediate needs.

With these thoughts in mind, the National Fisheries Plan can be viewed as a rational attempt to solve those fundamental difficulties in certain specific categories. Remarks with particular reference to present and long term needs of recreational fisheries will be made concerned with: (1) the organization of fisheries management (uniform state laws, state-federal relationships, regional organizations); (2) international fisheries (present organizations—ICCAT, ITTAC and IGNAF, future of a global fisheries management organization); (3) recreational fisheries science and management practices (stock analysis); (4) management techniques; (5) catch allocation; (6) local and regional marine councils; (7) recreational fisheries representation in coastal zone management decisions; (8) implementation and application of recreational fisheries concerns under the Fish and Wildlife Coordination Act, the National Environmental Policy Act and the Water Resources Planning Act; (9) federal and state responsibility for constituency development and participation.

It is obvious that increased activity on both the state and federal levels will will be necessary to achieve effective management of coastal fisheries resources. State-federal cooperative plans should be implemented for fisheries according to the philosophy already employed by the Coastal Zone Management Act and others whereby the states are afforded the opportunity to meet certain minimal standards under the assurance that if the state does not adequately respond the federal government will assume that function. Uniform and cooperative fisheries legislation and enforcement is long overdue and will inhibit and prevent satisfactory development of any rational plan.

Commercial Fishermen and the National Fisheries Plan

W. B. HANNUM, JR.
Sea Farms, Inc.
Key West, Florida

For years the U.S. seafood industry has been an orphaned cousin in rank of both public and political recognition. This has not been the fault of the industry, the public, or the politician. In spite of many fine industry organizations, we have nonetheless been splintered in needs and in purpose and in general recognition.

The farmer has created over the years a general recognition of his problems and the need for solution, regardless of his farm's location. The seafood industry and the sports fishing groups are only recently beginning to get the attention and recognition of problems and solutions necessary for reasonable viability.

The intrusion of foreign fishing effort, the increasing world need of protein, the fuel crunch, the publicity of the Law of the Sea Conference, and other news may have collectively helped to bring us to the notice of both public and politician. Regardless of how, we have arrived at a point of being heard and listened to; it is happening.

Regardless of being heard, we still have some serious obstacles. Many areas are bound by local, state, and federal regulations that do not hold true for the neighboring states. Some areas have periodic conflict between fishermen working different species. Other areas have problems of overfishing, conflict between large boats and small, divergent opinions about gear, and many others both too numerous to mention now and in some cases so local in character they are seemingly unimportant for national consideration. This last brings up a most important point, however. Fishermen, sport or commercial, are still fishermen and want recognition of their successes, problems, and needs for their locality.

Granted there are short-range current problems that are going to put some seafood operations and even some local sports fishing organizations out of business. *But* for the first time in my memory we have a chance to get a longer range look at our problems with some hope of real help.

Due to the forward looking dedicated aid from the National Marine Fisheries Service and a few farseeing legislators, we have a chance to have an input and to help to create a plan for the U.S. fisheries' future and perhaps its survival. If we goof this chance, we have no one to blame but ourselves.

Recognizing that there is still a large dose of suspicion by the fishermen that there will be unpalatable regulation, by the states that "Uncle" will usurp their prerogatives, by the federal offices that it is an unappreciated chore—it can still come into being! Only by input to the meetings needed to forge this plan can these suspicions be erased. Only by input can the plan be created. I hope enough of us are willing to do our part in both the listening and the input to get it done *now*.

Recreational Fishermen and the National Fisheries Plan

HENRY LYMAN
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Marine recreational fishermen like myself are keenly interested in the development of some sort of National Fisheries Plan. Our reasons for such interest may be expressed simply. (1) We do not know who we are. (2) We do not know what we have available to catch, nor what we actually *do* catch. (3) We cannot always get to the places we would like to go. (4) Even when we do get there, we find competition from other groups.

Let me elaborate. Although the series of national surveys of fishing and hunting conducted by the U.S. Department of the Interior has been extremely helpful in determining at least some basic figure on the number of marine anglers in this country, these surveys have only scratched the surface. Far more sophisticated work must be done to determine just how many marine anglers there really are, where they come from, what they spend, how they spend it, what they fish for, and what their physical and economic profiles may be.

Interest in such statistics, I am the first to admit, has some measure of selfishness involved. It is easy to say that there are approximately 10 million recreational fishermen in this country today who fish salt water. Such a figure does little to impress a public official in, say, Destin, Florida, who is considering cost comparisons between new highway construction or the building of an artificial reef off the town's coast. He wants basic facts on what benefits will accrue to his town through each project. Such figures are rare in the sport fishing world and, when available, almost never are presented in standardized form.

Federal efforts to standardize survey approaches have started in the National Marine Fisheries Service and are an important factor in a National Fisheries Plan. In the past, unfortunately, there has been a feeling that marine fishing statistics should be compiled by those trained in marine biology, with the result that counting anglers' noses has been very costly, extremely varied in presentation, and often wildly inaccurate. Those trained in the disciplines involving statistics should be the ones to gather these statistics. With a federal matching grant approach as a carrot—or stick, depending on your viewpoint—a National Fisheries Plan can make tremendous strides forward in standardization of reports in the field of numbers and dollars.

As far as the fish are concerned, the ordinary angler has extraordinarily little knowledge about the scarcity or abundance of the species he seeks. Since all so-called game fish in the oceans are migratory to some degree, an individual taking no common mackerel whatsoever off a section of the New Jersey coast may blame everyone from the Soviets to the pesticide manufacturers, while his

fellow fisherman in eastern Maine will be exclaiming over his success in catching of the same species. The recreational angler depends to a large degree upon information furnished to him by fellow fishermen, local tackle shops, and boat skippers, either directly or through the news media. Needless to say, such information may be distorted to some degree by visions of the tourist dollar.

A National Fisheries Plan should provide for research on a species by species basis on those fishes of primary interest to anglers. Obviously this cannot be done overnight. Some such programs have been initiated already, but they are not moving forward rapidly enough at present. For example, the striped bass has been researched to death, yet we have very little more knowledge today on how stocks should be managed than we had a decade ago. The work has been fragmented, has not been standardized nor coordinated. With an overall research plan laid out, gaps in knowledge could be filled, duplication of effort would be avoided and there is a strong possibility that some of the answers to proper management, and predications on supply, would result.

What I have said concerning my first point—the number and profile of marine anglers themselves—holds equally true when the sportsmen's catches are considered. Lack of standardization among many surveys conducted at local levels has made interpretation of the various figures compiled difficult and even contradictory. Here again, an overall national plan would serve not only to make management more efficient, but also would give the fishermen facts upon which to base his trips.

When a trip is taken, particularly by the shore and estuarine fisherman, access to the water is often difficult. Private ownership, presumably public areas restricted to use by residents only, governmental installations closed to the ordinary citizen, all are only a few of the problems facing the angler. He is forced to become a law-breaker or to fish shoulder to shoulder with his fellows in the few areas available to him.

This problem basically is one involving state and local governments. Whether much can be done by adoption of a National Fisheries Plan is doubtful. Certainly federal action could be taken to open up portions of some governmental coastal installations, which are now closed simply because they always have been closed. Model agreements for controlled access could be exchanged among states and communities. Conferences among those who are involved might be helpful. Frankly, I think the best approach would be to set realistic goals for public access to shorelines, try to reach agreement at the local level on implementation of the access program and, in the meantime, insure that present access points do not disappear.

Finally, I reach the matter of competition among what the economists are pleased to call user groups. If implementation of a National Fisheries Plan moves forward as it should, there would be little difficulty in determining just where recreational marine fishing activity is bound to be concentrated. A good deal of such information is available even now. With a complete Plan in effect, two things would happen. First, areas of fishing concentration could be set aside—zoned if you will—for that purpose. Second, suggestions for greater utilization of under-exploited species could be made to disperse the angling effort in

crowded areas. Obviously management of any of the fisheries could be undertaken to furnish the best use of the resource for the greatest number of citizens.

To cover all points concerning a National Fisheries Plan is impossible in the time allotted. It is impossible even if I had all next week at my conversational disposal, for the Plan will be modified, changed and hopefully improved as time goes on. The skeleton has been constructed and the fleshing out of the bones may take years. If the project goes forward as I believe it will, all those connected with utilization of our marine fisheries will benefit.

TUESDAY—AM—NOVEMBER 12, 1974

Chairman—Harold B. Allen, *Deputy Regional Director, National Marine Fisheries Service, St. Petersburg, Florida*

Marine Conservation and Domestic Management

JOHN S. GOTTSCHALK, *Executive Vice President, International Association of Game, Fish, and Conservation Commissioners, Washington, D.C.*

Once again I would like to preface my remarks by expressing my appreciation to Walton Smith and the other managers of this joint conference for the invitation to participate in what has become an institution in American fisheries affairs. These sessions have long been an important medium for the expression of opinions and the distribution of factual information about fisheries problems in general and of course especially those of our southern seas. We all trust that the increased concern of many people about the impact of the increasing pressures on our fisheries will serve to emphasize the value of the dialogues carried on at these meetings and that they will continue their useful function on into the future.

Our subject this morning consists of two very current and significant subjects: marine conservation and domestic management. Considered independently each could well provide the basis for lengthy discussion. This morning however we are considering them as a single subject, which paraphrased might be restated as a question—"How do we achieve marine conservation with domestic management?"

THE NEED FOR REGULATION

As indicated, this is indeed a subject of growing timeliness. For one thing, more and more U.S. citizens are using, both for enjoyment and dependency, our ocean's resources.

It is, of course, axiomatic that ultimately too much of a good thing causes problems. When too many begin to strive for the same scarce resource, the only available recourse is for society to institute appropriate regulation.

In the last two decades external forces have come into play which greatly increased the complications of appropriate regulation while at the same time

making it essential. These forces are the non-domestic manifestations of marine conservation which but a few years ago were largely limited to the strictly high-seas activities of various nations. Now, many nations have industrialized their fishing enterprises. Those in which industrial might has been merged with the political power of the government itself have brought unanticipated efficiency to the fishing scene. The result is an irresistible necessity to deal quickly with the problem of the conservation management of our marine resources. Hence, today it is apparent to one and all that some form of management is inevitable. To me it is ironic that that portion of the commercial fishing industry which has been the least regulated, and which has been the most vocal in demanding a reduction in foreign fishing competition, will likely be the first to feel the effect of regulation. I refer to fishermen of the Atlantic and Gulf of Mexico. Deserved or not, they will have brought regulation on themselves. For even if unilateral efforts to abate the excessive catches of foreign fleets in the western Atlantic are to no avail, it is apparent that in the long run, at some point in the future there will be domestic management based on international control.

For most of the fisheries on the east coast regulation will be a comparatively novel experience. Indeed most of our commercial fisheries even to this time are relatively untrammelled. To a large extent, only those controlled by international treaty operate under any semblance of regulation and only in the fisheries of the eastern Pacific has regulation proved to be reasonably effective and generally accepted.

Whether we like it or not, it would seem that there is considerable validity in the charge made by Carl Crouse, Director of the Washington State Department of Game, who, in an entirely different context, recently said, "In addition, I know of no renewable resource that has been managed by the people who commercialize on it that has been able to sustain itself on a perpetual and continuing basis." Crouse based his conclusion on more than a quarter of a century of observing the fisheries of our west coast. But the pattern has been generally the same from coast to coast. When a fishery was first opened to exploitation, the effort expended was less than the product capability of the stocks. But effort increased and as the standing crop diminished, fishing pressure continued to increase until the population had been fished into economic extinction. Finally, a kind of management regimen was established for the submarginal stock which purported to keep the effort constant with the biological portion of the stock. Granted that the conclusion is still arguable, some stocks, like that of the California sardine, have never returned to levels of former abundance. Others, like the Pacific halibut, have been brought back only to suffer again at the hands of excessive and unregulated exploitation.

In simplistic terms, increased fishing efficiency and increased effort have put inordinate pressure on fish stocks around the world. This phenomenon, based on the economics of scarcity, and the desire for profits first and conservation second, has only recently been recognized by fisheries experts generally. As a group, we fisheries people have tended to believe that the capability of fishery stocks to sustain themselves was far greater than it actually proved to be. Moreover, many have had a head-in-the-sand attitude and have been un-

willing to accept the fact that fishing enterprise could be so skillfully and powerfully organized that it could put sufficient strain on a great ocean fishery to bring it below the point of self-maintenance.

It would seem that the only species which are not suffering from the impact of the brutal onslaught of the foreign fishing fleets on the Atlantic east coast are those which by nature spend a substantial amount of their lives within the U.S. fisheries zone, or are not readily taken by conventional gear. One must surmise that it is the lack of intensive predation by fishermen perhaps coupled with a return of some poorly understood ecological balance that has brought the striped bass and the Atlantic weakfish back from relatively low levels in the not too distant past to exceptional abundance in recent years.

CURRENT REGULATORY SYSTEMS NOT EFFECTIVE

Upon examination it appears that most of the regulatory systems which have been attempted (and there have not been many) suffered because of fatal, built-in, inadequacies. While it may be unfair to belabor the point, it is now widely accepted that the original concept of ICNAF (International Convention for the Northwest Atlantic Fisheries) contained a fatal flaw. The convention was designed to be enforced only by the participating countries upon their own nationals. Thus the United States is expected to enforce regulations against violations by U.S. citizens. All of the other signatory countries are expected to do the same. Such a scheme is viable only to the extent that it is in a particular country's best interest to enforce the regulations. For reasons that may be touched upon later, regulations pertaining to fishing are frequently not taken very seriously. This seems to be true whether we are concerned with fishing on a farm pond or trawling in the northwest Atlantic. Moreover, the ICNAF system did not initially provide for effective surveillance of catch; nor was it attended by the breadth and intensity of scientific study necessary to determine what might be happening to the exploited populations. Now, at the eleventh hour when a crisis has developed, ICNAF has acquired a set of dentures but only after it had come to be held in disrespect as a regulatory mechanism by friend and foe alike.

In general then, there has been almost no attempt at regulation in the Atlantic and when it has come about, the regulations have frequently been the result of misguided political concepts of fishery problems rather than realistic applications of biological knowledge to the solution of fisheries problems. The situation is not so bleak, at least in principle, on the west coast, where a number of management schemes have been in force for many years.

These comments have generally been related to the question of regulating fisheries. The control of exploitation of other marine resources or the regulation of practices inimical to living marine resources are, to all intents and purposes, nonexistent. Several states and the U.S. Fish and Wildlife Service began showing concern about the destruction of estuaries and other coastal areas critical to certain valuable marine species some 20 years ago. For an equal period there

have been both national and international attempts to control the pollution of the oceans, particularly that caused by the discharge of oil from tankers. How effective these efforts have been may be judged by the fact that in retrospect the principal feature of Heyerdahl's experience in crossing the Atlantic several years ago was the prevalence of trash—blobs of oil, plastics, a cross section of the disposal material we are throwing all over the earth.

We find little change in the effectiveness of the regulatory mechanisms designed to cope with these problems. The international control of oil pollution is still not a fact. There is no effective means of preventing littering of our oceans, no more than there is of our highways. Some of the major companies have undertaken the development of strict regulations of their own vessels, but for every one which operates under a code of good behavior there are scores of other ships to whom the idea of prevention of oil leakage or dumping is an unthinkable sophistication. We finally do have a coastal zone management program which is designed not necessarily to give protection to the essential breeding and nursery areas upon which the wealth of our marine fisheries depends, but rather to give support to state systems for decision making in the coastal zone. I consider NOAA's handling of the Coastal Zone Management program to be a model of sensitive and effective administration. Unfortunately, in order to get any attention in law for the coastal zone it was necessary to accept language that speaks only in highly subjective terms about estuary conservation.

The sum and substance of all this discussion, and I submit, the history of the regulation of the exploitation of marine resources in the United States, is that it has been more notable for its failures than for its successes. It reminds me of the story of the awakening of one of our game management agents a few years ago. He was required by a government-wide dictum to attend a school and take a few hours of training in supervision. He duly went to a Civil Service Commission supervisory training course and on his return I questioned him as to the results. He said, "Well, what they emphasized in this course was the need for responsible supervision; they defined responsible supervision. Mr. Gottschalk, I am not getting responsible supervision." One must conclude that it does not take a training course to bring us to the realization that we have not been getting responsible management of our marine resources.

ESSENTIALS OF A REGULATORY MECHANISM

Without attempting to define and describe the reasons for our shortcomings, let us consider some characteristics of what might be an effective management system. It seems to me that there are three basic essentials in any kind of a regulatory mechanism. They are basic in the sense that without any one of them the system is bound to fail, but that is not to say that there are not other things also that need to be done. For example, no system will work if the people it is designed to regulate are not told of the regulations. This means there has to be an education/information program. Likewise, regrettably, it seems to be a fact that any regulation ever made will, perforce, be broken. There must be some system which will keep violations to a minimum. One part of such a system is

an enforcement program. But these are secondary aspects of a regulatory system and there are undoubtedly tertiary and perhaps still other levels of complexity. But basic elements are fairly simple.

The first is *better knowledge* of the resource and the demands that may be made upon it. Regulation is but a part of management, and management is but making decisions based on intelligent interpretation of facts in order to achieve a predetermined goal. In fisheries it is essential to have a reasonable knowledge of the size composition of the fish stock, the rate at which that stock is being harvested, and its rate of recruitment or how rapidly it is being added to. Once these basic facts are available the manager is in a position to know in general what he must do, although he may still be in doubt, or dispute, as to how he should go about doing it. He may have to prove, for example, that a reduction in the size of a particular year class is due to over-fishing of that age group rather than natural mortality.

Our failure to mount programs which provide us with the statistics required to understand what is happening to our fisheries is one of the most frustrating aspects of our current fishery dilemma. Biometrics of the fisheries, or population dynamics of the fisheries, or just plain statistics of the fisheries, whatever you may choose to call it, is perhaps the least glamorous phase of fishery research. As such, it is therefore vulnerable to the attacks of those who tend to see budget in terms of what is attractive rather than essential. Granted that the development of a useful yet cost-effective statistical system is extremely difficult, the fact remains that one of the great gaps in the programs of the National Marine Fisheries Service is the failure to maintain a sustained effort to resolve the problem of gathering necessary statistics on fisheries. It is essential that not only a system for the collection of catch statistics be obtained but that various fisheries themselves be subjected to the kind of sampling which will answer questions about stock and recruitment.

It is not just that the fishery manager needs these statistics in order to make his recommendations realistic. There is another far more important need for reliable numbers. It boils down to this, that in a democracy, government succeeds only with the consent of the governed. It is not enough to have understanding and agreement on a common general objective. There must be agreement on specific objectives and on the means for attaining them. Even at that there is no guarantee that the public will perceive and support desirable goals and the requirements for their achievement. We have ample evidence that people sometimes will simply not heed even regulations that are designed to protect them. It is totally unrealistic to expect the fishermen to accept regulations which are built on hopes derived from bits and pieces of data, and then extrapolated into a regulatory framework subject to challenge at every turn.

On the other hand, it is not necessary to have the absolute last little morsel of information before going to the public with a regulation that generally makes common sense. Fortunately the precision of general fisheries management is not nearly as demanding as that of, say, a lunar expedition. On the other hand, if a high degree of refinement were essential and had we an unlimited amount of money, it would be simple to get the necessary data. It is a distinguishing

mark of the accomplished and successful fisheries manager that he is able to judge at what point his data are adequate for him to come to a reasonable conclusion about a need for the character of a regulation.

SECURE LEGAL AUTHORITY

The second basic component of viable management is a secure *legal authority* for the essential regulations. This may be axiomatic but it is neither simple nor to be taken for granted. There are in fact three jurisdictions, state, national, and international, and any successful fishery regime must take into consideration the origins, precedents, and logical application of all of these if any regulation is to endure. It is obvious that there is no way in which the states can deal effectively with problems out across the distant ocean and involving such complicated and interdependent fisheries as exist therein. Neither, for that matter, can the national apparatus work effectively on a totally unilateral basis. In the brave new world of the future, international cooperation must come to the fore as the basis for the utilization of the wealth of the seas, except when resources can rationally be allocated to those nations who face the sea. These can be handled as national resources, but since there is no way in which states can effectively deal with problems that arise on the high seas, any form of extended jurisdiction will certainly bring assumption of full authority for management by the federal government.

COOPERATION VITAL

This brings us to the third and last characteristic of a fishery management scheme and that is *cooperation*. If it should happen that the federal government does achieve domination of the management responsibility for our coastal as well as off-shore fisheries it must seek a responsible means of building into its regulatory mechanisms a large portion of public and state input both as to knowledge and authority. A regulation built on cooperation rather than authoritarianism may be more difficult, but in the long run it will go farther toward the achievement of the end we seek, namely, a self-sustaining fishery that will contribute the optimum to the American fishermen and people everywhere. There is also a very practical necessity for the cooperative approach. Whereas the states are generally unable to cope with the distant water problems, by the same token they are able to deal with their resident citizens, and are in a position to make a real contribution in research and regulation in inshore waters. Based on recent experience it is extremely doubtful if the federal government will ever secure the financing to take over the full responsibility for the operation of any kind of a regulatory system.

This is more than enough in the way of preface for the other discussions which will occupy the session this morning. I have attempted to make the case that regulation of our fisheries is not only needed but inevitable, and that such regulation when it comes will have to be firmly based on knowledge, authority, and cooperation. There is only one other point I would like to make. It is that if we

are realistic in looking ahead toward the future needs of our American fisheries, we must recognize that the fisheries are not held in the highest esteem in this country.

Our people are not fish eaters in the first place, even though per capita consumption appears to be increasing. Our people are not particularly fish conscious. Granted that about a quarter of our population goes fishing every year, fish lack the emotional appeal of terrestrial livestock. Cattle and sheep can be seen in the flesh or in Marlboro commercials, with a romanticized background of scenic splendor. The only denizens of the sea that have succeeded as the objects of public emotional romanticism have been the seals, dolphins, and whales, to which are attributed various prized human characteristics such as big brown eyes, high intelligence, and family fidelity. If none of these factors were important as the basis for public indifference to the nation's fishery resources, there is still the fact that fish are a common-property resource. The "property" of all, they become orphans in the decision making arena. We use our fisheries and our fisheries interests as pawns in international chess games, sacrificing them on behalf of transit through straits, national defense, energy requirements, or whatever.

Therefore, until the United States develops a supportive policy for our fisheries, we can hardly expect to have really effective marine conservation through domestic management. There has been a grand awakening of the American public to the significance of our dependence upon the natural, closed system that supports us. If we capitalize on this awakening, we can gain the support of the public for prudent stewardship of the resources we treasure. With that support, based as it must be on an understanding of the great significance of our fisheries in helping to sustain an increasingly crowded and hungry world, not only can we carry out the regulatory responsibility, but move toward the restoration of fisheries which have suffered for the lack of it as well.

State-Federal Cooperation in Conservation and Management

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It not only seems a long time but it has been a long time since I first became involved with domestic management problems. This was in the years after World War II, and life seemed fairly simple in California where I was then working for the Department of Fish and Game as a marine biologist. All the states, at least those in the west, were convinced that they were managing their fisheries quite competently, and that they would continue to do so with no help from outsiders.

Foreign fishing off the American coast was yet to come, and only the faintest specter of federal intervention was on the horizon. That faint specter did lead, however, to the formation of the Pacific Marine Fisheries Commission and to interstate cooperation, if for no other reason than to keep the "Feds" out.

Over the years, we in state service came to accept the fact that for most species no one state could go it alone—not even one with as long a coast as California. Interstate, national, and international cooperation was essential to rational management.

Cooperative research became an accepted part of life. No state, however, was about to relinquish any managerial authority.

In the late 1960's, the Bureau of Commercial Fisheries floated the draft of a possible domestic management bill before the states that to us states-righters smelled of preemption and to which we in California proposed a number of emasculating amendments. We did see the need for and were willing to go along with more federal control than existed, and the difference between the state and federal views was actually more one of degree than of substance. Nonetheless, we took a rather hard-line position. Shortly after this, I joined the federal establishment and was exposed to the other side of the coin. It did not change my basic philosophy which is, in simplistic terms, that the least federal control is the best. The question remains: how far, to whom, and to what degree can managerial authority be delegated?

Today, much is going on that can, and I hope will, lead to resolution of this question and to implementation of a truly effective domestic management and conservation regime.

In the Congress, the draft legislation of the late 1960's, that I mentioned, was the prototype of the much-cussed and discussed HR 4760, introduced early in 1973, and the recently introduced Sullivan-Dingell bill, HR 15619, both of which attack the domestic problem.

The Executive Branch has been equally active. The speech presented for David Wallace yesterday and the panelists of that session discussed the National Ocean Policy Study and the National Fisheries Plan. Clearly there are many things moving—at the federal level, the state level, in industry, among sportsmen.

John Gottschalk has done a fine job in putting things into perspective. I am sure that he will get plenty of support for his view that fisheries interests tend to be used as pawns in international chess games, and that a prerequisite to effective domestic management is a positive federal posture toward fisheries. I am also sure that there will be those who think any dentures ICNAF may have acquired are too poor a fit to do much good.

I remain to be convinced that development of a suitable domestic management system can await the curing of our international ills. It seems to me that we must move ahead simultaneously and aggressively on both fronts if we are to have viable fisheries a decade from now. This will be particularly true if, as Harold Allen emphasized in his introductory remarks, extended jurisdiction becomes a fact in the next year or two.

Clearly, an effective domestic system will involve far more federal control than now prevails. The degree of federal preemption that will be required remains a major and explosive issue. That was made abundantly clear during the symposium on the National Fisheries Plan.

The philosophy of management is another highly debatable unresolved issue, as became evident yesterday during the Law of the Sea symposium: should the principles of maximum sustainable yield and full utilization remain a cornerstone of the United States fisheries position? I think most of us now regard optimum yield a far better concept, as attested by the papers given at a symposium on that subject at last September's meeting of the American Fisheries Society.

It has been said before. The fisheries community in its broadest sense must come to grips with the problems and agree on a system with which we all can live. Otherwise someone else is going to do the job for us. We are going to have to bite the bullet and indeed we are awfully late in doing so. I hope that at the end of this session we are a little closer to what I am sure is everyone's goal—rationally managed fisheries in the United States.

Prerequisites for Domestic Management and Conservation

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The United States has, in the past, been involved not only in international management attempts, but also in domestic management attempts. Rarely have these attempts been really successful.

The necessity for fisheries management, then, is not new. Both commercial and sports fishermen have begun to acknowledge this necessity, in some cases seen it increase—and in others, tried to ignore it in the hope that it would go away. It won't. So partly because of the growing food shortage, partly because of the impact of the Law of the Sea Conference, and partly because of a mixture of other reasons, commercial and sports fishermen, environmentalists, local and state governments, Congress, the National Marine Fisheries Service, nationalists, and internationalists are all calling for management. There are as many different proposals as there are proponents and many of the proposals are politically unrealistic or practically unworkable.

As far as existing arrangements go, one can look at almost any multilateral fisheries commission and see pretty clearly that it isn't working—either to protect the stocks involved or to protect the livelihoods of fishermen who fish these stocks. It's a particular source of frustration to me that the Department of State and the National Oceanic and Atmospheric Administration keep pointing to how successful the International Commission for the Northwest Atlantic Fisheries (ICNAF) is when just in the last few weeks New England fishermen have seen flagrant violations of ICNAF agreements.

Both internationally and domestically, overcapitalization can—often does—mean reduced biological and economic yield. And domestically, lack of agreement among states on how they should manage shared stocks is a serious problem.

As I said, many have recently become aware of this problem, some have tried to provide legislation to counteract it: the Law of the Sea Conference, of course, as well as the Magnuson/Studds 200-mile interim fisheries management bill, both in its original and amended versions; the Sullivan/Dingell bill (HR 15619/S 3783); the High Seas Fisheries Conservation bill (HR 4760); and the National Federation of Fishermen's Management bill, a draft which owes a clear debt to a University of Miami seminar which produced a piece of draft legislation that I submitted in my testimony opposing HR 4760 in May 1973. All these current efforts reflect thinking and work which, I emphasize, has been going on for some time.

Let me discuss some of the prerequisites for sound management of both do-

mestic and foreign fishermen and of U.S. coastal stocks and evaluate how well these alternatives I've mentioned fulfill those prerequisites.

First, it is a waste of money, time, and effort, to my mind, to try to manage a resource over which you haven't got clear-cut control. Therefore, to manage U.S. coastal stocks, we need an extended fisheries management zone. We need it *now*, through interim action. You heard Mr. Moore yesterday acknowledge that the Law of the Sea Conference may well go into 1976. To take interim action would be in line with the international reality: Over 100 nations at the UN Conference now acknowledge 200 nautical miles as the breadth for a coastal nation's resources management zone, and some of them have already declared their jurisdictions over that zone to one degree or another. As soon as the U.S. has control over both its coastal and anadromous stocks, we can determine what percentage of those stocks our fishermen can take, and what percentage we shall license others to take. Under the provisions of S 1988 [Sec. 2 (b)(1)] we could also act to conserve certain species beyond our interim 200-mile zone for fisheries jurisdiction. With clear-cut jurisdiction, we can enforce management and conservation regulations more thoroughly, and we can penalize violators—rescinding licenses and fining violators heavily are two possibilities. We need not drastically increase our Coast Guard fleet to enforce effectively, for we will be patrolling relatively few known fishing grounds, not a boundary line. We can also put vessel riders aboard the foreign fishing vessels we license to provide constant monitoring on what these vessels are taking—quite possibly in this way reducing both the number and the scale of violations by foreign fishermen.

Second, and very important, I urge all of you and others involved in fisheries not to go forward under the illusion that we are not going to have numerous and extensive measures designed to regulate the domestic commercial and sports fishermen. These will doubtless include limited entry—limited by effort limits or by catch quotas or by both as necessary. I think eventually, after some to-ing and fro-ing, both of these kinds of limits, in different combinations and permutations, perhaps, will come not from states operating independently, but from groups of states whose fishermen harvest the same stocks. One of the weaknesses both of current legislation and current policy is to deal either with one state or with the entire nation without considering that in fact, what the U.S. has is a series of several multi-state, regional fisheries.

Third, if management is really going to work fishermen must have input *from the beginning* in forming the policies and laws under which they will operate. One of HR 4760's greatest weaknesses is that it appears to most fishing industry people and to many state government people who've been exposed to it that it was a nightmare NMFS dreamed up completely without reference to or regard to those most directly involved. We in industry tried to make suggestions, but all NMFS seemed ready to do was change a semi-colon here, delete a phrase there. For this reason, among others, this bill is unacceptable to coastal fishermen.

The Sullivan/Dingell bill (HR 15619/S 3783) suffers from similar problems—including that of no real input from the fishermen who fish the stocks which it

proposes to manage. It was the product of people even more removed from the fishing industry than sometimes NMFS seems to be. It claims to provide a non-200-mile (but still unilateral) method by which to conserve the U.S. coastal fisheries, so it is particularly interesting that its most ardent supporters are the *distant water* shrimp and tuna industries and the Department of State. This proposed legislation builds on Article 7 of the 1958 Geneva Convention on Fishing and Conservation of the Living Resources of the High Seas and on assorted other legislative oddments. By basing this legislation on an existing treaty, its supporters are apparently seeking to give it a base in customary international law. But there are two flaws in this approach: first, the 1958 Geneva Convention is so weak it has never been used, and it seems a little silly to try to use it now; and second, Articles 9 and 10 make Article 7 of marginal usefulness for any rapid action to protect threatened stocks.

The kind of management legislation the fishermen I represent would like to see is more along the lines of the National Federation of Fishermen's "Fisheries Management Act of 1974." Some of our people took HR 4760, jacked up the title (and changed it a bit) and redrafted the bill to include substantial input from commercial and sports fishermen throughout the political and legislative processes leading to fisheries management. Probably the most significant difference between NFF's hybrid draft and the University of Miami draft is that in the NFF version, the fishing industry does not have veto power over government decisions affecting the fishing industry.

Almost daily we see the need for sound domestic fisheries management. Some fishermen don't like the idea, but very few will deny that it is necessary in certain fisheries. Our concern is that whatever management legislation evolves should include: (1) a clearly-defined zone of U.S. management responsibility — presumably 200 miles — for a zone is the easiest to enforce effectively; (2) management programs with the necessary regional variations, not a broad, something-for-everyone approach; and (3) provisions for substantive — not the current, largely cosmetic — input from those whom the legislation will affect, among which are both commercial and sports fishermen and state government people.

Priorities for Domestic Management and Conservation

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First of all, I wish to thank the GCFI for inviting the Southeastern Fisheries Association to be represented on this panel. Management and conservation have been our main interests since SFA was founded in 1952. As a panel member, I was invited to express my views on the priorities for and problems concerned with domestic conservation and management.

The first priority is to protect the estuaries from human and industrial waste and from indiscriminate landfill and bulkhead programs. I think everyone can agree on this and will support it the same as motherhood, the flag and good ole apple pie. And though everyone in this room is willing to pay for this protection, I dare say there are still those who see nothing wrong in allowing sewage to be pumped just offshore of some of our major cities or in filling the bays to build condominiums.

The second priority is to enact laws that will protect the resources from overproduction and, at the same time, kill laws that are aimed at helping one part of the country at the expense of another part, such as the proposed 200-mile bill currently pending in Congress. I believe that, except for tuna, 75% of all fishery products landed in the U.S., produced by domestic fishermen, are produced within 12 miles of shore. Of the amount caught outside 12 miles by U.S. fishermen, about one-third is shrimp. The point I'm trying to make is that most of our fisheries are already protected by the 12-mile limit.

This is not to say that problems don't exist in New England or the West Coast and Alaska, for they surely do. But, in our opinion, these problems can best be solved through bilateral and multilateral agreements, as are currently in effect, plus a decision from the Law of the Sea Conference under the auspices of the United Nations. The 200-mile battle has been fought for years. There will probably be questions later on so I will leave this subject for now.

An entity that cannot be ignored in this Conservation and Management Symposium is the commercial fisherman himself for, after all, here is the person who provides seafood for millions of people to enjoy. Protect the commercial fisherman by providing governmental assistance in those areas in which he cannot provide it for himself. Protect him by such proven programs as marketing and consumer education as well as biological projects. Protect him from institutional barriers put on him by state legislatures strictly for political purposes. Protect him from those well-intentioned souls who honestly feel a good conservation program is one that prohibits the use of all types of nets. And finally, protect

him from that bureaucrat who feels profit-making is not in keeping with the American way of life and from those rule-makers who have never had to meet a payroll.

Okay, we want to protect the resource and the fishermen, but can the states do it, or must the federal government step in? We haven't made up our minds yet. We do know of many good state programs but we also know of many bad ones. Probably one of the areas needing federal attention is in the judicial field. So often fisheries violations are treated insignificantly, and the small fines levied are such that there is no deterrent whatsoever. If the fine for undersized crawfish is $25, it's worth a gamble to bring in 100 lbs. at $3 per pound and chance getting caught.

I am most familiar with what has happened here in Florida and, on more than one occasion, the Director of the Department of Natural Resources and I have called for an investigation by the Governor's office when it became obvious that the judge in a particular county was not being fair. States are also more liable to pass a law based on politics rather than scientific data because of personalities involved. We feel that the federal government would be less likely to do that. Conversely, in those gray areas that surely will arise in the management of any resource, we feel that the state would be more sympathetic than the "Feds." This will weigh strongly when a position is taken by our Association.

To effectively manage many of our resources, it will become more and more important to work on a multi-state approach. If, for example, you are trying to protect kingfish with mesh sizes or closed areas, it would make much more sense to have the same regulations in all the states the animal passes through. The same can be said for shrimp resources, which are found in more than one state, and for other migratory species.

While we are not saying that the federal government should take over the management of our marine resources, they should have input. The federal government has a giant stake in all the fisheries through grants given to the states, as well as their Sea Grant programs, which are becoming better and better each passing year.

In conclusion, I would like to thank GCFI for allowing us a few minutes to briefly touch on some complex problems and to pledge the cooperation of the Southeastern Fisheries Association in working with all user groups for the protection and proper management of our fisheries resources. There is more than enough room for everyone if everyone is dedicated to the principle of sound and equitable management.

Our Changing Sport Fisheries

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Most of us are painfully aware that the world we know is changing rapidly, and not always for the better. This applies to sport fishing as it does to all other human activities. For example, back after World War II when the kind of fishing we have today was just getting started, bamboo was the standard rod building material. A sport fishing boat was any old crock too far gone to sell for a used yacht, but not quite rotten enough to try to burn for the insurance. Many party boat anglers still used hand lines. And a man who didn't sell his extra fish was a fool.

Nowadays, fiberglass has replaced bamboo as the universal rod building material, and several companies are experimenting with space age stuff like graphite and boron for making rods. Man-made fibers have completely replaced natural fibers for fishing lines. Sport fishing boats are highly developed, specialized craft, loaded with sophisticated fishing gear, electronic aids to navigation, communication and fish finding equipment.

Sport fishermen themselves are also changing, especially in their outlook. Many now realize that a number of species of fish and some marine habitats have been exploited to the point of economic if not biological extinction. And a man who doesn't release his extra fish is a fool.

Let's take a good look at some of the important changes in modern sport fishing with an eye to understanding what is going on right now, and what we may expect from the future. A good place to start is with boats and equipment. You might say that a four-way revolution has taken place.

First, sport fishing boats, ranging from the small, specialized center-console open boats that are so popular, up to the super-giant half-million-dollar ocean-going party-fishing boats, are vessels specifically designed to perform well under less than optimum conditions. Just as the fast rum-runners of the 1930's strongly influenced the development of yachts and naval small craft before and during World War II, so the development of fast, seaworthy, economical, sport fishing boats has exercised a powerful influence on the design and construction of quality yachts and work boats both here and abroad during the last 20 years.

Next, the development of high quality fishing tackle and accessories, rods, reels, lines, and other components that conform to new general criteria of performance, has given fishermen vastly improved tools for attracting and catching fish. Guesswork and mystery are rapidly going out of fishing and are being replaced by logic and greater understanding of why fish bite and why, sometimes, they don't.

Third, the advent of electronic and other aids to communication, navigation, and fish-finding has shown fishermen how to catch fish where they were never suspected to exist. Fishing areas have been expanded and seasons made longer. Science is replacing luck in fishing, and while some may disagree, we must admit that on salt water the day of the contemplative angler is just about over.

Fourth, sport fishermen and the rest of the world are discovering that fishing for fun rather than for commercial profit is big business. With close to 10 million salt water anglers spending at least $1.5 billion a year, leaders in game fishing conservation, management, and legislation are starting to muster increasing economic and political clout.

Fishermen themselves are becoming politically and socially housebroken. They are rapidly losing the old habit of calling lawmakers and conservation department officials a bunch of nincompoops before going to these same men, looking for a favor. While some old warhorses may still paw and snort, the new, younger leaders are quickly learning the value of doing their fact-finding homework before launching an attack on entrenched interests, or seeking a favor.

But there are other changes that are affecting us far beyond the scope of our own technological and intellectual progress. One of these is the very recent growth of massive foreign commercial fishing efforts close to our shores. We are all now quite familiar with the pattern of government-subsidized foreign fishing. What many of us don't quite realize is that only by having true workable facts about our own sport fishery at our fingertips can we sit down and talk turkey with the fisheries managers and negotiators of foreign countries. It was pitiful, for example, to sit at the first great International Billfish Conference at Hawaii, in 1972, and listen to our own very capable Dr. Don deSylva's inability to counter Japanese commercial billfish statistics with corresponding U.S. billfish sport fishing values.

Since then, our game fish researchers have started to make some progress in filling in the sport fishing economic statistical gaps. For instance, Dr. Luis Rivas now of the NMFS center at Miami, Florida, recently described to me a way of comparing the value of a marlin to sport fishermen with that of the value of the same fish to commercial fishermen.

He took as an example a medium-sized blue marlin that might be worth $150 on the dock at Tokyo after it had been carried home by a Japanese longliner working off South Pass in the Gulf of Mexico. If you could trace back the actual costs of charter fees, tackle, bait, fuel, and other expenses spent by sport fishing boats of the Gulf area to catch the same fish, the value of that fish to the U.S. sport fishing industry might be as much as $3000, or 20 times its cash value as meat on the Tokyo dock.

We need massive quantities of carefully analyzed facts like these at hand when our fisheries experts and negotiators get together with those of foreign countries to settle thorny mutual problems. This is why the new fish-catch and fishing effort information gathering program of the NMFS is so vitally important. Without provable economic and biological facts about our game fishes, our men are like a half-baked bank robber waving a cap pistol and shouting garbled threats in the bank of international fishing. We cannot afford to submit them to the humiliation of being laughed out of a chance to have their say.

Another change that is affecting the way we fish is the growing massiveness of our national sport fishing effort. This growth has been gauged at the rate of more than 5% a year. If we log 10 million steady salt water fishermen in 1975, a few moments with a pocket calculator shows us that if this trend continues, we

should have more than 20 million ocean anglers by the year 2000.

Where will they all fish?

What will they fish for?

Will there be any fish left for them to fish for, or will sport fishing eventually be outlawed because commercial fishermen and uninformed landlubbers think sport fishing is "wasteful" of edible protein?

These are new problems we are starting to face now and will have to tackle in the near future if we are to preserve our fair share of fish and fishing for the future. But who is going to pay for the kind of research and management we need now and in the future to keep our sport fishing industry viable? Will it be a matter of trusting to luck and "general funds," or should we seriously investigate the idea of a universal salt water license, the proceeds of which would be applied 100% to salt water game fish work?

Still another change in our way of life is the way we relate to commercial fishermen. Take for instance the business of the proposed 200-mile exclusive economic zone that finally received official U.S. sanction during the recent United Nations Law of the Sea Conference at Caracas, Venezuela. Both the tuna and the shrimp industries are dead-set against this concept, yet the majority of other commercial fishermen and practically all sport fishermen are for it.

In our admittedly new relationship of guarded sweetness and light with commercial fishermen, how tough should we get, and where do we compromise to gain desperately needed mutual decisions? In the "good old days" we could afford the luxury of damning commercial fishermen because they were commercial. Now we want them as allies to save the fish that both of us need for the very existence of our respective industries.

Finally, there are two underlying changes that will affect sport fishing in unpredictable ways in the near and more distant future. The first of these is really no stranger. This is the threat of economic dislocation brought about by the present worrisome inflation and fear of recession or even depression. People have lived through depression and inflation before and when things get tough they have a habit of doing for food and for profit what they once did for recreation—provided of course that there are fish to fish for.

But the second of these great changes—the new and ominous energy crunch—looks like a true storm cloud on the horizon. Modern sport fishing is admittedly an energy-consuming activity. Non-fishermen ashore have been quick to try to curtail the use of pleasure boats to save stocks of fuel for "more important" uses ashore. Yet nothing is said publicly about that fact that sport fishermen in the United States right now are producing somewhere between 1 billion and 2 billion pounds of edible fish annually, a very significant addition to the nation's diet.

We need to know exactly how many of what species we are harvesting by sport fishing methods so we can dispel the myth of energy use without beneficial production of food as well as recreation, and also so we shall know what effect our fishing has on the fish stocks that we harvest. And we need to plan for the future so that good fishing may be available to many people when fuel for pleasure fishing may not be as plentiful as it is now.

Speculation over why people fish certainly is not new. The great Izaak Walton confessed in his classic, "The Compleat Angler," that the highest point of fishing, to him, was when he sat down to dine on the catch in the company of fellow anglers, especially those who had not been as fortunate as he.

Modern anglers fish for a great many reasons, but according to a recent report of the Sport Fishing Institute, the most compelling reason can be boiled down to pure escapism, the need occasionally to get away from it all. A survey of fishing motivation conducted among salmon anglers of the British Columbian coast by Richard C. Bryan of the Fisheries and Marine Service of the Canadian Department of Environment disclosed that fully 61% of the anglers interviewed admitted to going fishing to "relieve tension," "to be outdoors," and for a "change from working pressures."

The value of fishing as recreation is now widely understood. Its value in this country as a source of high quality food for its participants is deeply underrated. This combination of facts, plus the growing awareness of the need to conserve fish and environment, puts some present day anglers in a contradictory position. How do you equate the old and honorable habit of fishing for the table and the freezer with the very modern admonition to release your fish and let them live?

We need to be able to advise serious-minded anglers when they ask questions like this. Perhaps the most fundamental change of all in the recent history of sport fishing has been the rise of leadership groups like the IOF, the IGFA, the Sport Fishing Institute, the National Coalition for Marine Conservation, the American League of Anglers, the Florida League of Anglers, and many other similar organizations.

I once heard a well-known New York State politician say that when it comes to doing the slave work of political party organization, he counts on perhaps 1% of the available party members to put their shoulders to the wheel. Two per cent more like to stand around and criticize. The other 97% don't seem to know or care what is going on.

I doubt that our average is any better, but with men like Dr. Walton Smith of the IOF, Bill Carpenter, Elwood Harry, and Dinny Phipps of the IGFA, Dr. Frank Carlton and Chris Weld of the NCMC, Curt Gowdy and Art Lee of the ALA, Dick Stroud of the Sport Fishing Institute, Lyman Rogers of the FLA, Frank Mather of Woods Hole, John Gottschalk, Hal Lyman and Frank Woolner of "Salt Water Sportsman," and so many others, we don't lack the kind of articulate, no-nonsense leadership we need.

What we need from this point on is to give these men and their organizations the kind of backing that will put a real weapon in their hands, not a silly cap pistol. Then, when people ask us, "Why try to hold onto the good things of the past? Don't you realize the whole world is changing?" we can answer with the old truth that the more things change, the more they remain the same.

Sport fishing isn't changing as much as it is growing up, learning its own strengths and weaknesses, understanding what it must do to survive in the changing present and the uncertain future. That is why we have met here in Miami. That is the message we should carry to our friends and to the whole world.

TUESDAY—PM—NOVEMBER 12, 1974

Chairman—Ogden M. Phipps, *Commissioner, Florida Game and Fresh Water Fish Commission, Miami Beach, Florida*

The National Marine Fisheries Service Recreational Fisheries Program

ROBERT J. AYERS
National Marine Fisheries Service
Washington, D.C.

Recreational fishing in saltwater without question is one of the most important recreational activities in this country. The Fishing and Hunting Survey conducted as part of the 1970 Census indicated that nearly 10 million people participated in this activity. A recreational fisheries statistics program we now have going in the northeast provides evidence that participants of all ages in recreational saltwater fishing and shellfish activities will number over 10 million in that region alone. Participants nationwide will certainly well exceed 20 million people.

This is my first opportunity to speak with you, the leaders in the marine recreational fisheries field. I particularly welcome this opportunity to discuss with you the National Marine Fisheries program, what it has been, and my views about what it should be and where it should be going.

The need for conscientious management of our marine fisheries resources has increased dramatically over the past couple of decades. This need for management has been brought about by increase in use by our commercial and recreational fisheries and, in some cases, competition from foreign fishing fleets as well. We face some critical problems in the years ahead. Ignoring these problems won't make them go away and burying our heads in the sand won't solve them. They can only be solved by facing up to them squarely, now.

We face a variety of problems. For example, we may be harvesting some of our species beyond the optimum yield level. A couple of examples that come to mind are barracuda stocks along the west coast and Atlantic bluefin tuna. Harvest rates must be brought into balance with the supply. This is not to say that I favor preserving some fish species just for the sake of preserving them. Conservation in my book means wise use, and to accomplish the long-term wise use of these resources will take the combined talent, knowledge and wisdom of all of us. I mentioned Atlantic bluefin tuna as one of the species for which the combined commercial and recreational harvest may be beyond the optimum

level. We now have a scientific investigation underway and the next speaker, Dr. Grant Beardsley, will discuss this study in detail.

One of our greatest needs in marine recreational fisheries management is a much better knowledge of how many people participate in saltwater fishing, where they fish, what they fish for, how successful they are, and what their major needs and desires are. We have initiated a program that will provide answers to many of these questions. I mentioned earlier that we have a marine recreational fisheries statistics program underway in the northeast section of the country. The purpose of this program is to provide answers to many of the questions that I just mentioned, as well as others. We plan to expand this program to include the southeast section of the country beginning in January. During calendar year 1976, assuming funding is available, we hope to conduct the same survey on the west coast. Thereafter, we hope to continue the program on each coast in alternative years. Assuming this program proceeds as we hope and is as successful as we expect, within a relatively short time the state and federal agencies involved in fisheries management, as well as organizations such as your own, will have available reasonably accurate basic statistics upon which to build future programs and make decisions. I won't attempt to describe the details of this program, but let me expand a little on a comment I made earlier about more than 20 million fishermen nationwide. The first results of our survey indicate that more than 10 million people participated at least once in marine fishing and shellfishing activities during the first six months of this year in the area from Virginia north to Maine. You may be wondering why the number is so much larger than the published results of the Hunting and Fishing Survey conducted as part of the 1970 census, which was 9.8 million people participating nationwide. The two surveys are not exactly comparable. For example, the Hunting and Fishing Survey did not include people involved in recreational shellfishing activities. Neither did it include persons below the age of 14 nor persons that participated less than three times a year or spent less than $7.50 on this activity. Our survey has no such limitation. It includes both fin fish and shellfish activities and all participants regardless of age as well as those people that participated only one time. We are quite excited about the first results of this survey. We think the information will be quite an eye-opener for individuals that have indicated dubiousness about the importance of recreational fishing.

I mentioned the increased need for management of marine recreational fishing. Sound management is necessary to provide for optimum catch levels and to prevent the overharvest of stocks as well as to resolve or ameliorate conflicts between commercial and recreational harvests. Sound management requires detailed knowledge of the fish and fisheries. We now have about 15 research investigations underway aimed wholly or primarily at recreational fisheries or their target species. The newest of these is our investigation of Atlantic bluefin tuna. Other studies include our oceanic game fish study, a biostatistical study along the middle Atlantic, and they range from the preparation of the Angler's Guide for the Atlantic Coast to a comprehensive stock assessment study of 10 species important to recreational fishermen along the southwestern coast of the U.S. The total cost of these studies including the marine recreational statistics

program is approximately $1,900,000 this year. I should mention that there was only one increase in the recreational fishing program this year, which was the Atlantic bluefin study. All of the other activities were either ongoing in previous years or a reorientation of a study that had previously been initiated or has been accomplished through reprogramming, which is moving funds already in our budget. We anticipate that new funds will be included in our budget for the next fiscal year for the initiation of additional new studies on recreational fisheries.

Another issue that needs attention is the need for a marine recreational fishing license. The National Marine Fisheries Service has no policy and has taken no position on this matter up to this time, but it is an issue that needs to be faced squarely, and soon. It seems to me there are a number of advantages for a marine recreational fisheries license. Such a license would provide an accurate registration of marine recreational fishermen—those that participate in this activity. If a registration of fishermen were available, the job of collecting the needed statistics that we have initiated in the northeast would be substantially easier and less costly. Simple registration of those that participate in this activity would be well worth the trouble and effort. Another important result of a marine recreational fisheries license would be that it would help to separate recreational fishermen from commercial fishermen. Regardless of your philosophy about fishermen who fish for pleasure and then sell their catch, in direct competition with those who make their livelihood fishing, most all will agree that separation of these two activities is absolutely essential. Proper management of a fishery harvest without a logical and accurate separation of these two functions is extremely difficult, if not impossible. Another obvious advantage would be the provision of funds to carry on needed programs of research, management, and for development of access for marine recreational fishing. This matter needs hard consideration by all of those interested in a sound marine recreational fisheries program including representatives of organizations such as these represented here today. While one can understand that commercial fishery interests might oppose creation of a marine recreational fishing license because it would call strong attention to the wide participation and growing importance of recreational fishing, it is difficult for me to understand the apathy on this matter prevalent throughout the recreational fishing fraternity when there is obviously so much to gain and so little to lose.

Another activity that the National Marine Fisheries Service needs to initiate is a close examination of recreational fishing to determine exactly where we should be putting our efforts and emphasis. For example, we need insight into the often asked question, "What constitutes good quality recreational fishing?" Is a good day's catch one big fish or ten small fish? Should we put more emphasis on fishing piers and fishing jetties? Is access the major problem? Supply of fish for the fisherman is always a problem, but what is the best way to grapple with this? Is the prospective development of exotic fisheries a matter that deserves high priority? At what level should forage fish be harvested for other uses? Certainly stocks of forage fish need to be maintained at a level that will provide adequate food for other predator species, but what is this level? I could go on and on asking such questions for which there are no answers or inadequate

answers. The point is there is much to be done. The cooperation and energetic efforts of all concerned—federal agencies, state agencies and organizations like yours—is badly needed to get some of these answers. The teamwork of all concerned is needed, particularly well-informed, interested recreational fishermen who have demonstrated their maturity and sense of responsibility to the resources they are concerned with in the manner that IGFA has in the Atlantic bluefin voluntary harvest reductions. The fishing public must practice constraint and conservation in its most basic sense. They need to become part of a team with energetic federal and state agencies, properly staffed and funded. If this teamwork can be developed, we just can't miss. It will take time. We won't accomplish everything in one day but such teamwork constitutes an irresistible force. For myself, I am pleased for the opportunity to be a part of it.

Oceanic Game Fish Investigations at the Southeast Fisheries Center— A Status Report

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Billfish and tuna stocks are the object of an intensive commercial fishery that has been operating in the Atlantic Ocean since the late 1950's. At its peak in 1964, 3.75 million billfishes and tunas were landed, of which about 10% were reported as sailfish, blue marlin, and white marlin. Concern among U.S. sportsmen and scientists quickly developed over whether the billfish stocks in particular could withstand this rate of harvest and still provide ample numbers for satisfactory sport fishing in the coastal waters of the U.S.

In discussions with nations that have extensive longline fleets it was apparent that we had little or no statistical data from the sport fishery for billfishes in the western North Atlantic, Caribbean Sea, and Gulf of Mexico. As a result, however, of these preliminary talks in the 1960's, the Japanese agreed to restrict their fishing activities off certain areas of the U.S. It was also agreed that discussions would be resumed sometime in the late 1970's to evaluate the status of billfish stocks in the western North Atlantic, Caribbean Sea, and Gulf of Mexico. The Oceanic Game Fish Investigations Program was initiated in 1972 to examine the feasibility of using big-game fishing tournaments to provide the necessary catch and effort data needed to determine changes in relative abundance and make evaluations of the status of stocks.

At the 1972 Game Fish Conference on Miami Beach we introduced the Program and discussed some preliminary data that had been collected. This year, after almost 3 full years of sampling, we would again like to review with you our results, make a preliminary determination of the validity of our sampling method, and examine how well equipped we will be in the event we enter negotiations in a few years.

Each year program samplers attend from 30 to 40 big-game fishing tournaments from Block Island to Jamaica and from St. Thomas to Port Aransas (Fig. 1). In addition we have seasonal samplers working in the Gulf of Mexico from May to October in cooperation with big-game fishing clubs and charterboat associations. We also have cooperative sampling arrangements with marine research agencies of the States of Florida, Georgia, and South Carolina.

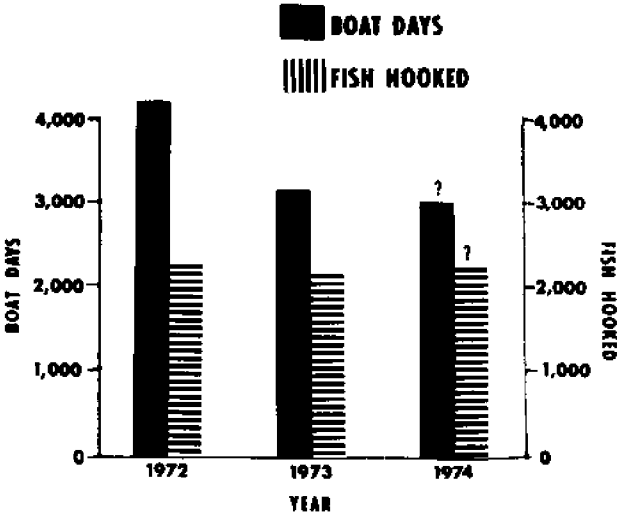

Fig. 1. Number of boat-days sampled and number of billfishes hooked in the western North Atlantic, Caribbean Sea, and Gulf of Mexico in 1972, 1973, and 1974. The data for 1974 are not complete.

Over the past 3 years we have attempted to increase our tournament coverage while refining our sampling to include only tournaments that are most meaningful to our data requirements. This year for example we were able to sample north of Cape Hatteras for the first time. Some big-game tournaments are not suitable for sampling because the boats do not return to a central location and our samplers cannot interview the angler or crew, the fishing hours are not standard, or for some other reason. The total number of fish hooked has not declined, and after all of 1974's data is included will probably increase to an alltime high in 1974. This suggests that our coverage is selective for those areas and tournaments where catches are high enough to provide meaningful results.

We separated the catch-effort data into two categories: the Gulf of Mexico and the Atlantic-Carribean Sea (Fig. 2). Hook rates for blue marlin are very stable with the Gulf maintaining a slightly lower hook rate than the Atlantic-Caribbean area. White marlin hook rates in the Atlantic-Caribbean area were almost identical, while in the Gulf hook rates rose in 1973 then fell in 1974. We were able to sample in the northeastern U.S. for the first time this year, and we expect our white marlin data for the Atlantic to be considerably more reliable as an index of population abundance in the future. No sailfish data are presented for the Atlantic-Caribbean area because some of our most important sailfish tournaments are still ahead of us in 1974. In the Gulf, hook rates for sailfish declined over 50% from 1972 to 1973 then increased in 1974. We pointed out in our 1973 newsletter that the sharp declines in 1973 may have been a result of the heavy flooding and large runoff of fresh water in the northern Gulf which could have

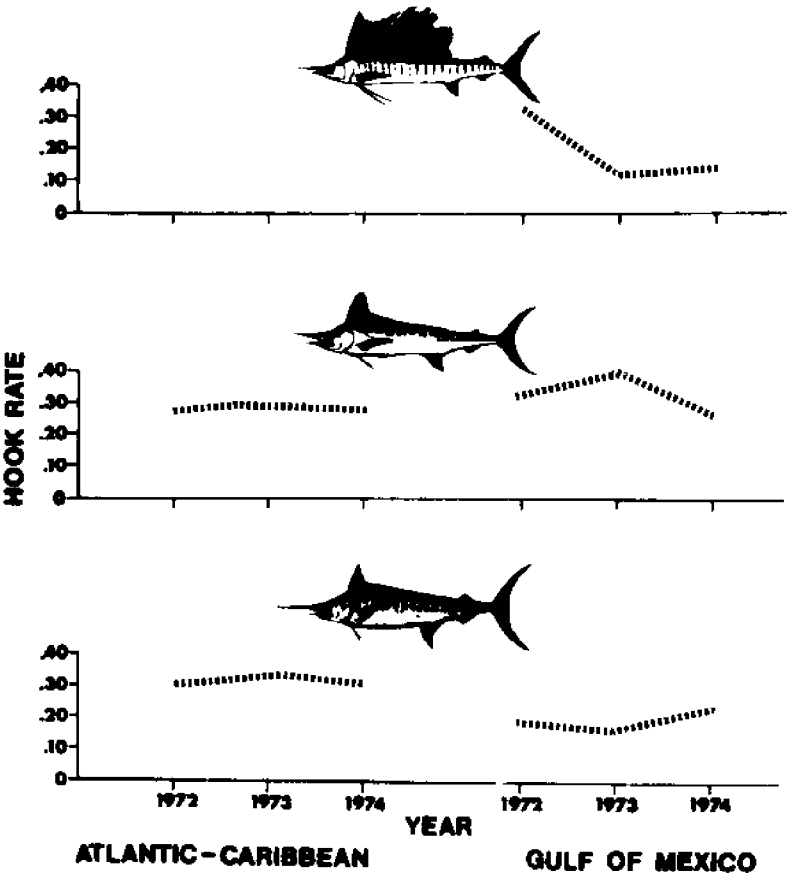

Fig. 2. Number of sailfish, white marlin, and blue marlin hooked per 8 hours of trolling in the Atlantic-Caribbean area and in the Gulf of Mexico in 1972, 1973, and 1974.

forced the sailfish out of their normal areas. It is interesting to note that the hook rates for tournaments in the Florida Keys in 1973 increased sharply over 1972. We believe that the consistency of our data indicates that our sampling is obtaining effective, reliable data and will provide us with adequate measures of changes in relative abundance of billfish stocks.

The Japanese longline data for 1972 have just been released and show the continuation of some alarming trends. We examined catch and effort data over a broad area of the western North Atlantic that includes most of the range of the sailfish, white marlin, and blue marlin populations in this area (Fig. 3).

Catch rates for white and blue marlins continued to decline with the catch rate for blue marlin reaching the lowest level since the beginning of the fishery

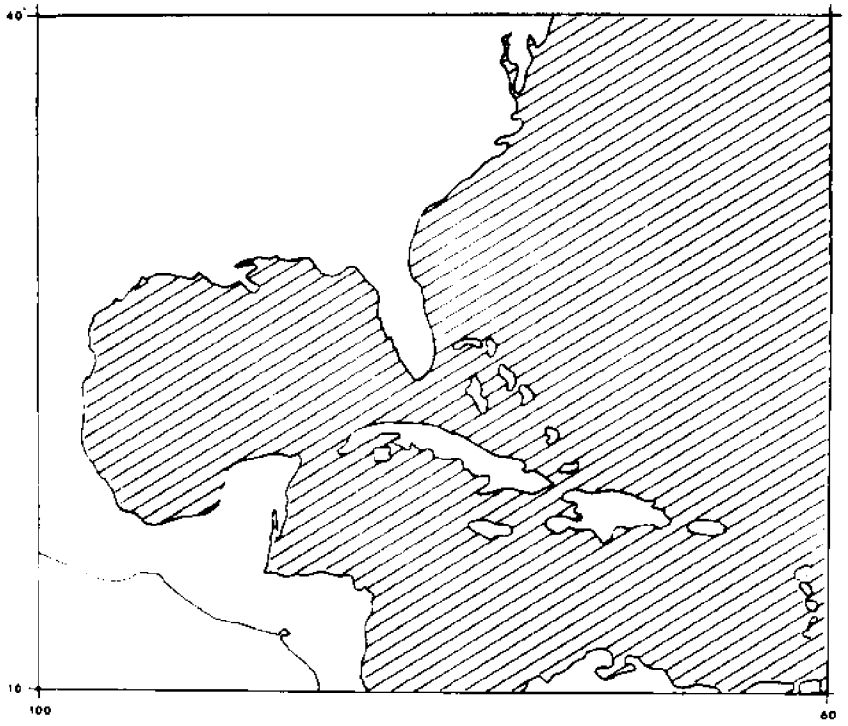

Fig. 3. The area in the western North Atlantic between 10°-40° North Latitude and 60°-100° West Longitude where longline catch rates were calculated.

in 1956 (Fig. 4). White marlin catch rates continued a decline begun in 1970. Our data from tournaments and dock sampling are comparable to the Japanese only for 1972. Even though our 3 years of data, when examined separately, suggest that the stocks of white and blue marlins are not declining in abundance, there is a very real possibility that what we are now measuring is a population that has already stabilized at a very low level of abundance.

We are actively studying other aspects of the biology and dynamics of billfish stocks in the Atlantic. We have just begun a preliminary investigation into the feasibility of using dorsal spines from white and blue marlins as indicators of age and growth. After examining a few initial samples we are very optimistic that we will be able to use these spines as an aging device, and fill a long standing gap in our knowledge of the biology of the marlins.

We are also examining size and sex distribution within season and within areas. For all three species the average length of females is greater than the males (Figs. 5, 6, and 7). This difference increases with the increase in the average size of the species and is even more pronounced when comparing weight.

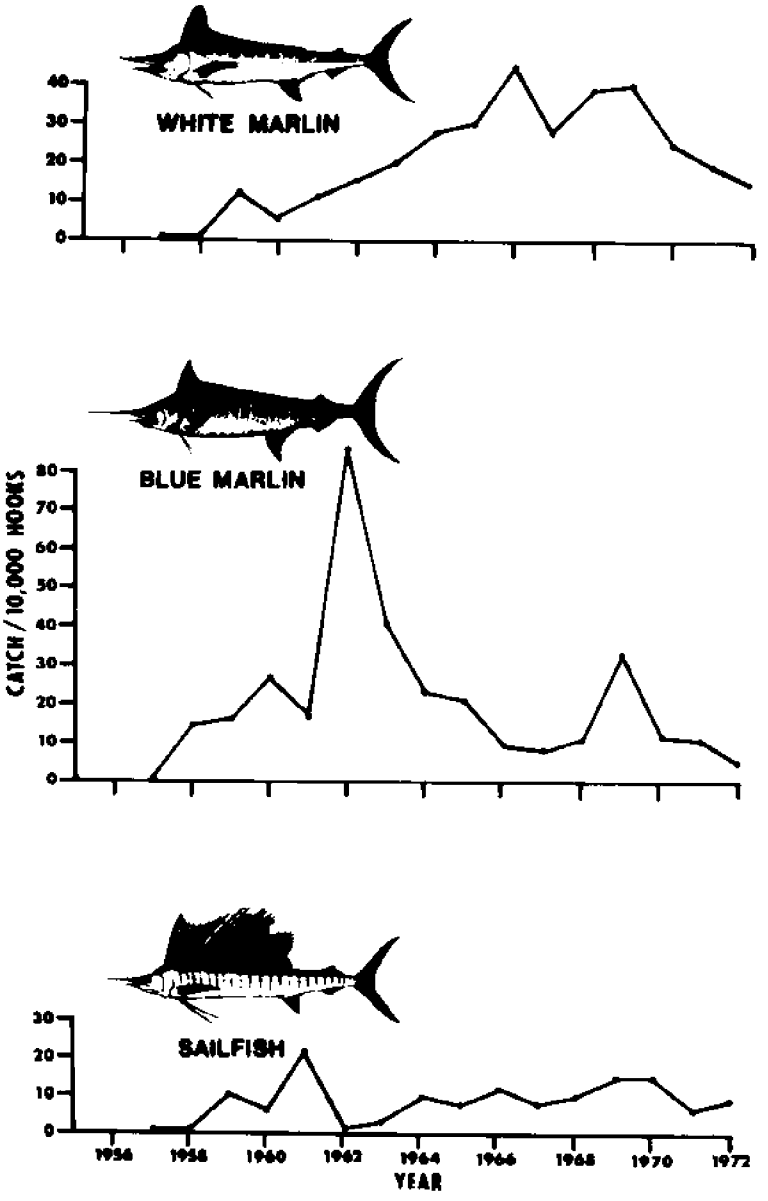

Fig. 4. Catch rates for white marlin, blue marlin, and sailfish in the western North Atlantic between 10°-40° North Latitude and 60°-100° West Longitude by the Japanese longline fleet from 1956 through 1972.

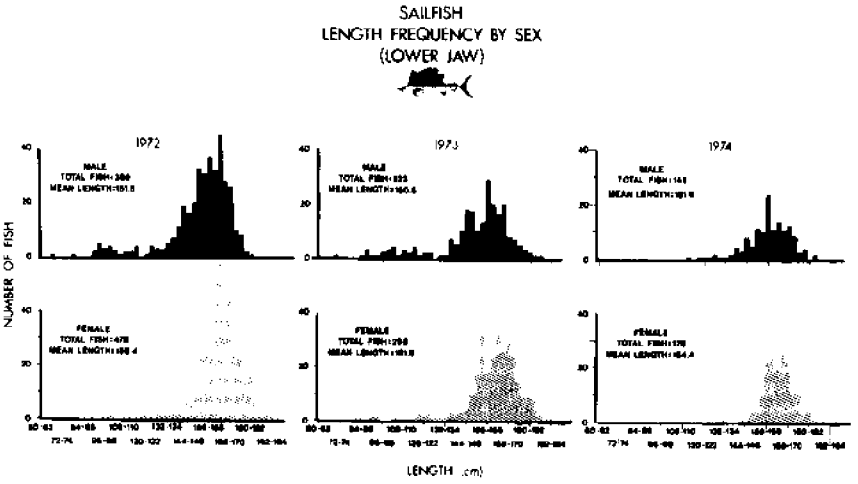

Fig. 5. Length-frequency distributions of sailfish separated by sex from 1972 to 1974. Lengths were measured from the tip of the lower jaw to the fork in the caudal fin.

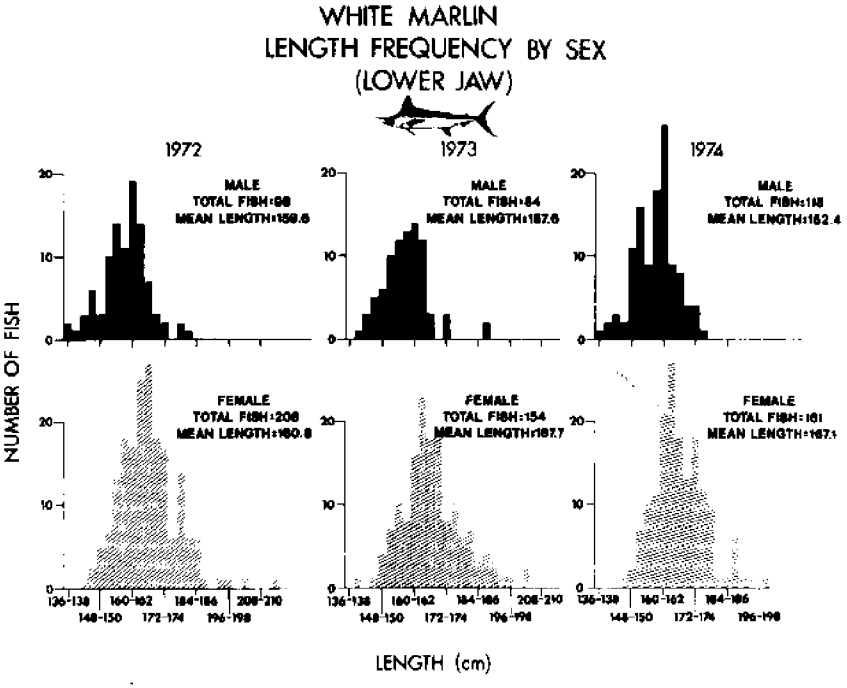

Fig. 6. Length-frequency distributions of white marlin separated by sex from 1972 to 1974. Lengths were measured from the tip of the lower jaw to the fork in the caudal fin.

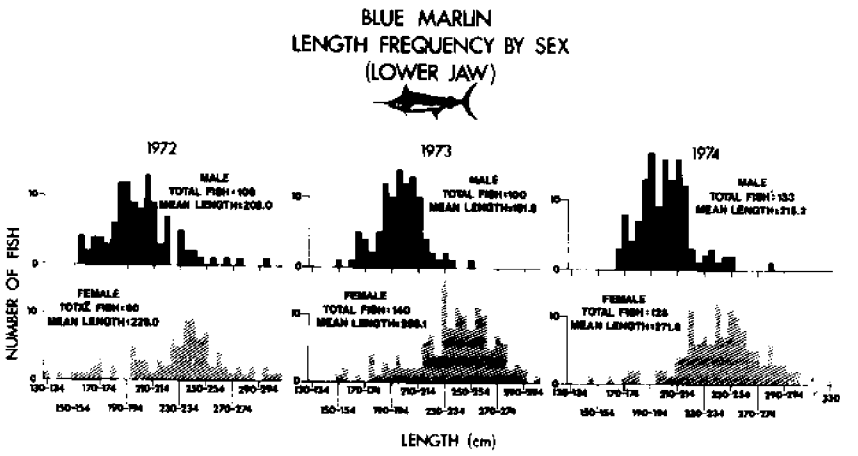

Fig. 7. Length-frequency distributions of blue marlin separated by sex from 1972 to 1974. Lengths were measured from the tip of the lower jaw to the fork in the caudal fin.

For sailfish and white marlin, females are more abundant in the samples for all 3 years. Blue marlin sex ratios are more near equal, however at certain seasons and in certain areas a pronounced dominance of one sex or the other is evident. In Puerto Rico and Jamaica in September and October, for example, small males are dominant in the catches. Over the past 3 years in the tournaments we have sampled in these areas males have constituted about 87% of the catches. In St. Thomas, however, only a month or so earlier in the year, females constitute about 80% of the catch. We are not sure of the exact significance of these differences. There is some indication that blue marlin separate by sex after the spawning season and only approach an even sex ratio during spawning season. There is evidence, however, that spawning occurs through September so we are unable to explain the differences noted in Puerto Rico and Jamaica. John Jolley with the Florida Department of Natural Resources showed recently that the sex ratio of sailfish off Florida is fairly even during the spawning season, June through October, but during November through May is about 2 to 1 in favor of the females.

One indication of declining abundance in a population of fishes as a result of heavy fishing is a decrease in average size. We examined average weights of blue marlin from the mid-Atlantic area and some rather interesting fluctuations were evident (Fig. 8). First, average weights varied greatly from year to year and similarly between fishing areas as might be expected if the same stock of marlin is being exploited. Secondly, there seems to be a fairly uniform yearly cycle between high and low points of about 3 or 4 years. This is another aspect of behavior that we are presently unable to explain. It does not appear, however, that there has been a decrease in average size of blue marlin in the mid-Atlantic

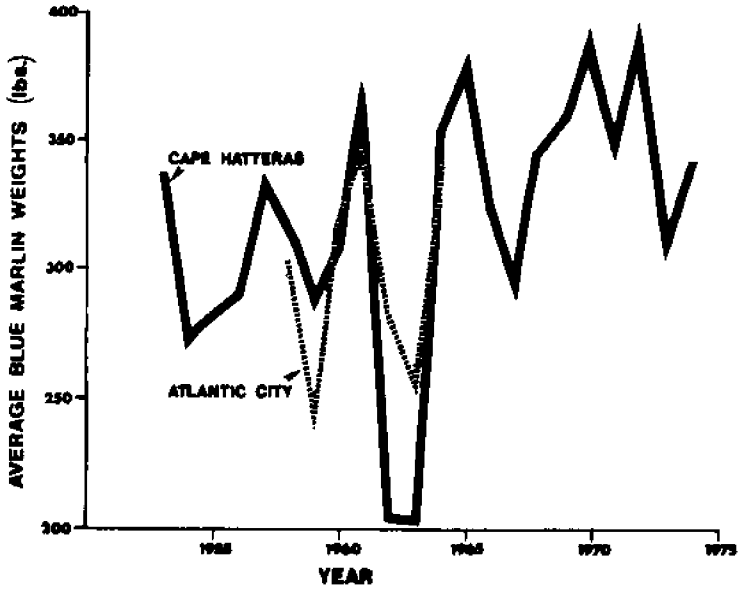

Fig. 8. Average weights of blue marlin landed at Cape Hatteras, North Carolina, and Atlantic City, New Jersey, from 1953 to 1974.

area at least. No decreases were noted in other areas of the western Atlantic either, although our data are not as extensive as in the mid-Atlantic area.

Last year plans were completed for the formation of a Cooperative National Marine Fisheries Service-Woods Hole Oceanographic Institution Game Fish Tagging Program. Mr. Chester Buchanan is the project leader for our portion of the program, and tags and tagging equipment are available from our Miami Laboratory as well as from WHOI. We hope to expand the tagging program and to identify certain problems that tagging experiments will aid in solving.

How good, then, is our data and will we be sufficiently prepared in a few years to enter international negotiations for conservation and allocation of our billfish resources if it becomes necessary? We are confident that our sampling method is valid and that we have identified a network of important and reliable tournaments throughout our area of coverage. By the late 1970's we will be fully prepared to begin talks with any foreign fishing nation. In 1977 we will have 3 full years of Japanese data available to compare with our own tournament data.

We thank all of the tournament committees, big-game fishing clubs, charterboat associations, cooperating state agencies, anglers, and crews for their patience and assistance. Without their cooperation, and in many cases special arrangements for our samplers, our program would not be able to complete its task, a task that we feel is vital to the maintenance of viable stocks of billfish along our shores.

The Western Atlantic Bluefin Tuna Situation

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In recent years there has been increasing concern over the status of bluefin tuna (*Thunnus thynnus thynnus*) stocks in the North Atlantic Ocean. Catches of giant bluefin by almost every fishery in the North Atlantic have declined to the point where many have closed because of a lack of fish. Some statistical and biological indicators such as tag returns and size distribution suggest that the stocks of North Atlantic bluefin tuna have been depressed below a level that is desirable from a biological as well as an economic standpoint. As we examined the available statistical and biological data on bluefin, it became obvious that a major research effort was required to clarify some of the questions and confusion that had developed over the status of this species.

In February 1974 NOAA/NMFS directed that a research program be developed at the Miami Laboratory of the Southeast Fisheries Center (SEFC) to obtain the necessary statistical and biological information to permit rational management and allocation recommendations on the bluefin tuna stocks in the North Atlantic.

In May one of our immediate actions was to initiate discussions with Canadian scientists to determine what could be done in 1974 to control fisheries for bluefin in the western North Atlantic. Both Canadian and U.S. scientists felt that the high prices being offered by the Japanese would encourage a large increase in the harvest of giant fish. From these discussions, we agreed to recommend voluntary catch quotas on both giant (mature) and small (immature) fish. We also recommended reducing landings of bluefin below a size of 14 pounds to protect the 0- and 1-year-old fish. The preliminary catch figures for 1974 show that the recommended quotas were exceeded in some cases but the overall goal of restricting expansion of the fishery was successful (Table 1).

The purse seine fishery observed the 14-pound minimum size restriction except when small schools were set on specifically for the purposes of tagging. Large numbers of 6-8 pound bluefin appeared along the eastern coast of the U.S. this year, and the seiners could have filled their quota with these fish if they had not observed the minimum size guidelines.

Our research activities this year have been involved with organizing and operating a network for data collection. Under NMFS contract Woods Hole Oceanographic Institution continued their involvement with bluefin tuna by catch sampling and tagging aboard the three New England-based seiners that fish for

Table I. Catches of Atlantic Bluefin Tuna
Canada to Bahamas, 1973-1974

(Figures in parentheses are estimates)

Area	Gear	Fish Size	Short Tons 1973 Catch	Short Tons 1974 Catch
Canada	rod-reel, trap	giant	408	760
Maine to Cape Cod	seiners-U.S.	giant	353	53
	hook, harpoon	giant	320	425
	sport	giant	?	?
Cape Cod to Cape Hatteras	seiners-Canada	school	676	120
	seiners-U.S.	school	983	870
	sport	school	?	(248)
		giant	?	(6)
Bahamas	sport	giant	17	(9)
Totals			2757	2491

bluefin. Over 1,400 bluefin were tagged from the seiners this year. About 1,000 of these were 1-year-olds.

Cooperative sampling was also developed with NMFS Northeast Region in Gloucester. Samplers from the Statistics and Market News Division obtained biological and statistical bluefin data from all of the major landing ports from New Jersey to Maine. Additional data were obtained from the processing plant at Cambridge, Maryland, through the cooperation of Bumble Bee Seafoods. SEFC staff worked in Portland, Maine, sampling large bluefin brought in for sale to Japanese freezer vessels.

Several experiments were initiated to obtain direct counts on the size of the post-spawning stock migrating through the Florida Straits. Information on larval abundance and distribution recently obtained from Cuban researchers provided an estimate of 42,000 spawning adult bluefin in the Gulf of Mexico in 1973. Aerial surveys were made during the spring migration off Cat Cay and Bimini, Bahamas, to establish procedures to make counts and estimates of the magnitude of the runs (Fig. 1) in future years. Some 3,079 giant bluefin tuna in 72 schools were sighted. Most of these sightings occurred within the span of a few days. An extrapolation of these counts to 24-hour periods permits estimates that 65,000 giant tuna passed by Bimini and Cat Cay this year.

We also attempted to conduct aerial surveys in Cape Cod Bay this fall testing the feasibility of low light level image intensifier systems to detect tuna

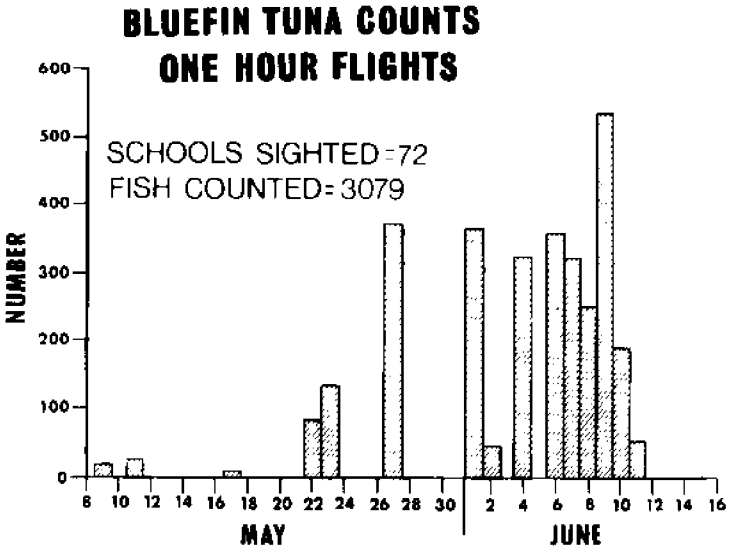

Fig. 1. Numbers of bluefin tuna sighted per day in 1-hour aerial flights from May 8 to June 16, 1974, off Cat Cay, Bahamas.

schools at night. Inclement weather and wind induced surface disturbances obscured any tuna schools that were present during the test period.

Additional experiments in the future include underwater directional hydroacoustic sensors off Cat Cay scanning seaward for about 2 miles. These can obtain highly accurate counts of bluefin during the entire run. The hardware is available from other federal agencies but financial constraints have delayed this for the present.

To provide information on where these fish go after they pass the Bahamas we plan to tag giant tuna with an array of radio transmitter tags equipped with time-delay releases that will be sent to the surface at pre-set intervals where they can be detected and positioned by satellite sensors.

We have airborne remote sensors that can detect schools of bluefin and using modern photo-interpretation techniques determine lengths to within a few centimeters. This will provide additional basis for an estimate of the size composition of the migrating tuna.

Some effort is being spent on a more detailed analysis of age and growth, last looked at in 1960. There is an indication that growth rates may have changed since that period. Size frequencies can be used to age the first few age groups and vertebrae can be used to age tuna up to about 10 or 12 years of age. We are making fairly extensive collections of vertebrae and other hard parts to re-evaluate past bluefin age and growth estimates.

We have recently learned how to easily extract otoliths from giant bluefin,

and this looks like a promising technique for age determination for the very large fish. A biologist from the Northeast Fisheries Center examined otoliths from 20 giant tuna captured in Canada and easily read as many as 25 clear rings on specimens weighing up to 900 pounds.

We also have been examining historical and new data on sex ratios. When bluefin migrate past the Bahamas their sex ratio is about two females to one male. This has been checked several times and seems to be consistent. In the coastal waters off New England and the Canadian Provinces, however, the sex ratio reverses to 2:1 with the males more abundant. The implications from this information are various. One hypothesis is that the northward migrating group separates somewhere between the Bahamas and northeastern U.S. and Canada, the males moving into coastal waters while the females continue their migration elsewhere, perhaps to waters off Norway. This is not unreasonable when we examine the number of tag returns from Norway from fish tagged off the Bahamas compared to returns from other areas.

For years it was suspected that the large fish that appear off New England and Canada in late summer were the same fish that moved past the Bahamas in spring. This year was the first time, however, that any fish tagged in the Bahamas has been recaptured in these coastal areas despite over 1,000 releases in the Bahamas over the years. The apparent change in distribution of the sexes as indicated by sex ratios between the two areas may partially explain this since out of these 1,000 releases probably only about 300 or 400 came in close enough to be available to the coastal commercial or sports fishery.

A close examination of sex ratios throughout the North Atlantic may determine if there are any different migrational and distributional patterns according to sex and what this might mean as far as management is concerned. If in fact we are harvesting only the male segment of the population off the northeastern U.S. and Canada we might be able to adjust our management recommendations to reflect this. Our proposed tagging experiment may be an excellent technique to determine if, when, and where the northward migration separates.

The International Commission for the Conservation of Atlantic Tunas began its annual meeting in Madrid on November 13, 1974. On October 11 a group of U.S. scientists met in Washington to review the status of bluefin stocks and to develop a scientific position in regard to management recommendations on an international basis. Two weeks later an open meeting was held in Washington to review our proposed position with representatives from both commercial and sports fishing industries. The consensus of these meetings was that the scientific evidence warranted the proposal of three basic recommendations: (1) Reduction in the harvest of adult bluefin to protect the spawning stocks. (2) Reduction in the harvest of young fish to increase recruitment to the spawning stocks. (3) Observance of a minimum size sufficient to protect the age-0 and age-1 fish.

The exact amount of the reductions as well as the recommendations will obviously be the focal point of considerable discussion among the nations that have significant fisheries for bluefin. We believe nevertheless that we have a sound case and we are optimistic that we can obtain international action on conservation and rational management of bluefin tuna stocks in the North Atlantic.

WEDNESDAY—AM—NOVEMBER 13, 1974

Chairman—Clifford V. Varin, *Fire Island Sea Clam Co., Inc., West Sayville, New York*

Shrimp Fishing with Twin Trawls

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Abstract

Shrimp fishing with twin trawls is the towing of two nets, instead of one, from each outrigger. The nets are joined side by side by a sled or "dummy door." The sled is towed by the third wire of a 3-wire bridle. This wire constitutes the only significant change in the boat rigging.

The system allows any boat to spread considerably more webbing at reduced towing speed than is possible with standard rigs. This is attributed to several factors: (1) The third wire pulls straight from the towing block and essentially takes up half the drag resistance of both nets; (2) This allows the use of much smaller main-trawl doors, for example, 6'x 32"doors will easily spread 75 feet of webbing; (3) The four smaller individual net configurations offer less drag than two large standard nets.

After considerable testing and fine tuning on board the University of Georgia's trawler *Capt. Gene* and on cooperating commercial boats, twin trawls are proving to be more productive in Georgia's fishery.

Several comparative tows have been made on individual boats using twin gear on one side and standard gear on the other. Data from this type of experimentation are considered invalid because changes in engine rpm's can be made to favor either side.

We consider our best example of increased production to come from a group of fishermen in a north Georgia port. For years, one fisherman (A) had been the highliner. Another boat (B) of the same class and horsepower switched to twin trawls. During our last roe shrimp season, boat B doubled the production of Boat A. During the brown shrimp season, boat B again doubled boat A. During the present fall white shrimp season, boat B is outproducing boat A by 20 to 30% a week. Seven boats in this fleet have switched to twin trawls.

A Shrimp Separator Trawl for the Southeast Fisheries

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The demersal trawl fisheries for shrimp and industrial finfish in the northern Gulf of Mexico overlap considerably and the increasing harvest and discard of groundfish by the shrimp fleet is of major concern to fishery managers. This situation has become more critical in recent years because the high value of shrimp has provided economic incentive for shrimping in high finfish density areas, justifying the increased labor cost associated with sorting out the shrimp. These high density finfish areas are the principal fishing grounds for the industrial groundfish fishery, based primarily on the harvest of sciaenids for petfood and human consumption.

Shrimp trawl catches range from 4 to 12 pounds of trash per pound of shrimp caught, of which up to 70% are sciaenids as well as other species usable to the groundfish industries. These groundfish are considered "trash" by the shrimp fleet and discarded overboard with total mortality to the fish. This destruction of trash fish is a serious concern to the groundfish industry whose total production is approximately 100 million pounds annually. Since annual Gulf shrimp catches have averaged over 200 million pounds for the past 5 years, over one billion pounds of groundfish may be destroyed each year by the shrimp fleet.

This discard problem is of particular importance in nearshore and estuarine nursery areas where very large numbers of juvenile sciaenids are captured and killed by shrimping during certain times of the year. These estuarine nursery areas have relatively restricted spatial boundaries but seasonably support high density shrimp and fish populations, particularly emigrant juvenile shrimp and pre-recruit groundfish. A high level of fishing pressure by the "mosquito fleet" usually occurs in these areas at a time when juvenile groundfish are still present in large concentrations, and results in an extremely high fish mortality.

Other problems associated with the discard also exist. Occasionally, high discard rates on fishing grounds have led to reports of large accumulations of dead and rotting material on the bottom in areas of high shrimp fleet concentrations, which make the groundfish fishing fleet catches unusable for human consumption or petfood. Further, large trash fish discards have occasionally created problems of dead fish washing up on public recreational areas.

The groundfish fishery in the Gulf of Mexico can be expected to grow in scope as the demand, both domestic and export, for fish protein expands and new products and processes for utilizing these resources are developed. Further expansion of the groundfish industry will result in increasing interaction

with the shrimping industry on the fishing grounds and a corresponding increase in associated problems. It is, therefore, essential that improved technology be introduced into the shrimp fleet to reduce the destruction of groundfish resources.

PREVIOUS DEVELOPMENTS

Shrimp trawls designed to separate shrimp from fish have been constructed and fished with varying degrees of success in Europe and the Pacific Northwest. French researchers in 1963 evaluated a shrimp trawl designed to separate shrimp from flatfish. This net was divided with a large mesh horizontal webbing panel into an upper and lower section, each with its own codend. Dutch experiments with a sorting trawl resulted in a design modification which incorporated a funnel-like separator and produced higher catch rates than the French trawl.

Behavioral research and fishing trials were initiated in 1968 at the Northwest Fisheries Center in Seattle, Washington, to develop a method for reducing trash in catches of Pacific Northwest pandalid shrimp. Large catches of these very small shrimp, up to several thousand pounds, are commonly produced in a tow. A normal tow in this area is usually composed of 80 to 90% shrimp and the remainder fish and discards. Since the price for Northwest pink shrimp is generally around 5¢ per pound, a boat must produce large amounts of shrimp to be profitable. Therefore, very little time can be spent sorting trash from shrimp. If the trash component of a catch becomes too large, the whole catch is dumped and the fishing vessel moves to a new area.

The Pacific Northwest shrimp separator trawl, which finally evolved, was a modified Gulf of Mexico type shrimp trawl. The net was constructed with a high vertical opening because the pandalid shrimp are often some distance off the bottom. The vertical separator panel on the Seattle net was attached across the net mouth with trash chutes in the center top and the center bottom of the net—one opening upward and the other downward—for fish escapement. Shrimp catches with this net were nearly free of unwanted trash fish.

The separator trawl for the Northwest shrimp fishery has been fairly effective, primarily due to the large size differential between the small shrimp and large fish, and because of the low ratio of fish to shrimp in most catches. Shrimp catches with the separator trawl are lower than standard comparison nets, but it was felt that a fisherman could compensate for the decrease in shrimp catch by making longer drags and fishing more hours in higher finfish density areas since the need for sorting could be essentially eliminated. In addition, catches of smelt, which are small in size, were difficult to reduce.

Preliminary evaluation of the Northwest gear in the Southeast Region met with limited success because the problem in our area is quite different. In the Gulf fishery, the fish and trash components of a shrimp catch are often as high as 90% of the catch. In addition, Gulf shrimp are much larger than Pacific Northwest shrimp and are often as large, or larger than, many of the fish encountered during trawling. This factor increases the complexity in using mesh panels to separate shrimp from the small fish in the catch.

Development of an acceptable shrimp separator trawl has also been attempted

by a few individuals associated with the shrimp industry in the Southeast Region, primarily trawl manufacturers. These individuals either lacked the financial resources, facilities, or time required to support such a gear development project. A project is presently being conducted by the Marine Extension Service of the University of Georgia in Brunswick to develop a separator trawl for removing jellyfish from a net. In general, though, few state agencies or universities are involved in research and development of applied fishing technology, since most lack the experience or facilities necessary to effectively develop and demonstrate a relatively sophisticated fishing system such as a shrimp separator trawl. The National Marine Fisheries Service (NMFS), however, is committed to the development of the nation's fishery resources including the development of harvesting systems required to encourage industrial utilization of these resources. For this reason, NMFS is undertaking the development of a shrimp separator trawl system to help reduce labor costs to the shrimp fleet and foster conservation of a valuable groundfish resource.

GULF OF MEXICO SHRIMP SEPARATOR TRAWL

The objective of this project is to develop a system which will accomplish selective capture of shrimp and provide in situ elimination, without injury, of trash and shellfish from the catch. Based on present economic factors, we have established a tentative minimum design criteria of 90% shrimp/trash separation while maintaining a 90% shrimp catch.

Each of the early separator trawl designs had a serious flaw. Horizontal separator panels tested by the French, Dutch, and initial net designs of the Seattle Laboratory, did not work well wherever tried in the U.S. The natural behavior of most shrimp is to instinctively swim downward to the bottom rather than upward as required for separation by horizontal panels. The Pacific Northwest vertical separator panel was attached directly from headrope to footrope and completely closed the mouth of the net. Unfortunately, a vertical panel moving through water perpendicular to the towing direction will become increasingly clogged with grass, trash, and gilled fish and while it is a fairly efficient separator for short tows or early in a drag, it becomes progressively less efficient on longer drags.

The Southeast Fisheries Center briefly evaluated the effectiveness of existing shrimp separator trawl designs for separating pink, brown, and white shrimp from trash fish and invertebrates in the late 1960's. These trials met with limited success due to the large size of Gulf of Mexico shrimp and the diversity of fish size. The Pacific Northwest vertical separator trawl was tested using large mesh separator panels. However, shrimp catch was reduced 30 to 40% when reasonable separation of trash was achieved. A horizontal type separator panel was designed and tested, but the best result which could be obtained was a 70% shrimp capture when a 75% reduction of trash was achieved. At that time, restructuring of Southeast Fisheries Center program priorities made it necessary to suspend research before development of a separator trawl could be completed. The present project to develop an effective commercial shrimp separator trawl for the Southeast Region was reinitiated in July 1974.

The shrimp separator trawl now being developed by the Harvesting Technology Task at Pascagoula uses a modification of the vertical separator panel. The design of this net is based upon observations of shrimp and fish behavior accomplished during previous projects, and an analysis of the shrimp-fish problem. It appears to offer excellent potential for satisfying the needs of a shrimp separator trawl in this region.

For several years the Harvesting group at Pascagoula has worked to develop an electric shrimp trawl for both resource assessment and commercial applications. For resource assessment, a mathematical model was developed to predict the efficiency or catch rate of the electric shrimp trawl. During field studies to establish the actual catch efficiency of the trawl and verify the model, some very important by-product information was obtained which has been used in the experimental design of our separator trawl. Divers found that after shrimp entered a net, almost all were carried into the wings of the net and pressed against the webbing. Closer observation revealed that essentially all of the water flowing into the trawl net is spilled out through the wings (Fig. 1).

Shrimp are relatively weak swimmers and the force of the water current is strong enough to carry them to the wings and hold them firmly against the webbing. After "kicking" away once or twice, the shrimp relax and remain pressed against the webbing; then, with an infrequent kick they tumble along the wing and gradually fall back into the codend. Very little water flow is found in the codend and bag, and shrimp movement in this area of the net is relatively unrestricted.

These observations indicated that a vertical panel positioned along the net wings could take advantage of the water flow pattern and high flow rate to help force separation of shrimp. The strong water pressure along the wings would press the shrimp to the separator panel, forcing them through the proper size meshes. Our divers have also observed that many fish swim freely in a net along the wing and other webbing panels. We decided that by tapering the separator panels in a "V" along the wings to the back of the net, fish could be led to an escape chute (Fig. 2). A vertical separator panel in this position would use the water flow pattern to separate shrimp and still lead many of the fish out of the net.

ALL RESULTS TO DATE

An empirical approach was used to establish the initial design, location, taper, size, and other configurations of the V-shaped separator panel along the wings of a standard 40-ft. semiballoon trawl. First we built a 16-ft. trawl, installed a vertical separator panel, and used divers to adjust and change the location and shape of the separator panel and trash chute until it was correctly positioned in the net. A small net was first used because it can easily be observed in tow from a small boat which requires a minimum amount of logistic support. After establishing the basic panel and trash chute design, these components were scaled upward for installation on a 40-ft. net and again diver-evaluated to optimize the configuration.

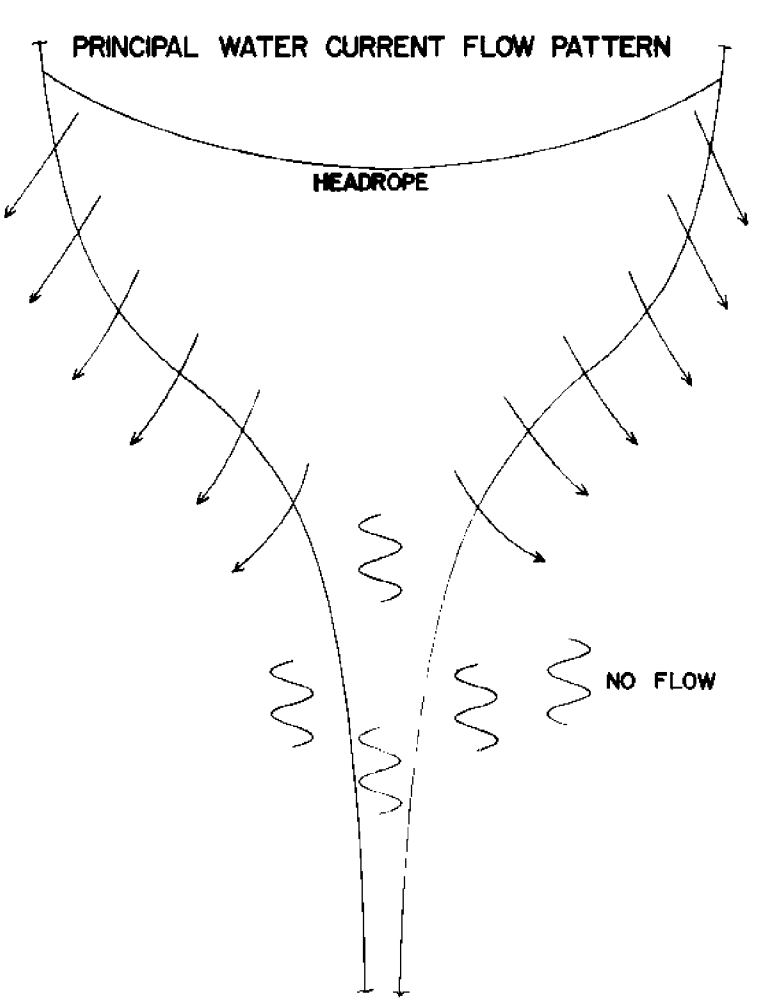

Fig. 1. General water flow pattern through a net.

The 40-ft. modified net was then used to establish the validity of the V-shaped wing separator panel and establish baseline catch data for use in measuring future progress. During these experiments, two secondary fish separation techniques shown in Figure 2 were also evaluated to establish their potential for improving separation, particularly of small fish. Separation of small fish from shrimp will be the most critical problem in development of an effective separator trawl for the Southeast fisheries. It is not at all uncommon, particularly when harvesting large shrimp, for fish as small or smaller than the shrimp (Fig. 3) to comprise 30 to 40% by weight of the total catch. Because many of these small

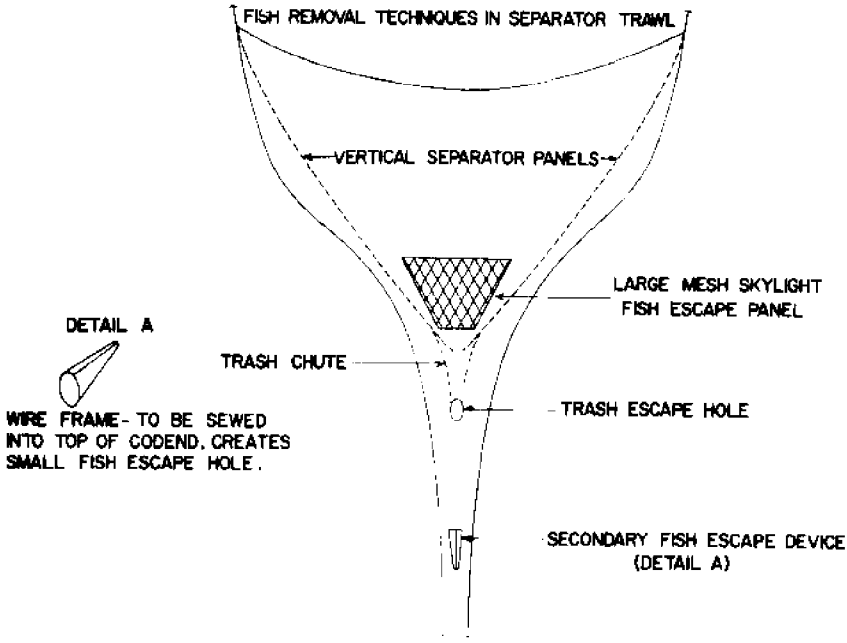

Fig. 2. Location of the vertical separator panel, codend fish escape device, and "skylight" panel in separator net.

fish will pass through a separator panel with the large shrimp, it will be necessary to develop secondary techniques to remove them either before or after they have passed through the separator panel.

The first fish escape technique evaluated was a small wire frame shown in Figure 2. This device, sewn into the top of the codend, creates a small hole through which fish which were small enough to pass through the separator panel can escape. The operating principal of this device is that while many fish will freely swim forward and upward to escape, shrimp will not.

The second fish removal technique evaluated was a large mesh "skylight" panel also shown in Figure 2. This modification is a wedge-shaped panel of large mesh webbing sewn into the top of the net directly in front of the throat and entrance of the trash chute. Our divers have observed that certain species of fish attempt to escape the net through the top panel. The "skylight" is intended to allow these species to escape through the upper panel before they pass through the shrimp separator panel or go out through the trash escape chute. Since shrimp tend to swim downward, this technique should not significantly increase their escapement rate.

The results of 1-hr. comparative tows between a standard 40-ft. semiballoon shrimp trawl and the shrimp separator trawl are shown in Table 1. Separator panels of 3½-, 3-, and 2½-in. mesh webbing were evaluated in terms of smallest

Fig. 3. Size comparison of shrimp to fish which comprised up to 40% of trawl catch during preliminary testing.

effective mesh. The fish escape device and "skylight" panel to improve fish removal were also tested. Results shown in Table I were obtained on catches of large brown shrimp, *Penaeus aztecus*, ranging from 14 to 16 count per pound, with a total length of 120 to 200 mm.

Conclusions based on the results shown in Table I are as follows:
(1) Vertical separator panels along trawl wings can be developed so as not to reduce the shrimp catch more than 10%. (2) It should be possible, through various separator trawl techniques, to approach a 90% reduction in the fish and trash catch for the Gulf of Mexico. (3) A 3½-in. square mesh panel caused less than a 10% shrimp loss and a 2½-in. panel is too small for 15-count shrimp. (4) A fish escape device in the codend reduces the fish catch an additional 10% but also reduces the shrimp catch 10%—other locations should be tested. (5) A "skylight" panel removed approximately 50% of remaining fish while only causing an additional 7% shrimp loss—further study and development should be devoted to this technique. (6) Square mesh panels are an effective approach—further development studies with rectangular meshes should be pursued.

No final conclusions on effectiveness should be drawn from the results, because installation and adjustment of the separator panel and fish separation techniques were made continuously throughout the above tests. All tows with the 3½-in. panel and five tows with the 3-in. panel were made with an initial trash escape chute design. Shrimp loss in this configuration for both panels was less than 10%. Because of fish gilling and clogging, the trash chute was redesigned

Table I. Comparison of separator trawl with standard trawl.

Type Gear	No. Tows (1 hr ea)	Shrimp Catch (lb/hr)	Shrimp Loss (%)	Fish Catch (lb/hr)	Fish Reduction (%)
Separator with 3½-in. panel	14	15.9	9.1	94.0	37.0
Standard net		17.5		149.3	
Separator with 3½-in. panel and fish escape device in codend	7	21.2	21.2	130.3	46.9
Standard net		26.9		245.2	
Separator with 3-in. panel	16	15.6	21.2	68.9	55.2
Standard net		19.8		153.7	
Separator with 3-in. panel and fish escape device in codend	10	16.3	31.5	66.9	64.9
Standard net		23.8		190.5	
Separator with 3-in. panel and "skylight" panel	6	14.3	28.5	52.8	77.9
Standard net		20.0		238.9	
Separator with 2½-in. panel	14	8.8	63.5	35.9	83.5
Standard net		24.1		217.5	

and enlarged for better trash flow, but the shrimp loss with the 3-in. panel subsequently increased to over 20% for the next 11 tows. This demonstrated that more design study will be necessary on configuration and flow patterns of the trash chute. Overall, however, individual results were very encouraging and demonstrated that the V-shaped vertical wing panel separator design should eventually be effective in separating shrimp. This design, in conjunction with secondary fish escape methods and improved panel characteristics, has excellent potential for achieving the 90% shrimp/fish separation and 90% shrimp catch design criteria.

ON-GOING DEVELOPMENT

Results from the preliminary tests are being used to design laboratory and model tests to establish optimum design characteristics for our future prototype separator trawl. We feel that the validity of the wing-vertical panel approach has been established and are now undertaking a series of laboratory shrimp response and net design studies to optimize the vertical V-panel, secondary fish escape techniques, and other proposed methods to achieve maximum shrimp/fish separation ratios without loss of shrimp. The results of these studies will then be used to design the first prototype commercial shrimp separator trawl.

Shrimp response behavior to webbing panels will be evaluated in a small flume test tank where shrimp can be subjected to a range of water flow rates under different webbing panel conditions. Separation panels can be developed to selectively pass shrimp or restrict fish, but these may require mesh shapes and/or materials other than those presently used in net construction. For instance, a change in mesh shape may be effective. Webbing hung on 0.707 spacings (perfect diamond) presents the largest opening dimensions to fish and shrimp passage (Fig. 4). To keep fish and shrimp from passing through a diamond-shaped mesh, a mesh smaller than the animal must be used. The objective of a separator panel, however, is to *pass* shrimp and *prevent* passage of fish. As shown in Figure 4, the mesh dimension that restricts most fish is the vertical height of the opening. Shrimp, on the other hand, approach a mesh horizontally due to their normal swimming attitude. This has been observed to be particularly true when they are forced to the wing panels by the high water current flow. Therefore, to pass shrimp, the most important webbing dimension is the horizontal opening.

The two different conditions of passing shrimp and restricting fish cannot be accomplished effectively with a diamond-shaped mesh. From Figure 4, it can be seen that a square mesh decreased the vertical opening presented to most fish and still retains good horizontal opening for passing shrimp. However, a rectangular mesh should be even more effective as a separator than either a dia-

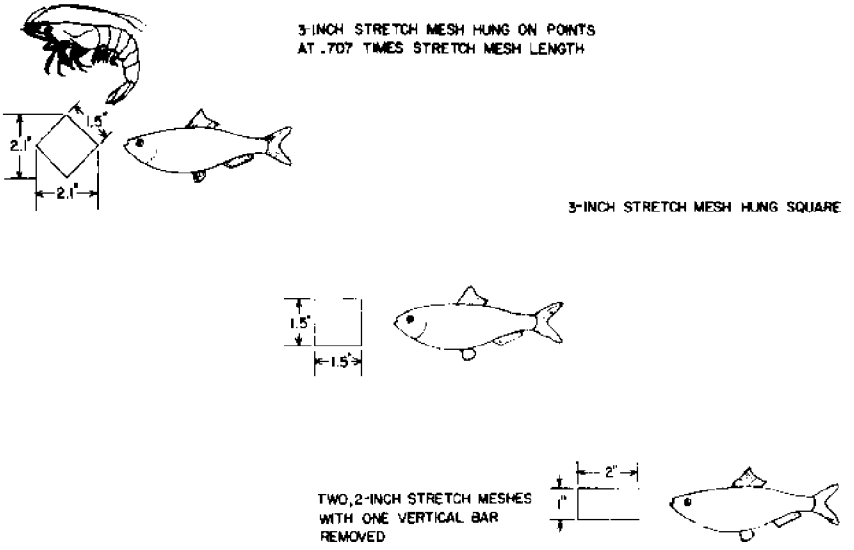

Fig. 4. Effects of mesh shape on separation. (A) Mesh hung on points presents maximum dimensions for fish and shrimp passage. (B) Same mesh hung square reduces vertical height for fish passage but also restricts shrimp; however, more effective than diamond for separation of shrimp. (C) A rectangular mesh achieves the best horizontal opening for passing shrimp and the best decrease in vertical height for restricting fish.

mond or a square mesh. The rectangular mesh contains both desired characteristics of a maximum horizontal opening for passing shrimp and a minimum vertical opening to prevent passage of fish.

Other characteristics of the separator panel which can probably be used to advantage that will be thoroughly evaluated are type of material, stiffness, and panel color.

A second experimental study will be directed toward optimizing design of the trawl net and configuration of the separator panel. The effectiveness of the V-shaped separator panel depends upon using the high water flow rates in the wings of the trawl to control and force separation of shrimp. We therefore need to thoroughly evaluate the water flow pattern in a net to optimally orient the separator panel where the water current flow is at a maximum to positively force shrimp through the separator panel. This will be accomplished on model nets in controlled flume test tanks and with divers. The small net or model studies will determine water flow patterns and velocities in different areas of the net, optimum location and configuration of the vertical separator panel, optimum trash escape chute design, and the effect of secondary fish escape techniques and other separation modifications which would affect water flow rate, pattern, and net performance.

The results of the two laboratory studies, together with the preliminary baseline evaluation results which we have obtained, will be combined to design and construct the first commercial prototype shrimp separator trawl for field evaluation. The prototype trawl will be diver evaluated to adjust trawl doors, footrope, headrope, separator panels, and secondary separation devices to ensure the net is correctly balanced for optimum fishing. Diver evaluation of fish and shrimp response will also be conducted whenever feasible or as the opportunity arises. Finally, comparative fishing trials will be conducted to evaluate and prove the commercial potential of the net. During fishing trials the effect of mesh size, shape, stiffness, panel visibility, secondary fish escape devices, large-mesh fish escape panels, and other secondary techniques will be established under various conditions of shrimp and fish size, species, and concentrations. Two comparisons which must be made during trawl evaluation are the weight of trash reduction achieved and the production rate of shrimp. Our design goals of a 90% reduction in trash without reducing the rate of shrimp production more than 10% seem realistic.

BENEFITS

The development of an effective shrimp separator trawl will directly benefit the shrimping industry through a reduction in labor cost and manpower requirements presently associated with the on-deck sorting of shrimp from other trash caught by a conventional trawl. Since it is the trash part of the catch that limits the length of each drag to 2 to 3 hours, it may be possible to compensate for any shrimp loss in the separator trawl by making fewer, longer drags and increasing the fishing time now lost between drags. The reduced trash load may also result in less damage to the shrimp catch from crushing and crabs, and could

possibly permit the use of lighter webbing in net construction. A shrimp separator trawl will permit shrimp fleet operations in high density fish areas previously impractical for shrimping.

The groundfish fishery will substantially benefit from the shrimp fleet using separator trawls through conservation of sciaenids previously subject to high mortality as shrimp trash. The reduction in unavoidable killing of the fish portion of a shrimp catch presently occurring with standard conventional shrimp trawls would greatly increase the resource base of the groundfish fishery and substantially increase the production potential of the fishery.

Life History and Fishery of the Red Snapper (*Lutjanus Campechanus*) in the Northwestern Gulf of Mexico: 1970-1974*

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Abstract

Trawl-caught snappers were taken between 5.5 and 82.3 m (3 and 45 fm). The highest catch per effort was in 29.3-45.7 m (16-25 fm) off Freeport-Galveston, Texas. Hook-and-line caught snappers were taken on reefs located in 13.7 to 146.3 m (7.5 to 80 fm) of water. Snappers exhibited a seasonal inshore-offshore movement and were not confined to rough bottom areas. Peak spawning occurred in June and July. Snappers grew approximately 200 mm (FL) during the first year and 60 to 90 mm in succeeding years. Young red snappers feed primarily on invertebrates; adults feed on vertebrates. Catch per effort and total effort by commercial fishermen have declined, while sports fishing for the species has increased. Shrimp fishermen marketed the larger snappers captured in trawls and discarded the smaller ones. The pressures applied to the fishery have adversely affected commercial landings on the Texas coast.

INTRODUCTION

Historically the red snapper *(Lutjanus campechanus)* has been one of the most economically important fin-fish landed on the Texas coast and in recent years has increased in popularity with sports fishermen (Moseley 1966). Annual commercial landings in Texas have decreased from 1020.6 metric tons (2.25 million lb) in 1964 to approximately 453.6 metric tons (1 million lb) each year from 1969 to 1973 (Lyles 1967 and *Texas Landings* 1969-1973). Few reports have been written on the biology of the red snapper and the present study was initiated to help determine the growth rates, spawning habits, food preference, and distribution of the species along the Texas coast.

Camber (1955) studied the fishery and fish with emphasis on the Campeche Banks. Moseley (1966) studied the life history of the red snapper found in Texas and Louisiana waters. Most other literature deals with descriptions of the fishery, fishing methods and exploratory cruises for new fishing grounds. Stearns (1884), Smith (1885a, 1885b), Collins (1887) and Adams and Kendall (1891) dealt with exploratory cruises for new snapper fishing grounds. Stearns (1885),

*This study was conducted in cooperation with the U.S. Department of Commerce, NOAA, National Marine Fisheries Service under PL 88-309 (Project 2-109-R).

Jarvis (1935) and Smith (1948a, 1948b) dealt with improving catch methods. Carpenter (1965) reviewed the fisheries, describing methods used, fishing grounds, production and marketing.

The taxonomy of the red snapper has been in question for many years. Three specific names have been used in the literature: *L. campechanus*, *L. aya* and *L. blackfordi* (Anderson 1967). The American Fisheries Society (1970) follows the nomenclature of Rivas (1966) and uses *L. campechanus*.

MATERIALS AND METHODS

Random samples of red snappers were taken by hook and line from reefs along the entire Texas coast, but most work was concentrated in the area off Port Aransas. Both electric and manual reels were used. Catch per effort was based on 15 hooks fished for 1 hour. Smaller snappers were caught with 13.5 m (45 ft) flat otter trawls of 4.4 cm to 5.1 cm (1 ¾ to 2 in.) stretched mesh. Trawling times varied from 10 minutes to 2 hours, depending upon depth and bottom conditions. Most tows were for 30 minutes.

Snappers were measured for fork and standard length (SL) (Fig. 1). In this report measurements are in fork length (FL) unless stated otherwise. The fish were weighed, their stomach contents were analyzed and gonadal development was noted. Stages of sexual maturity were determined by using the numerical index taken from the "Field Methods of Fishery Biology" (Food and Agricultural Organization of the United Nations, 1960). Identifiable food was blotted dry and each different food item was measured by displacement of water in a graduated cylinder. Water samples were taken with a Nansen bottle and temperatures recorded in degrees Celsius.

When seasons are referred to in the text or figures, the months are grouped in the following manner: summer (June, July, August), fall (September, October, November), winter (December, January, February), spring (March, April, May).

Sport and commercial fishermen were interviewed monthly. Fish from their catches were measured and, if possible, the locale in which they were caught and catch per effort were obtained. Several trips were made aboard party boats to observe sport fishery methods and catches.

Ninety-eight bottom trawl samples were taken in 1970, 84 in 1971 and 118 in 1972. From June 1973 through January 1974, 36 trawl samples were taken in areas where a shrimp fleet was working. In June, July and August 1974, 45 samples were taken with the fleet. All boats within an approximate radius of 10-12 miles were counted to determine the fleet size.

Trawl sampling depths ranged between 5.5 and 173.7 m (3 and 95 fm). Field work was accomplished from aboard the Texas Parks and Wildlife Department vessel *Western Gulf*, a 21.9 m (72 ft) long, double-rigged, steel hull shrimp trawler. An attempt was made to take samples at 9.1 m (5 fm) intervals each month, with supplementary sampling as time allowed. The majority of collections were obtained between 7.3 m and 64.0 m (4 and 35 fm) off shore of Port Aransas and Freeport-Galveston. In this study the Texas coast was arbitrarily

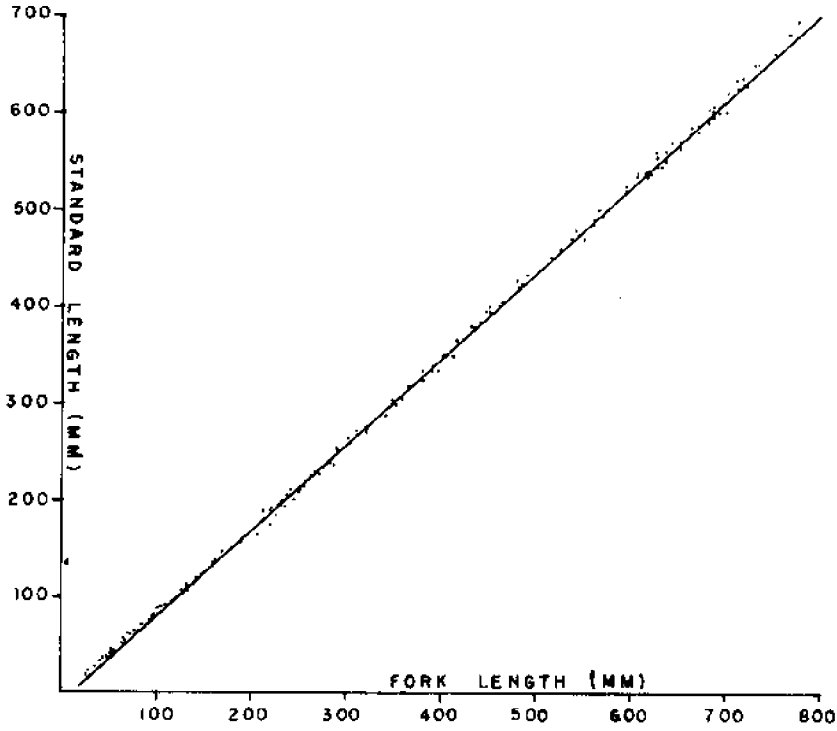

Fig. 1. Standard length vs. fork length of *L. campechanus*.

divided into three areas (Fig. 2); Area I is the region off Galveston-Freeport, Area II is the region off Port Aransas and Area III is the region off Port Isabel-Port Mansfield.

The project area covered in this report lies in the Gulf of Mexico from latitude 26° N to latitude 29°40′ N and bounded by the coastline of Texas and longitude 93°50′ W.

RESULTS AND DISCUSSION

General Distribution

Red snappers were found along the Texas coast from Galveston to Port Isabel. Hook and line samples (64) were taken on 11 reefs found in water depths of 13.7 to 146.3 m (7.5 to 80 fm) and *L. campechanus* was found at all the sites (Fig. 2). Young (34 to 250 mm) red snappers were taken in trawls from 5.5 to 82.3 m (3 to 45 fm) Table I).

Between February 1970 and January 1972, 64 trawl samples were made off Area I of the coast, 209 were taken off Area II and 27 were taken off Area III. In Area I, no juvenile snappers were found within 18.3 m (10 fm). They were most abundant between 29.3 and 45.7 m (16 and 25 fm) (Table II). A mean of

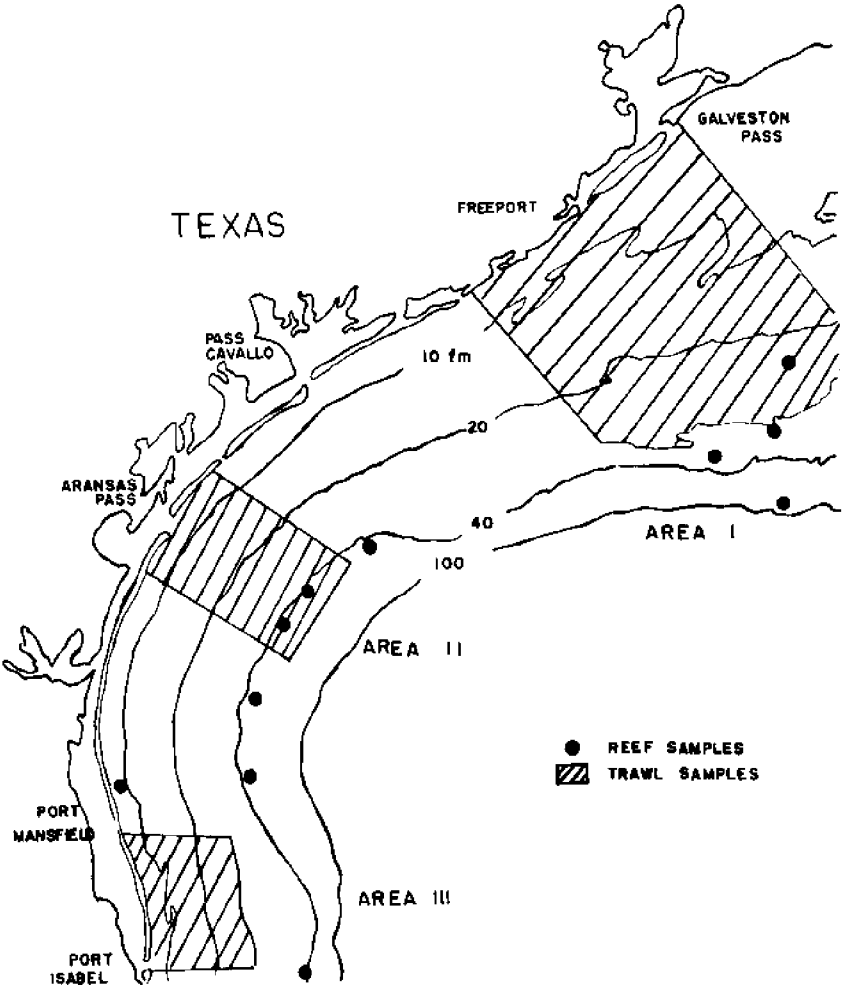

Fig. 2. General sampling areas for *L. campechanus*.

59.13 young red snappers were taken per trawl-hour from the 29.3-36.6 m (16-20 fm) depth zone. During the same period in Area II, the highest per hour mean catch was 4.94 per trawl and the young were found from 5.5 and 82.3 m (3 to 45 fm). Only 25 young snappers were caught in 27 trawl samples taken in Area III. Of these, 15 were from the 20.1-27.4 m (11-15 fm) zone.

Hook-and-line caught snappers were taken from reefs in all areas and months in which samples were obtained. Sizes of these snappers ranged from 200 to 845 mm. The largest individual weighed 12.0 kg (26.5 lb).

Camber (1955) reported commercial catches of snappers out to 219.5 m

Table I. Catch per hour of *L. campechanus* in the different depth zones 1970-1972

Depth fathoms	# Trawls	# Hours trawled	Total # Snappers	# Snappers per hour
0-5	54	14.75	5	.34
6-10	59	21.08	10	.47
11-15	48	31.08	79	2.54
16-20	46	27.75	405	14.59
21-25	35	19.97	317	15.87
26-30	25	15.75	74	4.70
31-35	17	9.00	40	4.44
36-40	6	3.42	1	.29
41-45	3	3.50	7	2.00
46-50	1	1.00	0	0
51-65	1	2.00	0	0
66-95	5	7.75	0	0
	300	156.75	938	5.98

(120 fm) off Campeche, Mexico, but he found them to be more abundant in depths from 36.6 to 146.3 m (20 to 80 fm). Moseley (1966) noted that adult snappers were caught in the Aransas Pass Channel in October of 1964. He assumed that these fish moved offshore shortly thereafter. During the present study, snappers were captured on reefs in water depths ranging from 18.7 m (7.5 fm) off Port Mansfield to 146.3 m (80 fm) off Galveston. The most prominent fishing reefs off Texas are located along the 73.2 m (40 fm) depth contour (Fig. 2). Sampling was concentrated on these reefs and most of the adult snappers were taken there.

Seasonal Distribution and Abundance

Little work has been done concerning the distribution of young snappers. Hildebrand (1954) took only 151 during intensive trawling off the Texas coast. Moseley (1966) and Miller (1965) sampled stations in 11.0, 16.5, 21.9, 27.4, 32.9 and 38.4 m (6, 9, 12, 15, 18 and 21 fm) off Port Aransas. Moseley stated that young snappers were more abundant in 16.5 m (9 fm) during September and 32.9 m (18 fm) in October. Miller reported no snappers in his collection. Gunter (1945) sampled two stations monthly in the shallow Gulf and also reported no red snappers. Camber (1955) collected young snappers in 13 trawl samples taken off Campeche, Mexico. His samples were taken from 28.3 to 32.9 m (15.5 to 18 fm) in August and he found that small red snappers were more abundant in 29.3 m (16 fm) than in 32.9 m (18 fm).

Our study demonstrated that young red snappers were present on level, trawlable bottom along the entire coast and that their distribution and abundance varied with the seasons. Monthly transects off Port Aransas showed the depth zones of abundance to be 20.1 to 27.4 m (11 to 15 fm) in the summer, 29.3 to

Table. II. Comparison between trawl catches of *L. campechanus* in Areas I, II, III (1970-71)

Depth Fathoms	# Trawls	# Hours trawled	# Snapper	# per hour
AREA I				
0-5	16	4.25	0	0
6-10	12	5.25	0	0
11-15	8	6.25	30	4.80
16-20	8	5.75	340	59.13
21-25	16	10.17	287	28.22
26-30	3	3.00	11	3.67
31-35	1	.25	0	0.0
	64	34.92	668	19.13
AREA II				
0-5	32	9.00	2	.22
6-10	42	14.08	4	.28
11-15	32	19.92	34	1.71
16-20	33	19.75	64	3.24
21-25	16	8.25	30	3.64
26-30	22	12.75	63	4.94
31-35	16	8.75	40	4.57
36-40	6	3.42	1	.29
41-45	3	3.50	7	2.00
46+	7	10.75	0	.00
	209	110.17	245	2.22
AREA III				
0-5	6	1.50	3	2.00
6-10	5	1.75	6	3.43
11-15	8	4.92	15	3.05
16-20	5	2.25	1	0.40
21-25	3	1.25	0	0.00
	27	11.67	25	2.14

64.0 m (16 to 35 fm) during the fall and 38.4 to 64.0 m (21 to 35 fm) in the winter. During the spring the fish were generally larger in size, fewer in number and distributed more widely (Fig. 3).

During the summer, juvenile snappers were taken from depths of 11.0 to 82.3 m (6 to 45 fm). The highest catch rate (18 per hour) was in 20.1-27.4 m (11-15 fm). These fish were caught during August and were the smallest (48 mm) mean sized snappers taken during the year. Summer catches of snappers in the other depth zones were composed of fewer (<2 per hour), but larger individuals (Fig. 3).

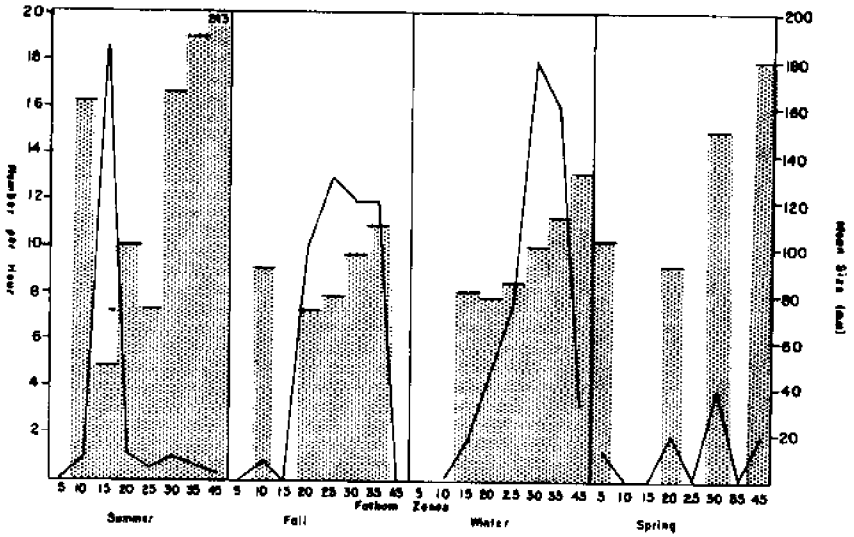

Fig. 3. Seasonal abundance and mean size (shaded areas) of *L. campechanus* caught by trawl in Area II, 1972.

Highest catch rates in fall ranged from 10-13 fish per hour between 29.3 and 64.0 m (16 and 35 fm). Young snappers were most abundant in 38.4-45.7 m (21-25 fm) at a mean size of 80 mm. The larger individuals found during the summer had disappeared from the catches.

The majority of trawl-caught red snappers taken in winter were found from 38.4 to 64.0 m (21 to 35 fm) where the number per hour ranged from 7 to 18. Most of the snappers were captured in the 47.6 to 54.9 m (26 to 30 fm) depth zone at a mean size of 100 mm. During the winter young snappers were taken as far out as 45 fathoms at a rate of three per hour.

In the spring, the catch rate declined and snappers were found from within 9.1 m (5 fm) to beyond 64.0 m (35 fm). The highest catch rate was four per hour in the 47.5-54.9 m (26-30 fm) zone. The mean size of these fish was 150 mm. In the other depth zones where snappers were taken, the catch rate was one to two per hour. Fish captured in 0.9 m (0-5 fm) had a mean size of 104 mm, the ones in 29.3-36.6 m (16-20 fm) averaged 94 mm, and those caught beyond 64 m (35 fm) had a mean size of 180 mm. Spring was the only season in which snappers were taken within 9.1 m (5 fm).

The youngest snappers were captured in the summer, and as the seasons progressed the fish continued to move offshore. Relatively few snappers above the length of 160 mm were captured by trawl. Apparently they moved to different habitat or were able to avoid the trawl. Fish as small as 150 mm (Fig. 4) were caught by sportsfishermen, but those between 150 and 220 mm were not numerous in trawl or hook and line catches (Fig. 5). Moseley (1966) also found relatively few fish at these sizes.

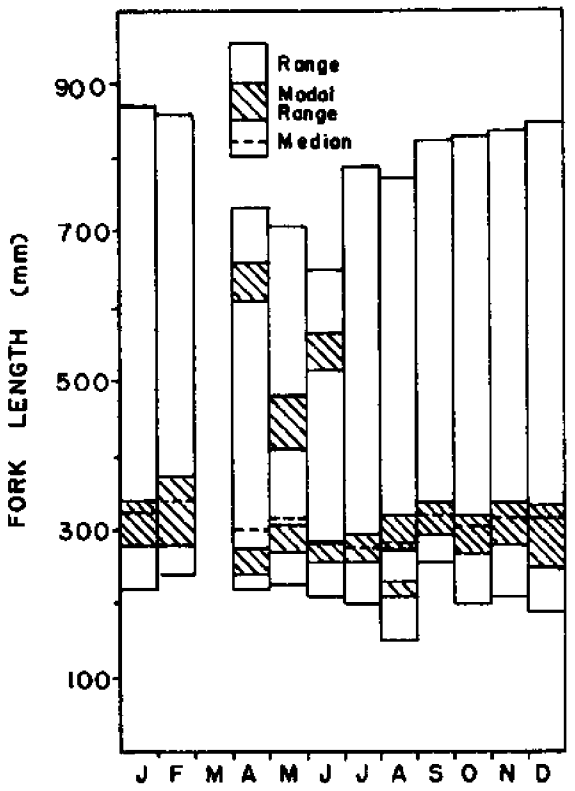

Fig. 4. Monthly range, modal range and median sizes of *L. campechanus* caught by party boat and shrimp fishermen, 1970-71.

Adams and Kendall (1891), Camber (1955) and Moseley (1966) suggested that as snappers grow they seek deeper waters. This agrees with our findings, but our data also indicate a movement of a portion of the population back to shallower water in the spring and summer months.

Moseley (1966) found no relationship between temperature and the offshore movement suggesting instead that the movement was caused by food availability in the deeper water. Bottom water temperatures in 1972 did not begin to fall appreciably until November, but the offshore movement of red snappers began in October, indicating that some factor other than temperature precipitated the movement. Mean bottom water temperatures were 27.4°C in August, 27.3°C in October and 23.4°C in November.

Seasonal hook and line catches in our study were different from the commercial catches. The months of lowest commercial production were November, December, and January, while high production months were March, April, and August (Fig. 6). Our best catch per effort was during the winter months, while

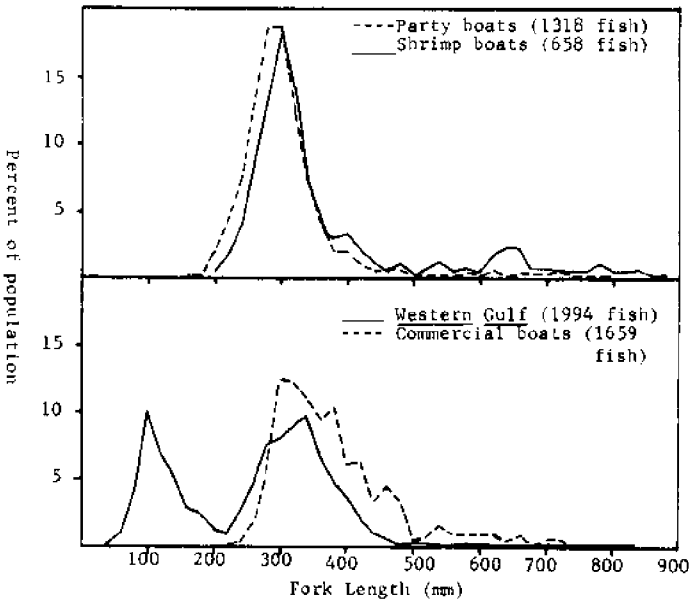

Fig. 5. Comparison of length frequencies between WESTERN GULF, commercial, party and shrimp boat catches of *L. campechanus* (WESTERN GULF catches include those caught by trawl).

the lowest was in the spring (Fig. 7). A fish house operator stated that less pressure was exerted during those months of low production because of poor weather conditions and the holiday season. Some of the fishermen fished the level bottom areas during the warm weather and moved to the reefs during the winter. This seasonal fishing may reflect a movement of larger fish off the reefs during the warm spawning season and movement back during the colder months. Our catches which were made on the reefs support this theory.

Camber (1955) reported that fish captured during the summer were smaller than those caught in the winter. The catch rate during this study was greatest during the winter, with the highest production both in weight and number per hour coming in February. The fish were generally larger during the late fall and winter, and the smallest sizes were captured in August. The smaller fish averaged less than 0.45 kg (1 lb) and probably reflect the previous years' spawn entering the catch. Catches of small fish also occurred in October and April. Measurements of snappers in the fish houses and party boats illustrate the small fish were entering the fishery continuously, but that there was a trend toward smaller fish during the summer months, especially in August. The smallest modal size of fish entering the fishery was 210 to 230 mm (Fig. 4).

In general, night fishing was much more productive on the reefs (Figs. 7 and 8). The few fish caught during the day were usually large individuals. A diel sample off Port Aransas in March 1970 produced an average number per hour

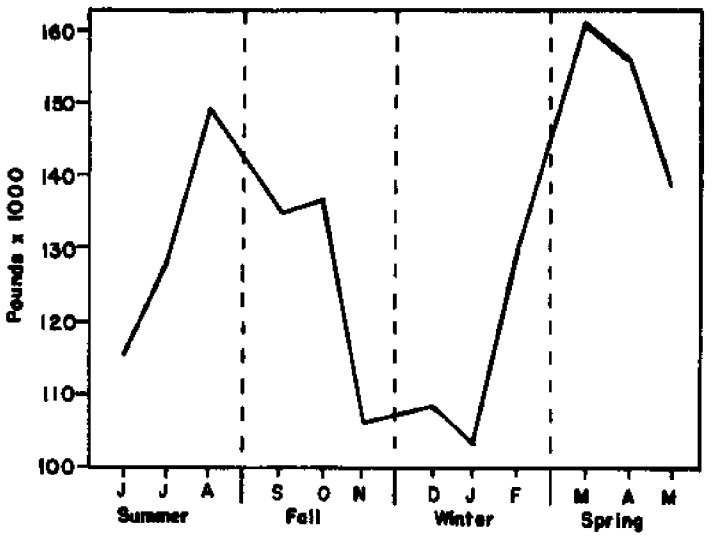

Fig. 6. Average monthly commercial landings of *L. campechanus*, 1961-70. Source: *Texas Landings*.

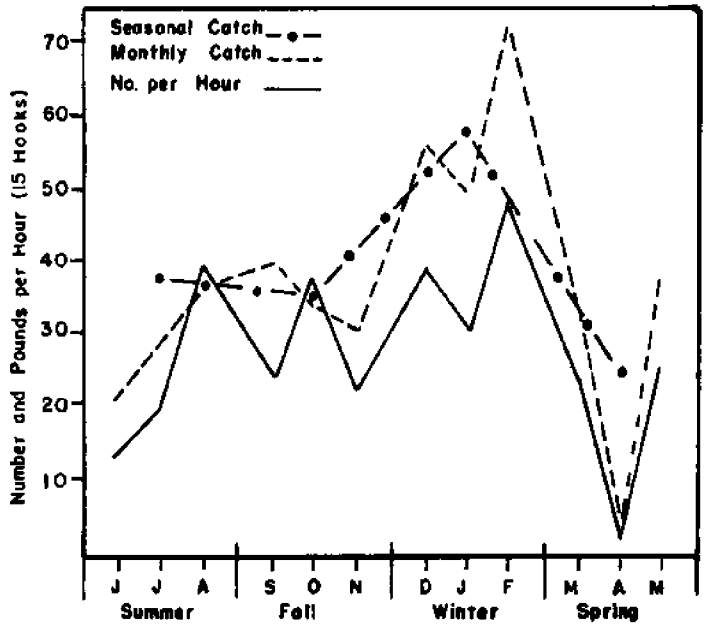

Fig. 7. Average seasonal and monthly catch in pounds per hour of *L. campechanus* and average number per hour per month caught on reefs during nighttime hours, 1970-71.

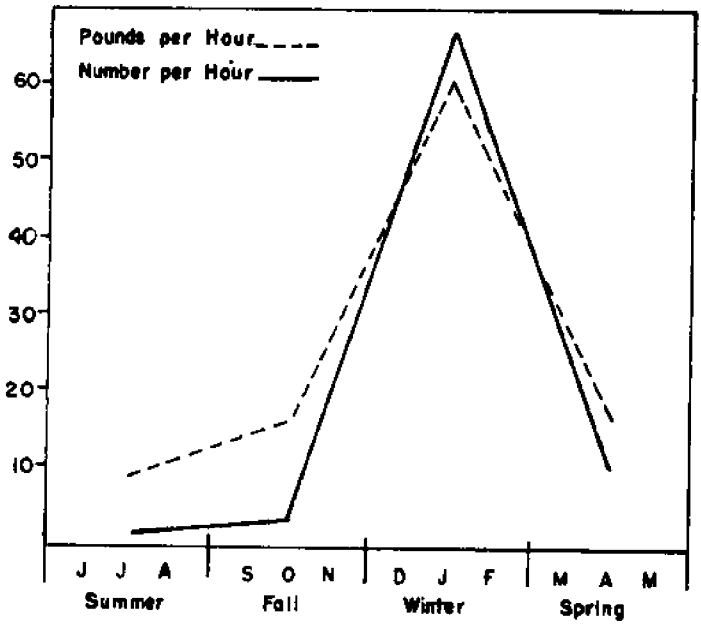

Fig. 8. Average number per hour and pounds per hour of *L. campechanus* caught on reefs during daylight hours, 1970-71.

of 0.5 at 1200-1400 hours, 40 at 1800-2000 hours, 30 at 2400-0100 hours and 4 at 0600-0700 hours. This was the general pattern (at least off Port Aransas) as most of the best catches were made at sunset and declined after midnight. The exception to this pattern was found in January 1971 on the 13.7 m (7.5 fm) reef near Port Mansfield where the catch rate during the day was 120.7 kg (266 lb) per hour of small fish (225-275 mm) and 3.0 kg (6.6 lb) per hour during a night sample. This may have been an incidental catch, but according to interviews with sport and commercial fishermen the area near Port Mansfield-Port Isabel produced good daytime fishing. Moseley (1966) mentioned "night lumps" off Louisiana where fishing was better after dark, and it may be that the reefs off of Port Aransas are comparable.

The interviews with fishermen and our data indicate that like juvenile snappers, the adults also demonstrate some inshore-offshore movement in relation to the seasons. It is probable that during the warmer months the adult snappers move inshore from the reef areas, spawn, and then move back toward deeper water in the cooler months. Moe (1963) stated that commercial and party fishing vessels off Florida accepted the seasonal movement as fact.

Spawning

The spawning period of the red snapper may be longer than has been previously postulated. Camber (1955) reported that spawning on the Campeche Banks

Table III. Red snapper (*L. campechanus*) examined for gonadal development, 1970-72

Month	No. females	No. maturing	% maturing	Smallest maturing individuals (mm)	No. males	No. maturing	% maturing	Smallest maturing individuals (mm)	Overall percentage
Feb.	17	0	0	0	15	0	0	0	0
Mar.	28	0	0	0	24	0	0	0	0
Apr.	9	0	0	0	1	0	0	0	0
May	67	18	27	270	80	9	11	265	18
June	57	29	51	255	50	20	40	250	46
July	169	44	26	265	142	38	27	260	26
Aug.	45	2	4	440	60	4	7	385	6
Sept.	30	1	3	470	46	9	20	230	13
Oct.	42	1	2	290	31	1	3	405	3
Nov.	28	6	21	335	18	2	11	240	17
Dec.	20	3	15	360	27	0	0		6
Jan.	57	1	2	410	66	0	0		
	569				560				

was from July to September with the major activity occurring in July and August. Moseley (1966) stated that spawning off the Texas coast extended from early June through mid-September. He took his smallest snappers (average 49 mm standard length) in September. Baughman (1943) found a 45 mm individual off Galveston in July and Hildebrand (1954) reported the smallest fish (51-54 mm fork length) in November and December.

The smallest snappers taken in our samples during 1970 were 60 mm in March, 65 mm in June and 48 mm in October. In 1971 the smallest snappers were 65 mm in June, 58 mm in July, 60 mm in September and 54 mm in December. During 1972 small individuals were taken in June (69 mm), July (70 mm), August (34 mm), September (61 mm), October (34 mm), December (53 mm), and January (66 mm).

Maturing fish were found from May through January, but the major period of spawning was June and July (Table III). Snappers with gonadal development of stage three (testis and ovaries occupy ½ of ventral cavity, eggs visible to eye as whitish granular) or higher were considered as maturing. Some spawning probably occurred in April, but too few fish were caught to reflect it. The percentage of maturing snappers increased during November indicating a second smaller spawning period in the fall.

The sex ratio was nearly 1:1. Of 1129 adult snappers examined, 560 were males and 569 were females. Five hundred seventy five juvenile and sub-adult snappers were examined and the sex could not be discerned in the majority of

them. The smallest female found was 138 mm, while the smallest male was 149 mm long. Moseley (1966) noted one growth ring on scales of individuals slightly over 100 mm SL. The percentage of individuals with one growth ring began to increase significantly when the fish were 200 mm SL in length. The smallest snappers in our samples containing maturing (Stage 3+) gonads were a 255 mm female and a 230 mm male (Table III).

Camber (1955) suggested that snappers do not feed while spawning and Moseley (1966) based his scale analysis on the growth checks formed during a non-feeding period. Commercial fishermen using hook-and-line sometimes caught gravid females, but they believed that feeding was at least curtailed. Some feeding does take place during spawning, as we examined a commercial red snapper catch in August 1971 and found that 8% of the fish were ripe. In 1971 commercial fishermen in Port Isabel noted that there were more snappers with roe from the latter part of May through June, and that the number of roe-bearing females decreased significantly in July catches.

The fishermen stated that catches in June were generally low. Monthly mean commercial landings show that June was the lowest month of production and that catches rose in July (Fig. 7). The higher July catches may reflect increased feeding by the snappers following the spawning period. The best commercial production was in March and April, indicating an increase in feeding activity prior to spawning. The high spring catches are during months of generally poor weather conditions on the Texas coast, indicating a good catch per effort. The third highest month of production was in August, which may reflect post-spawning feeding activity, plus recruitment into the population of fish spawned the previous year (Fig. 4).

No red snapper spawning grounds were found during the study. Commercial fishermen reported catches of roe-bearing females on level bottom within 36.6 m (20 fm). Moe (1963) reported spawning areas off the northwest coast of Florida between 18.3 and 36.6 m (10 to 20 fm). We caught the smallest snappers (34 mm) between 20.1 and 27.4 m (11 and 15 fm) in August, which indicates that spawning also occurs within 36.6 m (20 fm) off the Texas coast. However, larval studies of red snappers are needed to confirm this. Only 13 gravid (Stage 5) females were caught off the reefs during the survey, indicating that feeding is curtailed during spawning and spawning does not occur primarily on the reefs.

Age and growth

Due to the apparent long spawning season and constant recruitment into the population, we had difficulty in determining age and growth rates of red snappers. We did not study scales or otoliths, but made our estimates by using the length frequency method and increases in mean sizes. The snapper catch was grouped by month, by season, catch by various means (party boat, commercial catch, shrimp boat, and our catch), the total catch, males vs. females; no method proved satisfactory. Modes of abundance in the populations were evident, but varied widely in individual samples, making it difficult to determine age classes and growth.

Moseley (1966) made age-growth studies of red snappers by reading growth checks on scales and found a great deal of overlap of length frequencies and age classes. He indicated that snappers grow approximately 90 mm between spawnings up to the fourth spawning period and reach 200-220 mm SL during their first year. Growth is probably accelerated during the first few months of life since he captured juveniles in September and October that had a mean size of 49 mm and 75 mm SL, respectively. In 1972 our samples showed a similar pattern with juveniles averaging 49 mm in August and 74 mm 32 days later.

Studies being carried out by the University of Texas Institute of Marine Science (unpublished) indicate a slower growth rate after the first year. Preliminary results showed that the majority of fish had an initial growth check at a size of 200 mm FL. The smallest size at which a growth check could be determined was 120 mm FL. Their data indicated a growth of 75 mm in the second year, 53 mm during the third year, 47 mm in the fourth year and 65 mm between the fourth and fifth years. The mean rate of increase was 60 mm per year between the first ring (200 mm) and the fifth ring (440 mm).

Snappers tagged in Florida had a mean growth rate of approximately 65 mm per year (Beaumariage 1964; Beaumariage and Wittich 1966). These data were based on 29 fish ranging between 189 mm and 383 mm SL. They were free for 346 to 766 days and growth ranged from 11 mm to 112 mm per year. Moe, Beaumariage, and Topp (1970) reported a tagged snapper that was recaptured after almost six (5.8) years of freedom. It was 307 mm SL (370 mm TL) when tagged and had grown to 765 mm TL. The mean increase per year was approximately 68 mm. It is possible that the tags hindered growth, but these findings agree with the scale studies done by personnel from the University of Texas. According to Moseley's (1966) size distribution the snapper was probably over 2 years old when tagged and over 8 years old when recovered.

Our trawl data indicated that snappers disappeared from the catches at an approximate size of 200 mm and began to enter the hook and line fishery. They began to disappear from the trawl catches at about 160 mm to 240 mm FL and entered the hook and line catches at about 200-230 mm primarily in the summer months or approximately one year after the major spawning period (Figs. 3 and 4). This indicates that at about 1 year after spawning the fish are approximately 200 mm FL. At this size they may have been able to avoid the trawls and had not fully entered the hook and line fishery. Relatively few between the size of 160 mm and 225 mm were found in the samples and year class I fish may not have been represented in the length frequency distributions (Fig. 5).

The length frequency distribution of the commercial catch shows modes of abundance that generally agree with the growth rate of the fish reported by Moe, *et al.* (1970) (Fig. 5). The majority of fish were 300 mm long and probably 1½ to 2 years of age (Moseley 1966). They represent the initial peak of abundance in the commercial catch. Seven modes of abundance follow indicating successive year classes. The last peak at 720 mm illustrates that red snappers are approximately 8½ to 9 years old at this size. These findings are comparable to the actual growth rate reported by Moe, *et al.* (1970).

Our findings show growth rates after year class 1 of about 40 to 80 mm per year (Fig. 5). Scale studies and tagging data have demonstrated mean rates of growth from 60 to 90 mm per year. Growth of individual fish varies widely and with available data it appears that the mean growth rate of red snappers is approximately 75 mm per year after year class 1.

Food Habits

Stearns (1884), Adams and Kendall (1891), Camber (1955), and Moseley (1966) all reported on the difficulty of carrying out an adequate food-preference study for red snappers. When these fish are brought to the surface from the depths, many evert their stomachs due to the decrease in pressure, thus causing a loss of any food they might have contained. Stearns (1884) examined 450 fish and found food in only one. Camber (1955) studied 100 specimens and found 24 which contained food. Moseley (1966) found food items in the stomachs of 187 fish out of 712 which were examined. During the present study, 575 trawl-caught juvenile and sub-adult red snapper stomachs were examined. Of these, 52 were everted, 265 were empty and 258 contained food items. Also, out of 1,139 reef-caught red snapper stomachs examined, 687 were everted, 262 were empty and 190 had food in them.

The high percentage of food retention in the juveniles which were examined is probably because they were brought up slowly in trawls from lesser depths with smaller variations in pressure. The adult snappers were taken mostly on reefs along the 40-fathom line and were captured with commercial-type electric reels. The rapid ascent of the fish caused by the reel speed exerts pressure on the air bladder of most fish caught and causes them to evert their stomachs.

Juvenile red snappers were mostly dependent upon shrimp for food throughout the year; crabs and other crustaceans were also important (Table IV). These data are in agreement with Moseley (1966) who found high percentages of shrimp and other crustacea in the stomachs of juveniles from off Texas during the fall of 1964.

Adult red snappers were found to depend primarily on other fish as a source of food. During the fall and winter, these snappers also turned to the lesser blue crab *(Callinectes danae)* and other crustaceans for food.

In the spring, 13% of adult snapper food by frequency and 21% by volume was found to be tunicates. Similar observations were also noted by Camber (1955), Moseley (1966), and commercial fishermen off the Texas coast (Personal communication). Apparently snappers feed on those items which are most readily available, and the spring bloom of tunicates in some areas provides them with abundant grazing material.

Fewer and more varied items were found in the juvenile stomachs during spring than other times of the year. Unidentified shrimp and crustaceans made up 50% of the food items found (Fig. 9) and penaeid shrimp composed the greatest volume (Fig. 10). This leads to speculation that many of the shrimp or crustaceans that were small and unable to be accurately identified were probably *Acetes* sp., which were found most of the year, but which were not large enough to have much effect on the total food volume.

In summer, free-swimming squid made up a large portion of the young red snap-

Table IV. Stomach contents of red snapper, 1970 and 1971
(Presented as seasonal frequency of each item)

	JUVENILES (Trawl)			ADULTS (Reef)		
	Contents	Number	Percent	Contents	Number	Percent
Spring						
	Shrimp	6	6	Triglidae	1	2
	Crustacea	3	3	Synodus sp.	3	7
	Crab	1	2	Engraulidae	24	52
	Fish	3	3	Fish	5	11
	Squid	1	2	T. lepturus	1	2
	Detritus	79	84	Squid	1	2
				Alpheidae	1	2
				Crab	4	9
				Tunicate	6	13
Summer						
	Crustacea	3	10	Triglidae	3	7
	Shrimp	17	53	Fish	20	48
	Crab	3	10	Ophichthidae	2	5
	Detritus	2	6	Crab	5	12
				Detritus	7	17
				Crustacea	1	2
				Isopoda	1	2
				Shrimp	3	7
Fall						
	Shrimp	5	83	Fish	5	38
	Detritus	1	17	Crustacea	1	6
				C. danae	5	38
				Mantis Shrimp	1	6
				Tunicate	1	6
				Shell fragment	1	6
Winter						
	Shrimp	1	25	Fish	19	42
	Detritus	3	75	C. danae	5	12
				Sicyonia sp.	5	12
				Penaeus sp.	6	13
				Squid	2	4
				Shrimp	1	2
				Detritus	6	13
				Tunicate	1	2

per diet. This was true for both frequency and volumetric tabulations. Bottom-dwelling crabs and mantis shrimp were also important as well as fish which made up a large percentage of the food supply throughout the year.

The octopus was greatly utilized by juvenile red snappers during the fall of 1972. The data are influenced by catches from off the Freeport area, but fall samples off Port Aransas also contained octopods.

More varied food forms were utilized by young snappers during winter than any other season. Apparently the fish have to live off a wider variety of organisms due to the scarcity of more preferred food. Organisms which were found in juvenile stomachs only during winter include *Lucifer* sp., leptocephalus eel larvae, pelagic copepods, polychaete worms, and pistol shrimp (Alpheidae). These food items were found only occasionally and did not have an appreciable effect on the total volume of food which was measured.

All food items found in juvenile red snapper stomachs in 1972 are given in Table V. These items are listed as to the size of fish in which they were found. The general trend seems to be that the very young red snappers depend almost exclusively upon invertebrates for food and that there is a gradual increase in de-

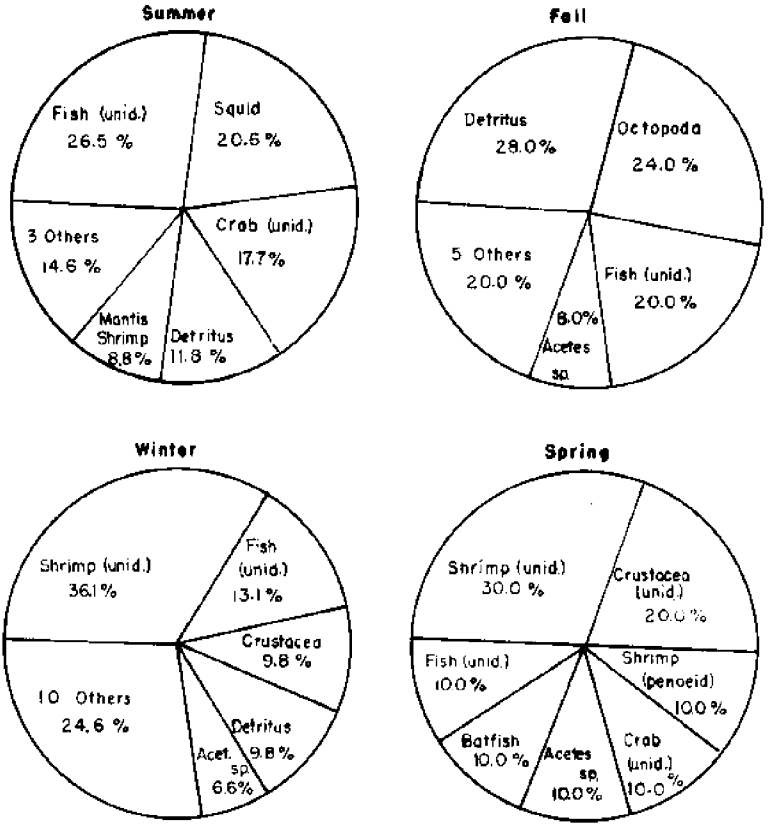

Fig. 9. Food preferences of juvenile *L. campechanus* (Frequency by percent), 1972.

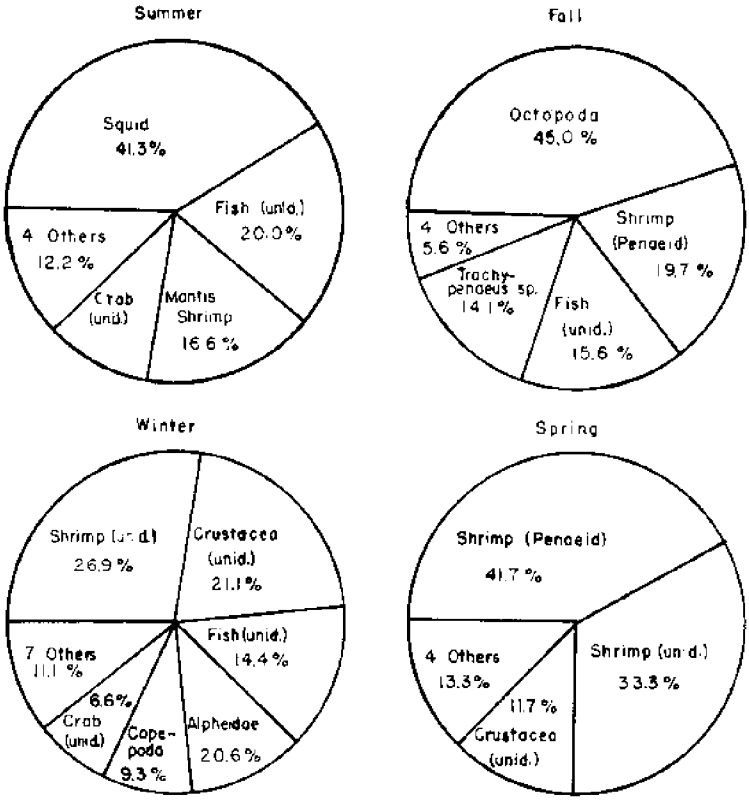

Fig. 10. Food preferences of juvenile *L. campechanus* (Volume by percent), 1972.

pendency upon vertebrates as the fish grow larger. Those fish smaller than 51 mm and larger than 225 mm were not taken in numbers large enough to give a good estimation of the ratio of vertebrates to invertebrates in their diet.

The data agree with those of Camber (1955) who found small shrimp in 14 of 15 juvenile stomachs examined, and of Moseley (1966) who found that juvenile red snappers were polyphagous, but that they depended mostly on crustaceans for food.

Amphipods, copepods, *Lucifer* sp., *Acetes* sp., leptocephalus larvae, fish larvae, and other members of the zooplankton were found in snappers up to 150 mm long. Between 101 and 150 mm, the small red snappers apparently go through a transition period in which food emphasis is shifted from zooplankton to juvenile forms of crustaceans and other fishes. By the time the snappers have grown larger than 150 mm, planktonic forms are no longer in the diet and have been replaced by a wide variety of juvenile vertebrates and invertebrates.

Adult red snapper which were examined utilized the greatest variety of foods in summer and the least in winter (Fig. 11). Fish were found to make up the highest percentage by volume for every season but summer, when *C. danae* made up

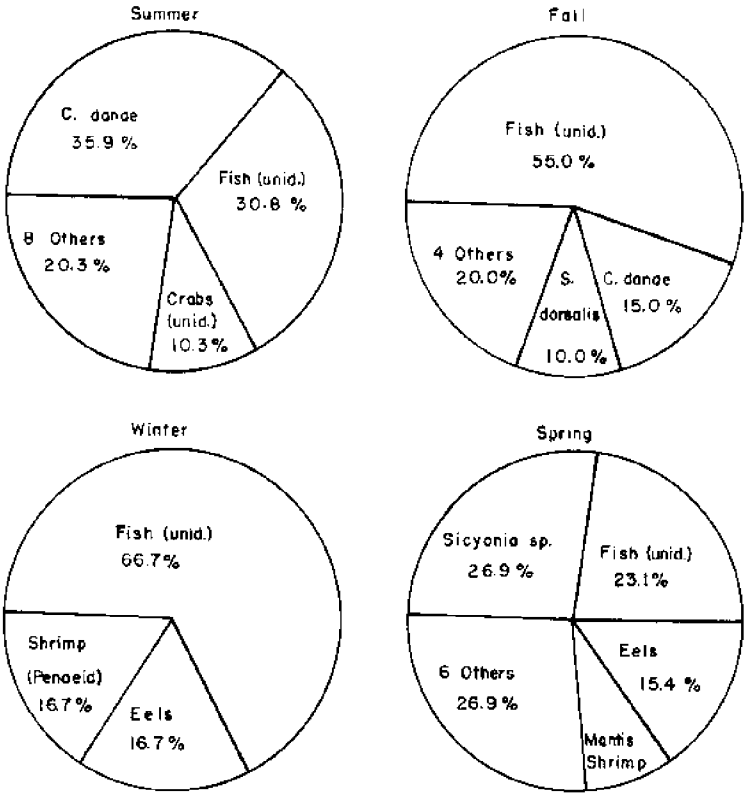

Fig. 11. Food preferences of adult *L. campechanus* (Frequency by percent), 1972.

39.2% of the catch (Fig. 12). Fish constitute the primary food item throughout the year. Seasonal primary food items included the following: spring—eels, mantis shrimp and *Sicyonia* sp.; summer—*C. danae* and *Sicyonia dorsalis*; winter—eels. The key factor involving the utilization of these items was probably availability of the organisms at various times during the year.

Predation

Red snappers are probably preyed upon by numerous organisms. One snapper (80 mm) was found in the stomach of a lizard fish (*Synodontidae*) caught in a trawl and another (340 mm) was found in the stomach of a 13.6 kg (30 lb) dolphin (*Coryphaena hippurus*) caught near a reef. Sharks probably also prey upon snappers. At times they would strike fish being brought up by hook and line and it appeared that when sharks were numerous in the area, the snapper catches would decline.

Morphology

Camber (1955) noted two different body shapes in red snapper caught from the Campeche banks. A straight line extended from the tip of the nostril through the

tip of the opercle would go through the tail on some fish and above the tail on others. We examined 392 snappers in this manner during the study. In 57% of the fish, the line went through the tail, 34% went above the tail, and 9% below the tail. In any given sample or size of fish there was a variation in the angle of the line.

Shape of body was compared with weight (Fig. 13). Up to about 350 mm all three types were similar in size. Beyond 350 mm the fish with the line running above the tail were heavier, and those with line below the tail lighter than the fish in which the line ran through the tail.

Commercial snapper fishermen claimed that some fish of a given size weighed more than others at the same size. They called these fish "blackbacks" because they were darker dorsally and had a distinctly different body shape. They stated that these fish were found in different locations and at different times of the year than the "normal" snappers. A commercial catch was examined that contained this type fish, but unfortunately no weights could be taken. However, the line from

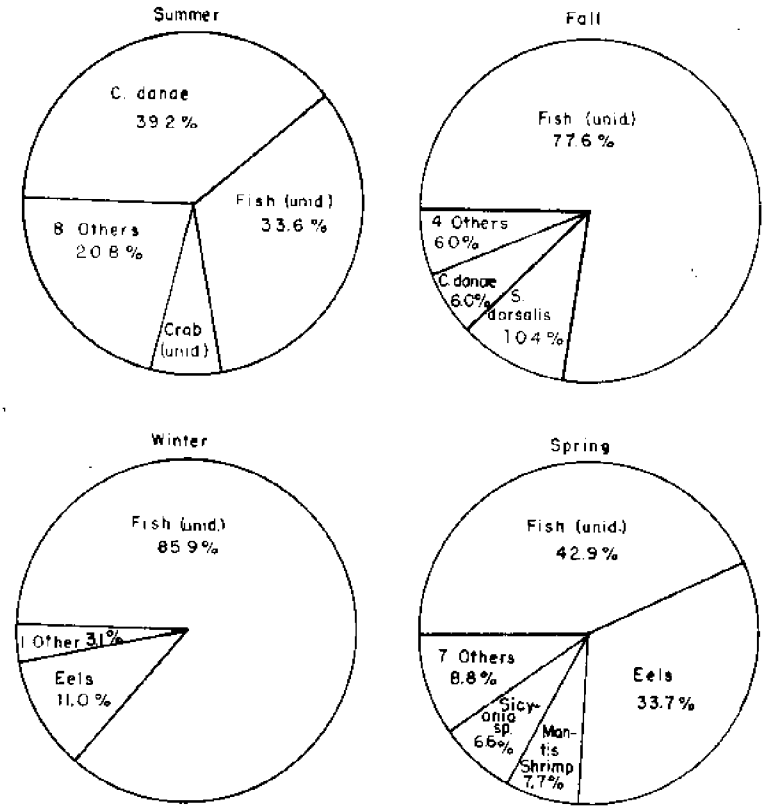

Fig. 12. Food preferences of adult *L. campechanus* (Volume by percent), 1972.

the snout through the opercle on those examined varied as it did in the rest of the populations examined.

More taxonomic work is needed on the species. Clarification of its taxonomy would aid in studies of its life history, especially in the area of age and growth.

Table V. Stomach contents of juvenile red snapper, 1972
(Listed by size of red snappers in 25 mm increments)

Fork length (mm)	Contents	Volume (cc)	Depth (fm)	% Vertebrates, Invertebrates Frequency
25-50	(2)Fish	.10	12	
	Shrimp	0.07	12	V-50
	Amphipoda	TR	16	I-50
51-75	Crustacea	2.0	15	
	Copepoda	0.25	15	
	(5)Shrimp	0.75	15.5	
	Squid	1.00	18	
	Octopus	0.75	22	
	Penaeidae	1.40	22	
	Crab	0.10	22	V-8
	Fish	0.20	23	I-92
76-100	Lucifer sp.	0.10	15	
	Eel (leptocephalus)	0.05	15	
	Crustacea	0.30	15	
	(1)Shrimp	0.30	15	
	(7)Shrimp	0.62	15.5	
	Fish	0.08	15.5	
	(1)Shrimp	0.15	16	
	Acetes sp.	0.10	18	
	Crustacea	0.50	18	
	(4)Octopus	2.2	22	
	Fish	0.25	22	
	Copepoda	0.80	23	
	Acetes sp.	TR	24	
	Fish	0.10	27	
	Acetes sp.	0.05	27	
	(2)Alpheidae	1.1	28	
	(1)Shrimp	0.12	28	
	(1)Shrimp	0.01	28	
	Squid	0.07	28	
	Copepoda	TR	28	
	Crustacea	0.01	28	V-12
	Crustacea	0.05	33	I-88

Table V. (Continued)

101-125	(1)Shrimp	0.40	15	
	Polychaeta	0.09	15.5	
	(2)Shrimp	.25	15.5	
	Sicyonia sp.	0.40	15.5	
	Acetes sp.	0.05	15.5	
	Ogcocephalidae	0.20	17-18	
	Fish	1.00	18	
	Sicyonia sp.	1.00	18	
	Fish	0.25	22	
	Octopus	0.25	22	
	Crustacea	0.03	23	
	Lucifer sp.	0.03	28	
	Alpheidae	0.10	28	
	(2)Shrimp	.40	28	
	(2)Fish	.02	28	
	Trachypenaeus sp.	1.00	32	
	Acetes	TR	33-36	V-29
	Fish	0.25	40	I-71
126-150	Crab	0.30	17-18	
	(1)Shrimp	0.70	17-18	
	(2)Crab	2.7	21-22	
	(2)Sicyonia sp.	3.75	22-23	
	Mantis Shrimp	1.00	22-23	
	(1)Shrimp	TR	28	
	Fish	0.15	28	
	Mysidae	TR	28	
	Isopoda	TR	28	
	(2)Shrimp	1.30	29	
	Acetes sp.	0.10	33	V-13
	Fish	TR	33-36	I-87
151-175	Mantis Shrimp	2.10	8	
	(2)Squid	4.80	17-18	
	Fish	0.90	17-18	
	(1)Shrimp	6.00	21-22	
	Crab	5.10	21-22	
	Trachypenaeus similis	1.70	21-22	
	(4)Sicyonia sp.	4.3	22-23	
	Crab	0.20	22-23	
	Synodus sp.	1.00	22-23	
	Penaeidae	2.50	27	
	Fish	0.20	27-32	V-19
	Crustacea	0.20	29	I-81
176-200	Squid	9.40	17-18	
	Crab	0.70	17-18	
	Squid	13.80	17-18	

Table V. (Continued)

	(2)Batrachoididae	12.0	21-22	
	Sicyonia sp.	5.6	21.23	
	Crab	1.50	27	
	Fish	1.00	33	V-30
	Crab	0.75	33	I-70
201-225	(2)Squid	17.2	21-22	
	Crab	2.00	21-22	
	(2)Fish	2.1	22-23	V-33
	Callinectes sp.	0.50	22-23	I-67
226-250	Batrachoididae	7.10	21-22	V-50
	Mantis Shrimp	2.90	21-22	I-50
251-275	Diplectrum sp.	4.00	22-23	V-100
276-300	No specimens taken			
301-325	Mantis Shrimp	13.50	21-22	V-0 I-100%

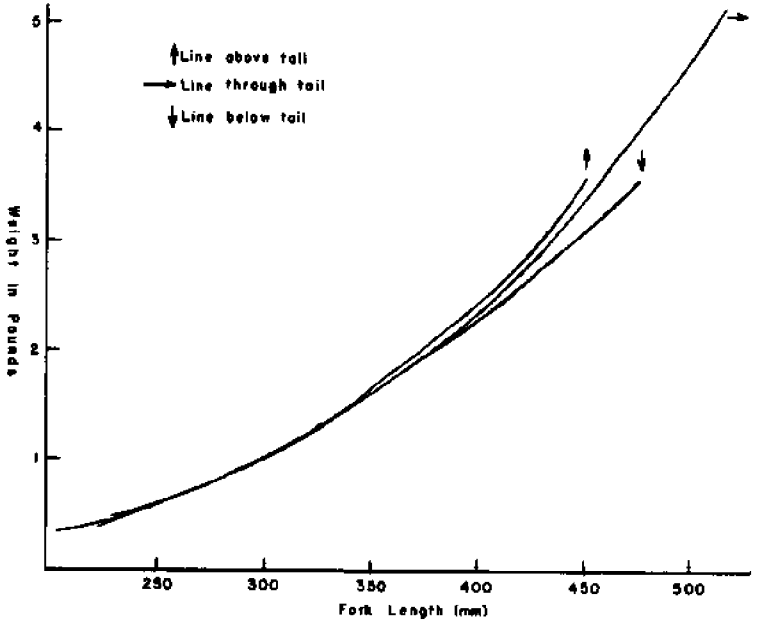

Fig. 13. Comparison of length-weight relationship between three different body shapes of *L. campechanus*.

The Red Snapper Fishery

Sports and commercial fishermen were interviewed along the coast for information pertaining to the fishery. Trips were taken on party boats and, if possible, measurements of fish were obtained monthly at various fish houses. Many of the dealers and fishermen expressed concern over the apparent decline in the fishery.

Relatively few boats were involved solely in commercial fishing for the species. As far as could be ascertained in 1972, there were seven boats working out of Port Isabel, three out of Port Mansfield, and one part-time boat from the Port Arthur area. At least two, and perhaps three, of the boats from Port Isabel limited their fishing to waters off Mexico.

The commercial snapper boats fished with a small crew (two to four) using powerful electric reels. They would cruise known productive areas using depth recorders to find schools of snapper. When a school was found each man fished with two lines with about 30 hooks per line to capture the fish. They would alternate use of the lines so that while fish were being removed from one and it was being rebaited, the other was always fishing. Generally the "bites" lasted for only a short time and the fishermen would continue the search for new schools of snappers. A fisherman related that searching for fish took 95% of the time, while actual fishing time was about 5%.

It was difficult to ascertain the catch rates of commercial boats, but fishermen stated that prior to 1965 they averaged about 454 kg (1,000 lb) a day, while in recent years they felt fortunate to catch 227 kg (500 lb) per day. Their estimate of about 50% decline corresponds with commercial landings during the same period (Table VI).

The fish houses, especially in the Galveston area, also relied upon catches made by shrimpers, fish sold to them from party boats, and snappers landed by out-of-state commercial fishermen. At times shrimp fishermen would fish for snapper by hook and line during slack shrimping periods and would also sell the larger ones caught in the trawls.

When fish were brought to the fish house in Port Isabel, they were graded into three sizes designated "baby" (less than a pound), "medium" or "store size" (one pound to 4½ lb), and "large" (above 4½ lb). A catch of 1902 kg (4,200 lb) examined in June had a weight ratio of 10% "large," 13% "small," and 77% "medium."

There were approximately 11 party boats involved in snapper fishing; 4 in Galveston, 4 in Port Isabel, 2 in Freeport, and 1 in Port Aransas. At least one of the boats was able to handle 100 persons fishing one reel with two hooks, while the smaller boats took 12 persons. Besides the large party boats, there were charter vessels that took small individual parties to the snapper banks and sportsmen that fished for snapper from their own craft.

In 1970, catch rates (weight per 15 hooks per hour) from larger boats ranged from 4.5 kg (9.9 lb) to 34.0 kg (75 lb) per hour and averaged 21.1 kg (46.6 lb) per hour. The highest catch rates were between October and December.

Commercial landings of snappers have fluctuated greatly since statistics have been collected (Table VI). Camber (1955) and Carpenter (1965) listed some of the factors influencing production as market conditions, war, size and efficiency of the fishing fleet, labor-management relations, labor shortage, and weather.

Table VI. Historical catch statistics of *L. Campechanus* landed on the Texas coast* (thousands of pounds)

Year	Quantity	Year	Quantity
1887	75	1950	1,233
1888	65	1951	1,117
1889	22	1952	1,523
1890	5	1953	1,101
1897	465	1954	1,345
1902	2,068	1955	1,262
1908	2,252	1956	1,534
1918	1,243	1957	1,443
1923	1,009	1958	1,399
1927	1,237	1959	1,665
1928	1,055	1960	1,153
1929	804	1961	1,829
1930	930	1962	1,742
1931	691	1963	2,169
1932	985	1964	2,250
1934	635	1965	2,212
1936	907	1966	1,653
1937	1,141	1967	1,409
1938	1,279	1968	1,128
1939	1,156	1969	925
1940	1,233	1970	916
1945	288	1971	1,082
1948	1,324	1972	1,238
1949	1,055	1973	781

*Source – Fishery Statistics of the United States, 1965-71 & Texas Landings

The highest period of production in recent years was 1964 when 2¼ million pounds were landed. From that period to 1969, landings steadily decreased to less than a million pounds per year. Total production was highest in 1964, but in 1963 the catch per effort had dropped by 50% (Table VII). The number of hooks used in the fishery steadily increased from the 1940's, until 1963, when the effort more than doubled. When catches declined the effort began to decline and in 1969 the number of hooks used decreased by about 40% of the number used in 1973. The catch per effort also declined by about 40% during the same period.

Production of fish captured with otter trawls also fluctuated greatly from year to year (Table VII). As gross tonnage of shrimp vessels increased there appeared to be a general increase in landings of trawl-caught snappers and a decrease in hook and line catches (Fig. 14).

Carpenter (1965) noted that total production was higher than in previous years, but that the catch per vessel had declined. He attributed the decreased catches to heavy pressure exerted on snapper populations. More effort was expended by Texas fishermen in the mid-sixties, but both effort and catch per effort have declined since then.

Table VII. Texas commercial landings of *L. campechanus* captured with hook and line and otter trawl, 1950-1971*

Year	Pounds captured with hook and line	Number of hooks fished	Pounds per year per hook	Pounds captured with trawls
1950	1,224,000	540	2,267	8,900
1951	1,105,800	404	2,737	600
1952	1,514,300	414	3,658	1,600
1953	1,100,500	462	2,382	200
1954	1,235,400	725	1,704	109,300
1955	1,205,100	1,186	1,016	56,600
1956	1,453,500	1,005	1,446	80,000
1957	1,404,300	1,085	1,294	38,700
1958	1,341,900	1,103	1,217	57,100
1959	1,630,500	1,264	1,290	34,600
1960	1,140,700	1,424	801	13,700
1961	1,799,100	1,741	1,033	29,800
1962	1,708,600	1,871	913	33,700
1963	2,115,500	4,643	456	53,200
1964	2,133,500	4,740	450	116,300
1965	2,127,700	4,487	474	84,100
1966	1,566,400	4,496	348	86,700
1967	1,297,300	4,474	290	111,300
1968	1,046,000	3,039	344	81,500
1969	776,700	2,762	281	148,000
1970	776,700	1,451	535	139,700
1971	925,300			157,100

*Source—Fishery Statistics of the United States 1950-1971.

Sports fishing has increased in recent years (Carpenter, 1965, and Moseley, 1966) and this may have offset the decrease in pressure exerted by commercial fishermen. Data from our study show that large numbers of juvenile snappers (50-160 mm) are probably caught in trawls and discarded. Apparently the combination of these factors has exerted too much pressure on the fishery, thus the decline in commercial landings.

In April 1973, a new project was initiated with one of the objectives being to determine the discard practices of the commercial shrimping fleet. Samples were taken with the fleet from June 1973 through January 1974 and June through August 1974. This project will not be completed until June 1975, but some results pertaining to juvenile red snappers have been obtained.

Results to date indicate that juvenile red snappers did not begin to enter fleet samples significantly until the latter part of August when about 19 per hour were captured with one net (Table VIII). The catch increased until a high was reached

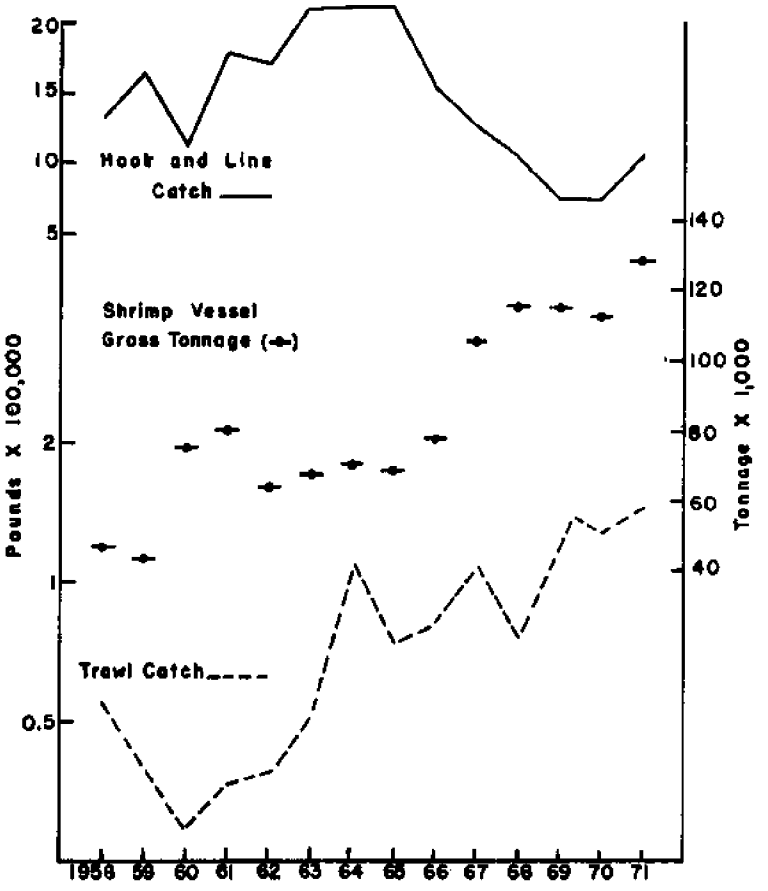

Fig. 14. Comparison of commercial hook and line catch, trawl catch of *L. campechanus* and gross shrimp vessel tonnage, 1958-71. 1958 and 1959=Net Tonnage. Source: Fishery Statistics of U.S.

in November then decreased sharply in December. The average catch was about 15 per hour and snappers were captured between 16.5 m and 54.9 m (9 and 30 fm). The high catches in November may be misleading because fewer samples were obtained, but the data indicate the numbers of young snappers captured by the shrimping fleet and are in general agreement with our findings in 1970-72 (Fig. 3).

The size of shrimp vessels and trawling techniques may have had more effect than the increase in the number of vessels alone. Hildebrand (1954) reported relatively few snappers in his samples. Most of the boats during that period were using large (90-120 ft) trawls and engines with relatively low horsepower. Since that time more efficient trawling methods have been developed using larger and more powerful vessels. It is probable that increased trawling speed and more efficient trawls are capturing more young snappers than in the past.

Table VIII. Catch of juvenile red snappers (*L. campechanus*) while trawling with commercial shrimping fleet June 1973 through January 1974, June through August 1974

Month	Hours trawled	Number snapper caught per hr.	Depth sampled (fm)	Depth of capture (fm)	Mean number of boats in fleets sampled	% of samples containing snapper
June	10.50	0.2	4-15	13	22	20
July	20.60	2.5	4-16	9	27	6
Aug.	14.50	19.2	10-20	10-15	26	50
Sept.	2.25	41.3	4-18	16-18	11	25
Oct.	5.50	58.0	10-23	10-23	16	100
Nov.	.50	154.0	22-23	22-23	9	100
Dec.	2.00	12.5	25	25	14	100
Jan.	1.00	2.0	27-30	27-30	16	100
Totals	56.85					32

Many of the snapper fishermen believed that the discarding of young snappers was the cause of the decline in the fishery. Moe (1963) reported similar sentiments from fishermen in Florida. However, before making a final judgment more data are needed on populations and life history studies dealing with fecundity, larvae, and mortality. It is possible that the numbers of juveniles captured in the trawls are small in relation to the total population.

If the capture and discarding of young snappers by the shrimping fleet is affecting the commercial red snapper fishery, the most apparent solution to the problem would be the development of more selective fishing gear—trawls that catch less "trash" with the shrimp. This would curtail the capture of young snappers and benefit the shrimper by shortening sorting time and allowing longer tows.

It is our view that the red snapper on the Texas coast is in no immediate danger of complete depletion though there has been a decrease in commercial landings. There are still areas that are not trawlable and serve to protect young snappers from the trawls. The problem exists mainly in the commercial fishery, which requires large catches per effort to be profitable. If the numbers of young snappers captured in the trawls could be reduced, perhaps the commercial snapper landings would increase.

SUMMARY

Juvenile snappers were captured on level, trawlable bottom from off Galveston to off Port Isabel. Few were caught within 18 m (10 fathoms) or beyond 64 m (35 fm). The highest catch per effort was in 29.3-45.7 m (16-25 fm) off the Freeport-Galveston area.

Reefs ranging in depth from 13.7-146.3 m (7½ to 80 fm) were sampled and red

snappers were captured by hook and line at all sites. Fishermen stated, and trawl landings of snappers showed, that large snappers were captured on level bottom and are not confined to reef or rough bottom areas.

The smallest snappers were caught by trawl in the summer. As the season progressed, the snappers grew larger and moved offshore to deeper water. During the spring, trawl catches declined and there was a movement of the larger juveniles back inshore. The offshore movement began before the water cooled, so movement may have related to food availability.

Catches of adult snappers on reefs and on smooth bottom are seasonal and may indicate a movement off the reefs during the warm spawning season and back to the reefs during the colder months. In general, fishing on the reefs was most productive from sunset to midnight.

The major period of spawning was June and July with a probable smaller spawn occurring in fall. Examination of gonads indicated that spawning may have extended from May through January. Commercial landings of snappers were highest in March, April, and August. The larger catches in the spring may have been due to increased feeding prior to spawning and those in August to post-spawning feeding activity and to recruitment into the population from the previous years' spawn. No spawning grounds were found, but data from commercial fishermen indicated that at least some activity took place on level bottom within 20 fathoms.

Juvenile snappers feed on invertebrates and adults on vertebrates, but both will eat the most available food. The food items of young snappers appear to change from planktonic to juvenile forms when they reach about 150 mm. Snappers are preyed upon by lizard fish, the dolphin-fish, sharks, and probably other species.

Total Texas commercial snapper landings and catch per effort have declined considerably in recent years. Effort by commercial fishermen has also decreased, while sports fishing for the species has increased. Shrimp vessels which are more numerous and efficient than in the past also apply pressure to the fishery, not only by catching snappers for market, but by discarding the juveniles captured in trawls. Our samples indicate that areas where the young snappers are abundant coincide with the brown shrimp (*Penaeus aztecus*) shrimping grounds. The period of highest catches of trawl-caught small snappers was from late August through November.

If fishing gear are developed that will catch less "trash" with the shrimp, it will benefit both the shrimp and red snapper fisheries. The shrimper's catch will be easier to sort and it will allow longer trawl tows. If the trawl catch of small snappers is decreased it should allow more of them to enter the hook-and-line fishery.

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RUFAS—A Useful New Resource Assessment Tool

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Abstract

Exploratory fishing surveys have been conducted since the early 1950's to systematically assess biological resources of the southeastern United States. The goal has been to compile a resources inventory depicting spacial and seasonal distribution of the resources quantitatively. Utilizing a wide variety of gears, emphasis was placed on resources not used by the U.S. commercial fishing industry.

As experience developed, specific gears were refined and used for particular species. Of note is the calico scallop dredge. More recent technology led to the development of remote sensors as replacements to cumbersome fishing gears. Surveys prior to 1969 showed it was possible to make advance predictions for a calico scallop fishery since distribution and abundance are established at spat set and can be later delineated. From the Harvesting Technology Program in Pascagoula, Mississippi, in cooperation with the General Electric Company at the Mississippi Test Facility in Bay St. Louis, Mississippi, a towed, remotely controlled underwater vehicle became operational in 1968. Named RUFAS (Remote Underwater Fishery Assessment System), the vehicle was well-suited for surveying sedentary benthic organisms such as scallops. RUFAS has been utilized as a benthic surveillance system since 1969.

Slides are presented describing RUFAS: The 800 pound vehicle operates to a depth of 50 fathoms (91 meters). It is "flown" from a surface ship through a 34-conductor power cable. Essential underwater components include sled and control vanes, TV camera and dysprosium iodide lamp, 35mm pulse camera and sodium arc lamp, camera sphere, flotation, pinger, custom-built transducer, thermister and 1⅛ inch diameter power cable. Shipboard components include flight control console with vehicle and ship depth recorders, TV monitors and video tape recorders. Data acquisition procedures are described.

A second generation, RUFAS II, has been developed in cooperation with the Mississippi State University Sea Grant Program. The 1,000 pound vehicle, which operates to a depth of 400 fathoms (732 meters), is briefly described. Main features are TV camera with pan and tilt capability, forward observation avoidance sonar and automatic roll and pitch terrain follower to hold constant distance above the sea bed. It is towed on a 7/10 inch diameter torque balanced electromechanical conductor cable. Long range plans may increase the optical footprint size, which is determined by water clarity and height off bottom, with an acoustical footprint utilizing side scan sonar, to about 150 feet in width.

Florida's Estuarine Surveillance Protects Fisheries

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A major portion of Florida's coastline has been altered substantially by development. This development has resulted in numerous dredge and fill projects and pollution, which together have substantially lessened the productivity of the water bottoms and degraded the marine water quality. It is estimated that approximately 20% of the estuaries have been changed to the extent that they no longer produce the marine life so important in maintaining the inshore fisheries. Many of the marshes and shallow grass beds that were so vital in the food chain of the marine fishes have been filled and the coastline no longer has the capacity to sustain the fish and shellfish population that existed in former years.

Commercial fishermen have been blamed for the decline in the coastal fisheries but ironically the rural areas that have been fished commercially for many years and the urban areas that have prohibitive netting laws produce very little. The basic life sustaining habitat is gone from the latter areas and so have most of the inshore fish populations. Therefore, it is essential that the various agencies that have responsibilities in the field of conservation, land management, or pollution control coordinate their efforts in order to provide the maximum amount of protection to the remaining estuaries, marshes, and marine grass beds that provide the essential habitat for the inshore recreational and sport fisheries.

Knowing that no one agency has sufficient authority to control or manage all the factors that lead to environmental degradation, Harmon W. Shields, then Director of the Division of Marine Resources, took action several years ago to aggressively enforce all the laws within the Department's jurisdiction and to pass on to other state agencies information relating to mutual areas of concern for their information and action.

The 150 officers of the Florida Marine Patrol have approximately 8,000 miles of coastline to patrol and each was assigned a section of coast in which to report all shoreline alterations. Special report forms were designed with which to record the who, what, when, and where of each development and its legality. The report also shows the criteria used to determine legality, arrests made, or to what agency the information was relayed if the development action did not fall within the jurisdiction of the Marine Division. Many illegal projects were halted, many arrests were made and much valuable relative information was passed on to other environmentally responsible agencies for their disposition.

But stopping shoreline degradation is not enough, and it was realized that something should be done to rebuild some of the natural habitat that had been destroyed. Mr. Shields reassigned laboratory staff to compose a booklet in layman's language showing the importance of the major dune, marsh and submerged vegetation

and how these could be replanted in devastated areas. The booklet will relate to the importance and replanting of sea oats, sea grapes, running beach grass, and other plants, in the dunes; spartina, needlerush mangroves, in the marshes; and turtle grass, shoal weed, on the submerged bottoms. It will also point out the benefits of artificial fishing reefs and tell about their construction and the permitting procedures necessary for their approval and construction. There will be a bibliography of relative scientific publications enclosed and the booklet will be available to contractors, real estate developers, public and private agencies and citizens groups. It is our hope to have an ecologist available to meet with groups, inspect the locations of proposed revegetation, advise of the practicality aspects, and aid in getting the stock for the replanting. Since Harmon Shields' appointment as Executive Director of the Florida Department of Natural Resources, I have taken his place as Director for the Division of Marine Resources. We feel that much can be done in some areas to help nature restore what man has destroyed. If harmful shoreline development can be stopped or minimized, the water quality improved, and devastated areas replanted, the populations of Florida fin and shell fish can be substantially increased. Toward this goal we are working.

WEDNESDAY—PM—NOVEMBER 13, 1974

Chairman—Clifford V. Varin, *Fire Island Sea Clam Co., Inc., West Sayville, New York*

Management or Bankruptcy in the Gulf Shrimp Industry

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Professor of Marine Biology
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The shrimp producers have kept afloat for several years because of the steadily rising price for large and medium shrimp. The recent drop in price is disastrous because the numbers of shrimp available each year are limited, and the fleet has grown so large that no vessel can catch enough shrimp to make a profit at normal prices.

The proportion of baby shrimp in the catch has been steadily increasing, attesting to the failure of present state management programs. There are three commercial shrimp fleets—the boats and smallest vessels that fish in or near the nursery areas; the nearshore vessels; and the offshore vessels.

To avoid bankruptcy of the industry, the states need to give their commission authority to reduce the numbers of fishing craft in all three fleets through limited entry, accompanied by closure of nursery areas to all forms of shrimp gear while baby shrimp are present. If no action is taken, the federal government will eventually have to take over shrimp management.

Should we have management of the shrimp resource beyond the state level? We must answer several questions before deciding whether or not it is desirable. Then we must inquire as to its feasibility.

The only reason the shrimp fleet was not in serious trouble several years ago was a sharp rise in the price for large and medium shrimp (Fig. 1). The recent slump in shrimp prices has been disastrous. I cannot give you prices by sizes after 1970 since, unfortunately, the federal government is about 4 years behind in publishing this information. I even received my 1971 book too late to use. The chief reason this drop in price has had such a bad effect on the fishermen is the lowered catch for the same amount of fishing effort, which comes at a time when costs of operation are rising.

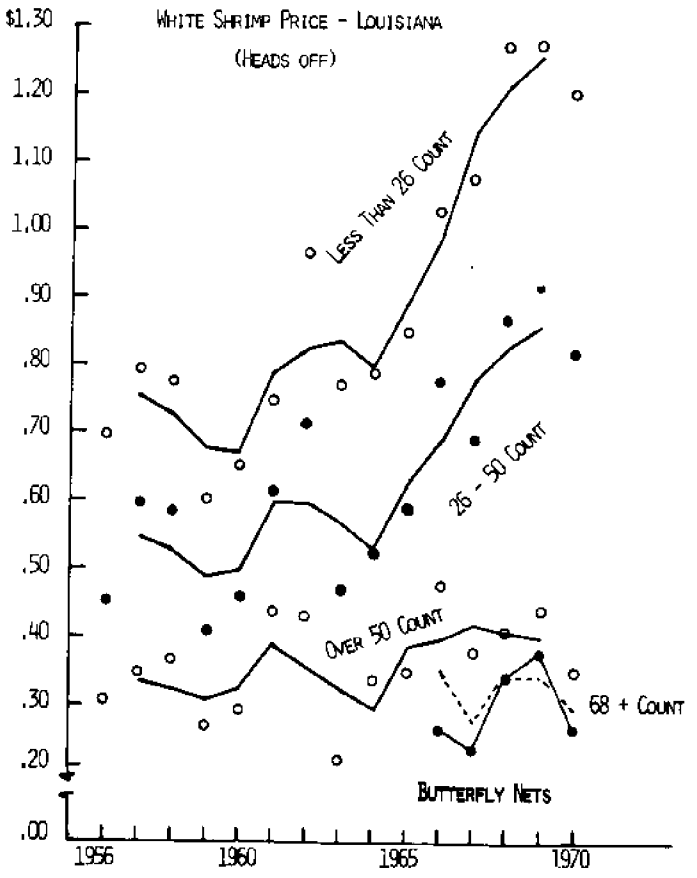

Fig. 1. Dockside price per pound of white shrimp in Louisiana (heads off) for large (less than 26 count), medium (26 to 50 count) and very small (over 50 count). In lower right is shown the price from 1966 to 1970 of baby shrimp (68 and over count) and the price paid for all shrimp sold by butterfly nets.

There is ample evidence that the lowered catch per boat is not caused by lowered abundance of each successive brood of shrimp but rather by a great increase in the amount of fishing effort. Figure 2 shows that the yield has reached a plateau around which it fluctuates from year to year. Greatly increased fishing effort has resulted in only a slight increase in yield so that the catch per yard of net has continued to fall.

Figure 3 shows the continuous increase in the average tonnage of shrimp vessels accompanied by an increase in their numbers. We know that the catch per yard of net is related to the speed of towing so that the change in efficiency is greater than can be shown merely by the yards of net used.

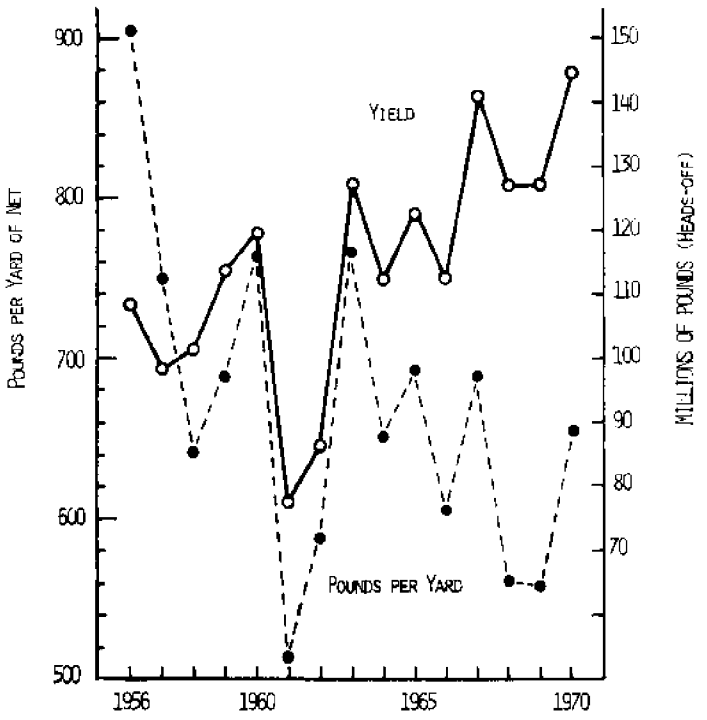

Fig. 2. The annual Gulf shrimp yield in millions of pounds, and the annual catch per yard of net opening by shrimp otter trawls (pounds, heads off).

You will note that the recorded number of undertonnage boats has also greatly increased. This increase in undertonnage trawlers has been accompanied by an increase in the amount of raw shrimp used for canning. The two appear to be related as shown by the fact that the catch of tiny shrimp (68 count and above) increased about three times in 15 years (Fig. 4). Taking more and more of each year's shrimp population at such an extremely small size appears to be counterproductive. The shrimp canners were putting up large packs before they commenced using such large quantities of baby shrimp.

Referring back to Figure 1 you will note at the bottom of the figure that the price for shrimp by the butterfly nets in Louisiana was lower than the average Louisiana price for 68 and over count shrimp in three out of five years. It is clear that the butterfly nets are taking baby shrimp. The statistics show no butterfly nets in Louisiana prior to 1966. From 1966 to 1970 they increased from 330 to 430.

Concerning management techniques in Louisiana White (1973) states:

The opening of the season is set in inside waters to harvest brown shrimp re-

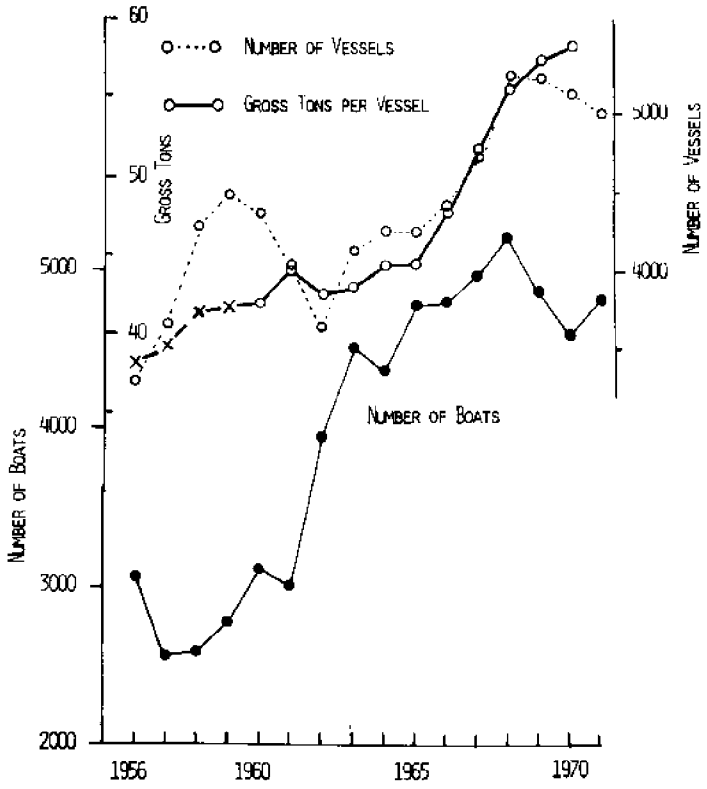

Fig. 3. The annual number and average tonnage of documented Gulf shrimp vessels, and the number of boats under 5 net tons.

> cruited into Louisiana's coast when a majority of this population is of commercial size (*100 shrimp per pound count*). It is also necessary to harvest this population prior to their offshore emigration. (italics mine)

In harvesting this crop Gaidry (1973) states:

> During the open season in Louisiana approximately 12,000 licensed trawl boats, using test trawls similar to that used in the biological samples, constantly search for the highest density areas of shrimp . . .

Gaidry states that Louisiana had 12,595 shrimp trawl vessels in 1971 and 11,170 in 1970. The supposedly accurate figures of the National Marine Fisheries Service show only 1,693 shrimp trawl vessels in Louisiana in 1970. St. Amant (personal communication) told me that Louisiana presently has about 12,000 shrimp trawlers over the 40-foot length, about 8,000 less than 40-foot, plus about 4,000 boats over 15 feet in length with commercial licenses.

Gaidry (1973) in his report on Louisiana states:

> The principal commercial gear used in fishing the passes is the wing net or

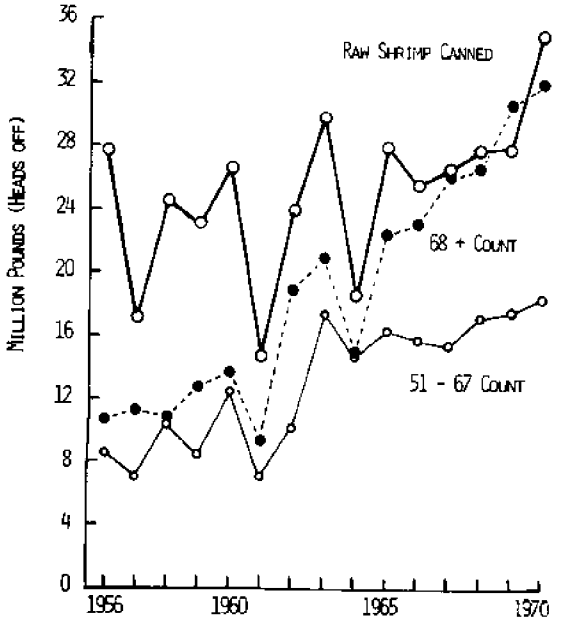

Fig. 4. The quantity of raw Gulf shrimp canned each year, and the quantities landed of baby shrimp (68 and over count) and of very small shrimp (51 to 67 count) in millions of pounds (heads off).

> butterfly net...This net may be used either from a stationary platform or a commercial shrimp boat. The net is usually employed against the current of outgoing tides, thus capturing shrimp leaving the estuaries.

Concerning the capture of small shrimp Gaidry says:

> The mesh size as now regulated (¾-inch square, 1½-inch stretched) is capable of harvesting a shrimp so small as to count 150 shrimp to the pound (a size that is of little value to either sports or commercial interests). Under the present legal framework fishermen can harvest shrimp in the nursery, discarding the small shrimp so that the overall catch will count under 68 per pound. Often, as the data verifies, over 80 percent of the nursery catch is discarded...The ultimate goal is to have a majority of the standing brown shrimp crop of commercial size *(100 whole shrimp to the pound).* (italics mine)

This is approximately 162 heads off shrimp per pound!

To understand more of the differing ideas as to what needs to be done about shrimp, I show in Figure 5 the gross tonnage of shrimp trawl vessels by gross tonnage categories for the 1970 state fleets from the federal statistics, which I have already noted, do not coincide with the numbers licensed by the states. The preponderance of the inshore fleet (boats and the smallest group of documented vessels) is in Louisiana with its vast marsh areas. Texas far outstrips the other states in tonnage of large and medium offshore vessels. Alabama has more tonnage in

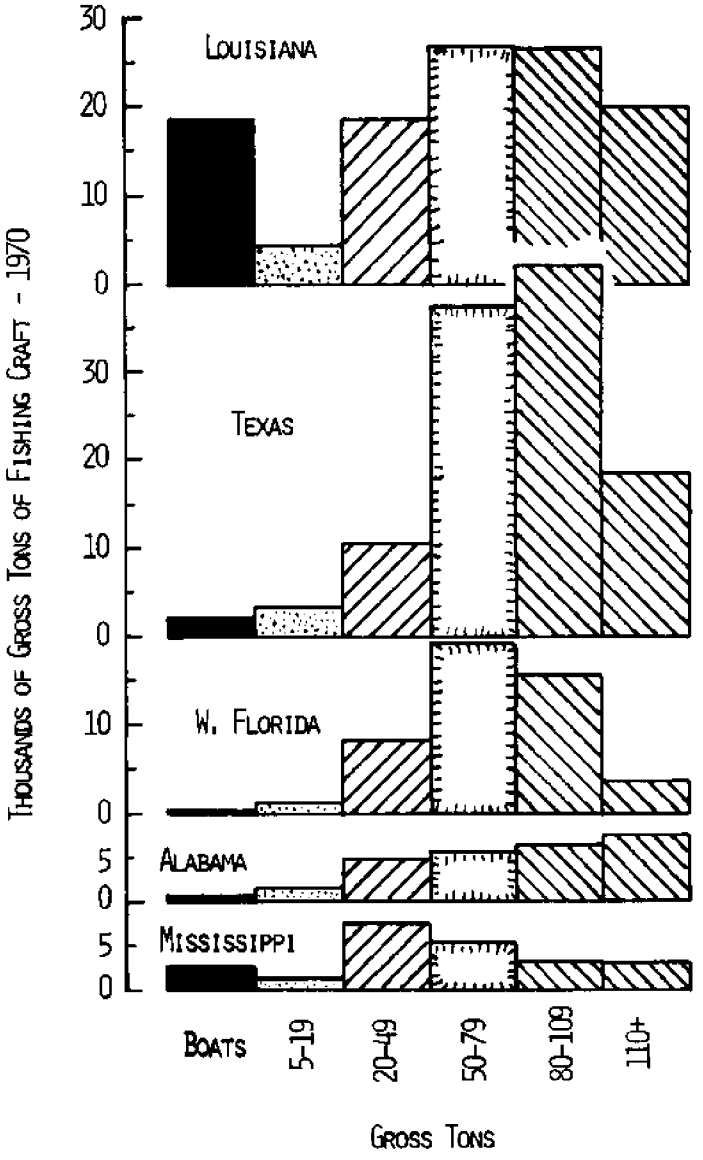

Fig. 5. Showing for the shrimp trawl fleet of each Gulf state the thousands of gross tons in each tonnage category. Undertonnage boats are estimated at 5 gross tons each.

the largest offshore category than in any other. Only Mississippi has more tonnage in nearshore vessels than in any other size: these are chiefly older Biloxi-type trawlers. In 1971 the median age of the Mississippi fleet was 17 years in contrast to 8 years in Alabama.

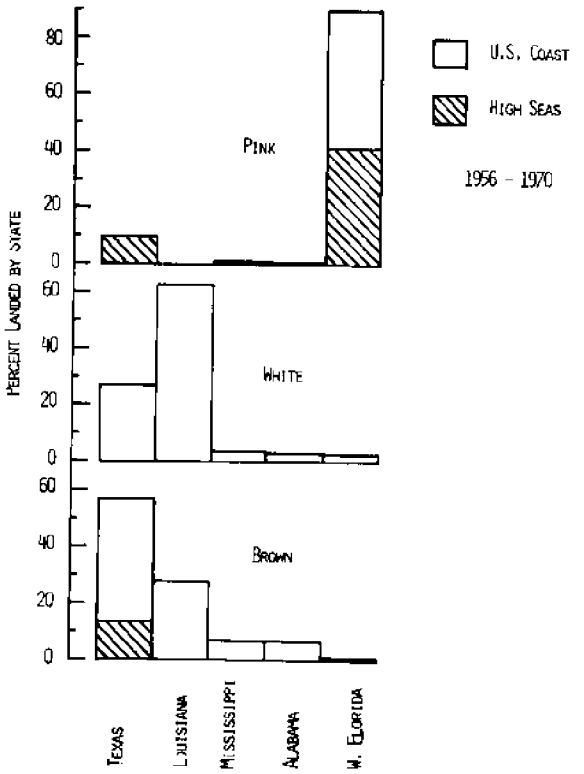

Fig. 6. Showing the percent of each of the three species of commercial shrimp landed in each Gulf state from along the U.S. coast and from off a foreign coast over a 15-year period.

The boats and the smallest documented vessels fish mainly in or near the nursery areas. The next size, the nearshore fleet, fish in the deeper inshore waters and a few miles offshore. The three largest groups seldom fish in inside waters, and some of them often fish off foreign coasts. Naturally, the two larger groups of vessels would like to have the smaller shrimp protected. The boats and inside vessels would like to catch the small shrimp before they leave the estuaries.

Another difference between states lies in the species of shrimp caught. Figure 6 shows that almost all the pink shrimp taken off U.S. shores are landed in Florida, although vessels from other states assist in taking them: the pinks landed in Texas and about half those in Florida are taken off the Yucatan and eastern Mexican coasts. The other states depend upon both white and brown shrimp but because they range farther offshore and in greater depths, the brown shrimp are the mainstay of the larger offshore vessels.

The difference between the sizes of shrimp landed from the inside and outside waters along the U.S. coast and those taken off the Mexican coast is very great (Fig. 7). Thus during three 3-year periods a great many under-sized shrimp

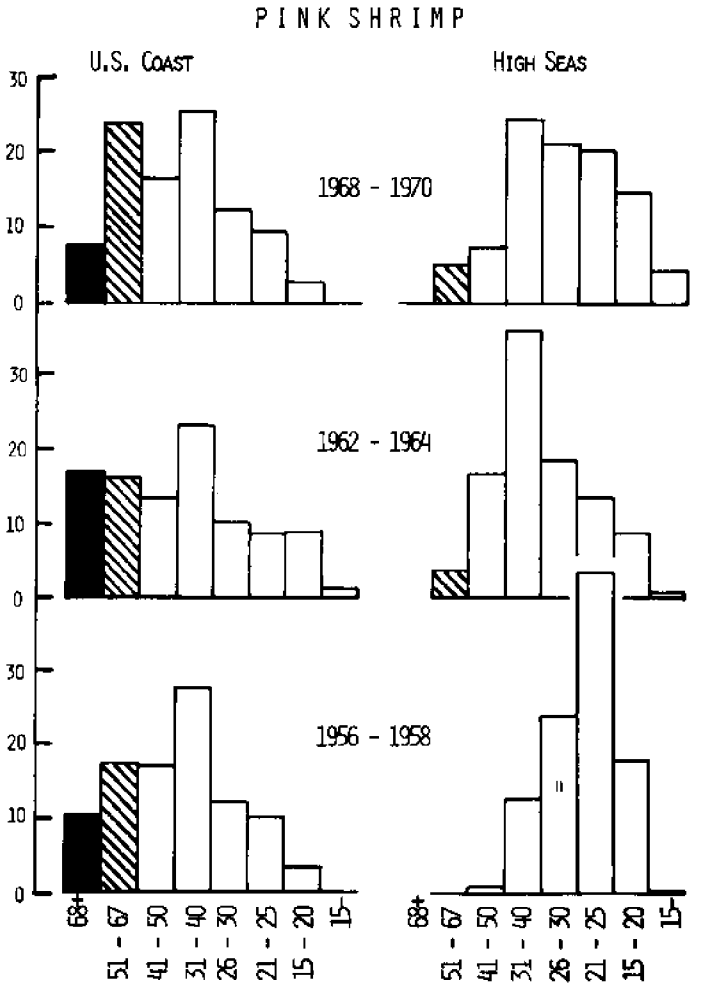

Fig. 7. Showing for pink shrimp the percent of the catch landed in each size category by three 3-year periods for shrimp caught along the U.S. coast and for shrimp taken off a foreign coast.

were landed from the waters off Florida, but very few were brought home from Campeche. This illustrates a principle. You cannot afford to travel a long distance in a large expensive trawler to bring home a low-priced product. Of course these small shrimp would not keep long without heading and this also could not be accomplished by a small crew. These small and low-priced shrimp can be taken profitably only when they can be taken either in great abundance, or by cheap gear and landed without heading for the peeling machines. Thus even on the closer grounds along the northeast Mexican coast very few small brown shrimp were landed (Fig. 8).

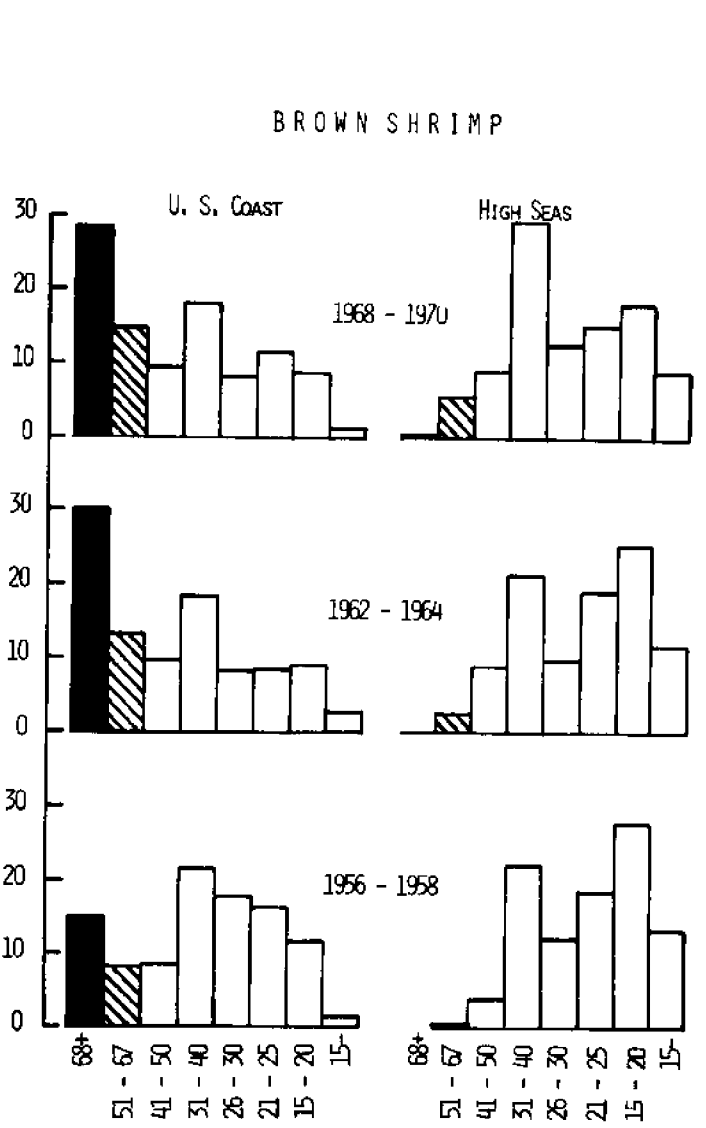

Fig. 8. Showing for brown shrimp the percent of the catch landed in each size category by three 3-year periods for shrimp caught along the U.S. coast and for shrimp taken off a foreign coast.

There is little doubt that were fewer shrimp taken at a very small size more would survive to a larger size. Would this be of any benefit except to the consumer? I have already shown that the catch per unit of fishing effort has been falling. If anything occurs to raise the numbers of larger shrimp produced by each brood the result will be a higher yield, but the catch per unit of fishing effort will rise only temporarily until more new vessels enter the fleet. Under such circumstances one can scarcely blame a small boat fisherman for wanting to capture the shrimp before they leave the estuary. Although to the consumer the protection of small shrimp

may be of some value, for the large number of small boat fishermen it merely looks as if they are being asked to suffer for those with larger vessels.

We all know that a fishery cannot continue without a profit. This profit depends partly on the quantity caught, partly on the price paid for the shrimp, and partly on the cost of operation. In a recent analysis by Lacewell, Griffin, Smith, and Hayenga (1974) it was found that in 1971 the average 53- to 65-foot shrimp vessel in the Gulf made slightly more profit than the average 66- to 72-foot vessel. The larger vessels caught more shrimp and because they can fish deeper, they caught larger shrimp and got a better price, but the operation of the larger vessels was so expensive that the smaller vessels made a little more net profit. With the rising costs of all supplies, especially fuel, the larger vessel will be even more handicapped. Thus Terrance Leary recently stated that it now costs the Texas vessels 64 cents for fuel for every pound of shrimp landed.

The chief obstacle to the making of a fair profit has been over-investment in shrimp vessels. Every time a profitable year occurs more new vessels enter the fishery further dividing up the available shrimp. The federal loan program to prevent inefficient operators from being forced out of the fishery has only intensified this problem.

To help the situation we must first choose from several goals such as: (1) Attainment of the largest poundage of shrimp from each annual brood. (2) Attainment of the largest amount of money from each annual brood. (3) Employment of the largest number of fishermen and shore workers to catch and process each annual brood. (4) Attainment of the largest profit from each brood.

The first-named objective, the largest poundage, means a waste of capital and labor. It is just about what is actually occurring as competition between an excessive number of vessels lowers the catch of each boat.

The second goal, attainment of the largest amount of money, would mean obtaining a much lower total poundage of larger and higher priced shrimp. This higher total value would not only produce less shrimp but it would cost more to harvest since it would be taken chiefly by the larger offshore vessels. Therefore, the profit margin might be reduced.

The third possible goal, employment of the largest number of fishermen and shore workers would mean less concentration on raw fresh or frozen headless shrimp, and more effort to enhance the value of the catch by further processing. This is exemplified by the shrimp canners. In 1970 they used about 35 million pounds of baby shrimp costing them less than 30 cents a pound and converted them into 2½ million cases of canned shrimp worth 26.7 million dollars in the warehouse, or about 76.5 cents per pound of raw headless shrimp. However, in 1970 the catch of baby shrimp (above 67 count) was 22.1% of the entire Gulf catch while 15 years earlier in 1956 the canners used 27.7 million pounds of raw shrimp; the baby shrimp were only 10% of the Gulf catch.

This proves three things. First, that it is possible to can shrimp without using baby shrimp. Second, that through the use of peeling machines the number of employees in the shrimp canning industry has been reduced. And third, that despite the much-touted management programs in the various Gulf states, the slaughter of baby shrimp has been steadily increasing. Apparently the present management

programs are a failure.

The fourth possible goal of management is to obtain the highest net profit from each annual brood of shrimp. In reality this is the only goal that can insure a viable industry. This goal of maximum net profit cannot be attained while we are trying to harvest the population prior to their offshore migration. Nor can it be attained while baby shrimp are slaughtered in the narrow exits to their nursery areas. It reminds me of Franklin Roosevelt helping the food shortage by paying the farmers to slaughter their baby pigs.

A lot revolves around the proper size to harvest shrimp. The Galveston laboratory of the National Marine Fisheries Service conducted marking experiments on pink shrimp on the Tortugas fishing grounds in 1961. From this single experiment Kutkuhn (1966) concluded that for these pink shrimp the mortality rate was sufficiently high so that the maximum value of a brood was highest when you commenced harvesting at about 70 heads off count. However, he was using a spread of only 45 cents between the price of the 70 count and the 26 and over count. In 1970 as I have shown, the spread had increased from 45 cents to 85 cents with no increase in the price of baby shrimp. In the meantime the fishing intensity has probably doubled so that the harvest is taken in a much shorter time. Both of these facts indicate the need for a larger size shrimp.

Based largely on Kutkuhn's experiment, Lindner (1966) concluded about 9 years ago that it was safest not to start taking shrimp until they reached a headless count of 60 per pound. This was with a weekly fishing mortality of only 7%.

In the Tortugas marking experiments of Kutkuhn, only 21% were recovered of which only 75% were recovered at sea. Profiting by this first large scale marking experiment, Costello and Allen (1968) performed a more sophisticated experiment on the Tortugas pink shrimp in which the recovery rate increased from the earlier 21% to 33.3% with 93% recovered aboard the fishing craft. Furthermore while Kutkuhn obtained only a 7% per week fishing mortality they discovered that it had risen to 13.1% per week.

From the available data, I would say that one could obtain both a larger poundage, and a much increased value, by not harvesting shrimp below a 50 count heads off.

It behooves us to thoroughly reexamine the question of the best size to commence harvesting shrimp. Obviously, the present tendency to take more and more baby shrimp is poor management.

The marking experiments by the Galveston laboratory to obtain growth and mortality rates were not pressed after I left the laboratory in 1962; consequently 13 years later we still lack adequate mortality rates for white and brown shrimp. Are we now going to start all over again on more research while the shrimp fishery suffers, or shall we try to manage with available information while the states attempt to fill in the gaps in our knowledge which the federal government left because of vacillating research programs?

I note that the federal government complains about the high cost of collecting the statistics so sorely needed for proper management and neglects to keep them up-to-date while they squander your Sea Grant funds on such inhouse projects as RUFAS II, and on the analysis of their own statistics.

History repeats itself. Only a few years back the Saltonstall-Kennedy Act provided adequate funding for contract research and the Secretary of the Interior appointed the American Fishery Advisory Committee to aid in selecting worthwhile projects. Within a very few years, this Committee complained that there were no funds left to allocate. The federal government was utilizing almost all the S-K funds itself, even for such non-research items as running Market News offices. The Bureau of the Budget then stepped in and reduced their original appropriation by the amount of these S-K funds.

It appears to me that a large share of the Sea Grant funds and some of your 88-309 funds are commencing to follow the path of the former S-K funds.

In the 18 years since I first came to the Gulf, the five Gulf states have all developed competent biological staffs, but the federal government is determined to circumscribe both their funds and their authority, and to blame the states for depletion of even the offshore fisheries. Let me quote from their recent handout entitled, "A Draft Outline for the National Fisheries Plan"(1974):

> This multiplying fishing pressure and the lack of effective management has resulted in overfishing of several important species. Present management lies mainly with states whose policies, interests and authorities often differ, resulting at times in conflicting and inefficient regulations. Moreover, the roles of state and federal governments in management beyond the territorial seas has not been clearly defined leading in some cases to a management vacuum. Largely as a result of these forces, there has been a serious depletion of some major fisheries stocks off the U.S. coasts and a major deterioration of some important segments of the fishing industry.

We hear a great deal nowadays about man's destruction of the estuaries, and while there is some truth in it, it is nevertheless being used as the whipping boy for our failure in resource management. It would appear that in many cases state politics are too potent to permit adequate management by state officials. Meanwhile, Uncle Sam is watching your performance awaiting the approaching opportunity to take over. I submit that unless the Gulf states can forget politics long enough to breathe life and authority into their own commission, the industry faces a continuing disaster, in which case Uncle Sam will eventually step in. Perhaps most of you remember the international shrimp treaty with Cuba that was ratified and would have taken over your authority but for the advent of Fidel Castro. If you want adequate management, and want to do it yourselves, the time to act is rapidly growing shorter.

Your problem has three facets—biological, economic, and social. All three must be solved in one package. Millions upon millions of dollars have been spent upon shrimp research since Weymouth and Lindner started investigations in 1930. That was 45 years ago and we now know a great deal about shrimp biology, despite federal failure to follow through. It is time to stop twiddling our thumbs and start using this accumulated knowledge.

The federal government, forgetting the need for mortality rates, is presently turning its attention toward shrimp mariculture. You have one prime example of mariculture in Florida which lost millions of dollars for the stockholders and destroyed many hundreds of acres of supposedly public marsh. It is time the shrimp

industry inquire as to the legality of turning large portions of productive marsh into private ponds. At the same time you might inquire as to why fixed, anchored, and moving nets are all permitted to fish for shrimp in narrow passes.

I assume that we all want to strive toward the highest net profit from each annual brood of shrimp. Both this highest net profit and the highest yield cannot be attained simultaneously. The quantity of shrimp available each year is limited so that there can be no profit when there are too many boats competing for the same shrimp. The old hackneyed method of decreasing fishing pressure by cutting down the efficiency of each unit of gear will not work; it will only make bankruptcy a little closer. The only real solution is to reduce the number of fishing units. This poses a problem since there are in reality at least three rather distinct commercial fisheries—the boats and very small vessels that fish entirely in or close to the sheltered nursery areas, the nearshore vessels of more draft that fish in the larger primary bays and venture a few miles offshore in good weather, and the offshore vessels that fish anywhere in the Gulf. Clearly then there needs to be a reduction in all three fleets.

Another factor to consider is the seasonal nature of the fishery. Many of the inshore vessels are tied up for long periods and trawl only when shrimp are abundant locally.

A third factor that cannot be ignored is the great number of 16-foot trawls used by non-commercial fishermen, usually with outboard motors. At the October meeting in Biloxi of the Gulf States Marine Fisheries Commission, St. Amant said there are about 45,000 of these 16-foot trawls in Louisiana, and Swingle estimated 4,300 in Alabama. Thus in Louisiana alone these so-called sport trawls can cover a sweep of nearly 14 miles. At a towing speed of only 3 miles an hour they can fish 40 square miles or about 25,600 acres per hour. The impact of these thousands of nets dragging over the shoal nursery areas on the vegetation and on the bottom fauna can only be destructive. How many baby shrimp do they take or destroy? Many of these shrimp are sold without appearing in the statistics.

In addition to limitations of the various classes of shrimp fleets, there must be an end to the senseless slaughter of baby shrimp. This can only be accomplished by closure of the shallower nursery areas to all forms of shrimp fishing during periods when they are occupied by undersized shrimp. When a state publication says that their data verify that 80% of the shrimp caught in these shallow areas are discarded you wonder why they allow such shameful waste. Knowing the ability and integrity of the state administrators, I surmise that perhaps politics plays some role in this inability to practice sound conservation.

Whenever limited entry into a fishery is discussed, there are invariably hysterical outcries about depriving anyone of the right to fish since fish are considered to be a public resource. These people should take a look at what happened to our open range when everyone turned their livestock loose without any consideration of the devastating effect of overgrazing. Finally, the number of cattle in each area was officially limited to what the range could support.

Failure to act will mean the loss of an enormous investment. It is not in the public interest to jeopardize an investment of upwards of 250 million dollars in fishing craft and gear. The goal of limited entry is to return the fishery to a profitable

basis so that several thousand fishermen can make a decent living. For the 16,000 shrimp fishermen in 1970 the average investment was about $15,000 per fisherman. This often represents a life savings and years of arduous toil. For many Gulf coast communities the shrimp fishery is the major industry and when there is no profit to pay for nets, ice, fuel, groceries, and vessel repairs the entire community suffers. Furthermore, the life of a shrimp vessel is limited. Without sufficient profit to amortize his investment, the fisherman is really living off his capital and will inevitably be forced out of the fishery.

Let me give you an example of how limited entry works. In British Columbia the salmon gillnetters faced a situation analagous to what we are facing. The salmon stocks were being overfished, but there were so many gillnet boats that the fishermen could not make a living. The government offered the fishermen two types of license which they called A and B. The B license was a cheap license that could be renewed for 10 years. A B boat could not be replaced by another. Many older fishermen or part-time fishermen took out a B license.The A license cost more, but the boat could be replaced by another of equal tonnage, and it could be renewed indefinitely. The money from the A licenses was put into a special fund which the government used to purchase A boats. The government then auctioned off the purchased A boats but they were not given a salmon license.

In a few years this system has already reduced the fleet to where they are able to take off some of the fishing restrictions.

Are the states willing to admit that only the federal government has the all-seeing wisdom to manage their resources, or do they wish to retain control where it belongs? The choice is yours for the time being.

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Can We Predict the White Shrimp Population Successfully?

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Abstract

Biological sampling data obtained in January and February on offshore overwintering shrimp populations in the Ship Shoal to Trinity Shoal area were shown to correlate mathematically to the inshore spring white shrimp commercial landings of Terrebonne Parish and the total spring inshore white shrimp commercial landings for Louisiana.

Materials and methods for biological sampling, analytical procedure, and mathematical relationships are also presented.

This presentation has been published as "Correlations between Inshore Spring White Shrimp Population Densities and Offshore Overwintering Populations" by Wilson J. Gaidry and is available from the Louisiana Wildlife and Fisheries Commission.

State-Federal Approach to Management of Penaeid Shrimp on Regional Basis

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Abstract

Most fishery scientists and managers generally will concede that their efforts to manage mobile estuarine and marine fishery stocks are far from adequate. Traditionally, we have maintained that our lack of success was due to lack of knowledge of the biology of the species. More recently we have had to face the facts that social, economic, and institutional arrangements may be greater deterrents than our lack of biological knowledge. One of the most serious problems of the state fishery administrator is the jurisdictional limit of his responsibility which almost never coincides with the geographic limits of the stocks.

The South Atlantic Technical Committee for Shrimp Management was established in 1973, to examine the feasibility of jointly managing the shrimp fisheries of North and South Carolina, Georgia, and the east coast of Florida within the concept of a state-federal partnership.

Today, the first phase of a two-part study or management planning profile of the shrimp industry is introduced. This document provides a baseline upon which regional plans are currently being developed. It attempts to review most pertinent aspects of the resource and the industry. Against this background, the report seeks to identify the most important problems facing the resource, the industry and the resource manager and to focus on those that could be helped by a regional management approach.

Rock Shrimp Research and Marketing

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As far back as the 1950's, Department of Natural Resources' research biologists (then the Florida Board of Conservation) were recommending the use of rock shrimp as an additional shrimp resource. These shrimp were taken in fair abundance during normal shrimping operations on the Tortugas pink shrimp grounds, but were always discarded by the shrimpers for lack of a market. Similar recommendations were also made for the northwest coast and the Florida east coast where rock shrimp populations appeared large. Because of the hard shell and the resultant difficulty in splitting these very tasty shrimp, their major commercialization did not occur until a machine was found that could handle this operation. Rock shrimp are now marketed both split and unsplit, but the split product is by far the most popular. This discovery, plus a strong marketing and consumer education program by both state and federal agencies which included development of promotional materials, television and institutional demonstrations, and the use of rock shrimp at several national trade shows, finally succeeded in bringing to fruition the biologists' recommendations.

Major populations of rock shrimp thus far found in Florida are located on the east coast centered near Cape Canaveral, the Tortugas grounds, and the northern Gulf of Mexico off Apalachicola. There are also very important grounds in Mexican waters near Contoy Island. Although restaurants were the first and are still the major consumers, sales to individuals are increasing rapidly as is the overall demand for rock shrimp. Thus the biggest problem presently encountered by the rock shrimp industry is consistency of supply.

Since the initial commercialization of this animal did not occur until the last 3 or 4 years, relatively nothing is known about its basic biology other than that gained during study of the other more important shrimp. Virtually nothing is known about the seasonal abundance, movements, and migration patterns or even growth rates, spawning or nursery grounds. This lack of information is one of the reasons for the rather erratic supply. Nevertheless, rock shrimp production in Florida, including landings from Contoy, Mexico, may reach 3 million pounds in 1974.

In an effort to answer these biological questions, Florida's Department of Natural Resources Marine Research Laboratory has been actively involved in shrimp research over the past several years. We have always provided the information learned about rock shrimp during research on other species of shrimp. In addition, a major review of rock shrimp catches during Project Hourglass on Florida's west coast was published in early 1973. A major research project on rock shrimp is presently under way. Federally assisted under PL 88-309, it is headquartered at Port Canaveral, Florida, and consists of two types of data collections: (1) sys-

tematic biological samples are taken at selected stations monthly; and (2) exploratory transects from Cape Canaveral to the Georgia-Florida boundary are conducted as time and weather conditions permit. The main objectives of this project are to determine the basic natural history biology of this increasingly important seafood resource. Determination of growth rates, movement and migration patterns, location of spawning and nursery grounds, seasonality and population abundance are among the major aspects being considered. Data gathered over the first 2 years of this 3-year study has been excellent and it is felt the major goals will be achieved.

With the receipt of this biological information and a continued strong marketing effort, rock shrimp will become a major fishery specialty for Florida. It is quite possible that as demand for these delicacies increases, production could reach 10 million pounds a year, greatly benefitting the fishing industry and the seafood purchasing consumer.

This is Contribution No. 264, of the Florida Department of Natural Resources Marine Research Laboratory, St. Petersburg, Florida.

The Economics of Shrimp Production and Marketing

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My mission, as I understand it, is to describe the economic condition of the shrimp fishery today and to trace the causes of the most adverse situation ever to confront this heretofore healthy, growing industry. However unpleasant the autopsy, there is often wisdom for the future hidden in the trauma of the past.

Let me begin by examining developments in recent months on the demand or market side of the picture. We have witnessed a steady increase, over at least a decade, in the real demand for shrimp, an increase in the strictest economic sense of the term. Per capita consumption has increased markedly, despite a steady increase in real prices. Shrimp have become much more costly year by year to consumers, both institutionally, where two-thirds of the shrimp are consumed, and at the retail or home consumption level. The zenith of this trend was reached about a year ago during the time of the meat boycott and in the weeks that followed. As red meat prices increased sharply, demand was shifted to other options and shrimp prices increased even faster. The rapid increase in shrimp prices during the fall of 1973 represented the calm before the storm.

Midwinter 1973-74 saw the confluence of two major developments. The American consumer began to anticipate the possibility of a business recession with its threat of lower income and unemployment. Consumption of what consciously or subconsciously was considered to be gourmet or luxury items was curbed. Unfortunately, partially inadvertently, partially unavoidably, shrimp products were positioned in the consumer's mind as this kind of item, far beyond the reality of the situation. Breaded shrimp, in the context of a restaurant meal and on a per-serving basis, is price-competitive with a broad range of middle priced entrees. Consumers, however, began to eat in restaurants less often and began to avoid luxury purchases in retail food shopping.

At the same time, concurrent with recession psychology, a sharp increase in the cost of fuel developed. People traveled less for both business and leisure and the restaurant trade suffered a sudden recession of its own.

Concurrent with these domestic developments was a deepening world-wide expectation of recession, particularly in one of the major shrimp consuming nations, Japan. Japanese food distributors were already experiencing difficulty introducing frozen shrimp in the Japanese market when recession psychology contributed to further deterioration of the market for high-priced imported products. As Japan withdrew as a major competitor for the world supply of shrimp, breaders in the U.S. found imports relatively attractive. These events produced simultaneously a dramatic decline in demand and a moderate increase in supply.

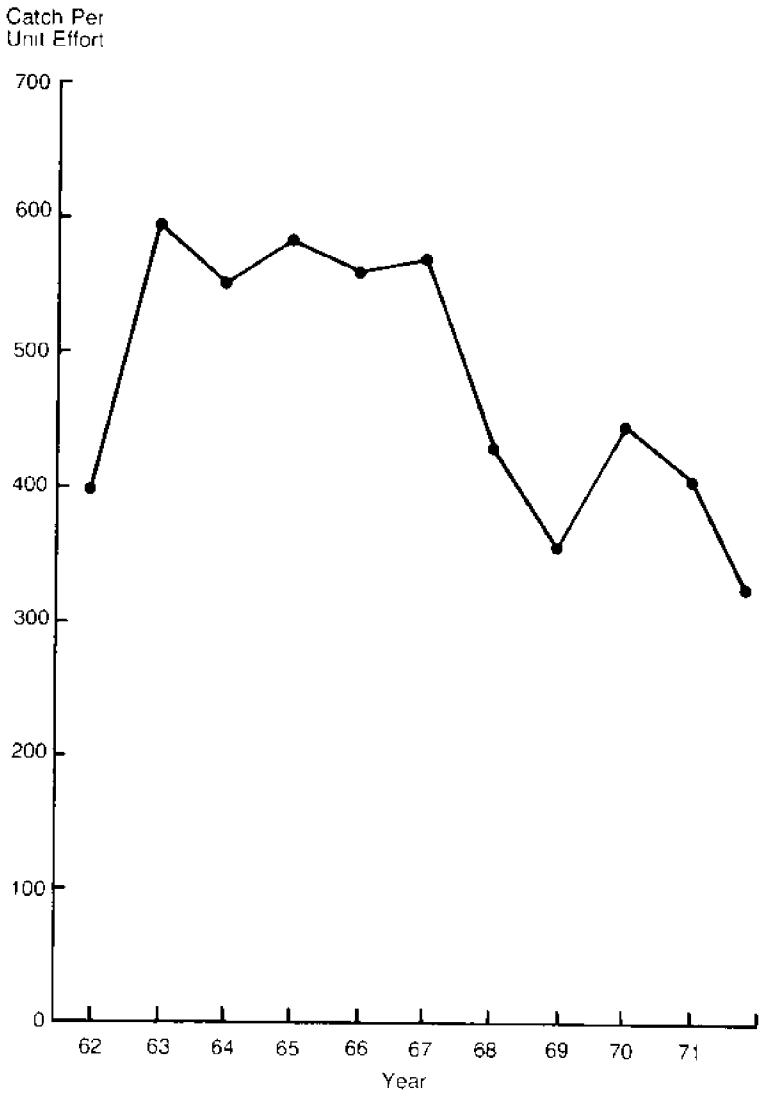

Fig. 1. Annual catch per unit of effort for years 1962-1971, Gulf of Mexico.

Specifically, imports had increased by October 1, 1974, by about 35 million pounds over the corresponding period a year earlier. Inventories had increased 20 million pounds or about 25% over the normal level for that same time of year. To characterize the impact of price on fishermen, the average price paid in September for all sizes of shrimp landed in 1973 was $1.97. The same figure for September 1974 was $1.17, a decrease of 41%. Shrimp producers supply a raw

material to a food processing-marketing industry and when the consumer reduces purchases even a little, middlemen begin immediately to reduce inventories and temporarily stop buying altogether. The price whiplash on the basic producer of the raw material in fishing is often violent. When there is confidence that the variation in consumer demand is temporary, middlemen usually cushion the shock by accumulating larger inventories for the future. There is a tendency to view the current situation as longer lasting, however.

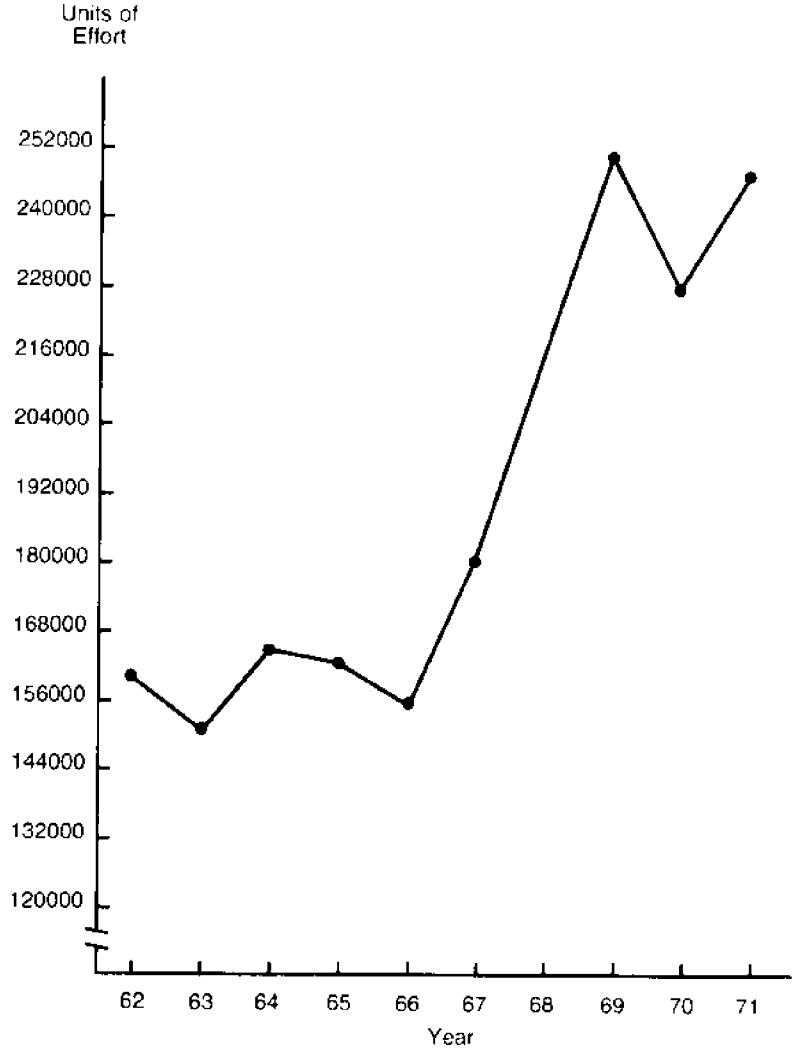

Fig. 2. Annual total effort by vessels for the years 1962-1971, Gulf of Mexico.

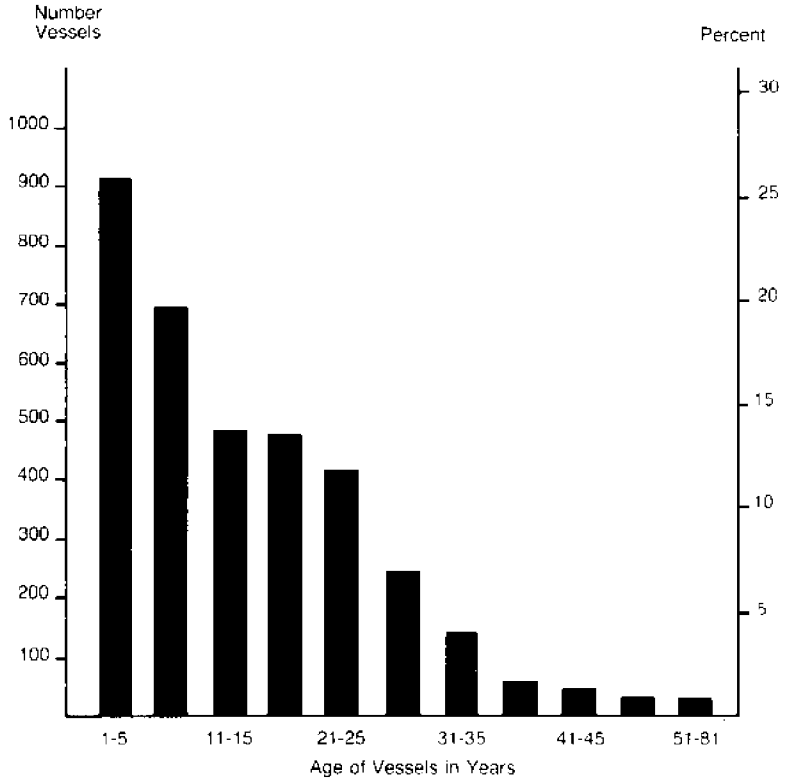

Fig. 3. Frequency distribution of number of vessels and percent of vessels by age in years, 1971.

Now let me shift to the supply side. We have witnessed in recent years a basic decline in catch per unit of effort for shrimp (Fig. 1). The National Marine Fisheries Service started two years ago, through the State-Federal Management program, to sponsor research in the economics and management of the Gulf of Mexico shrimp industry, through Texas A&M University. The National Marine Fisheries Service has been collecting catch, effort, and price statistics over the last 12 years. In 1971, through the cooperation of several owners, we began collecting cost information on a sample of about 50 shrimp trawlers. Texas A&M University is continuing this work now on a permanent basis. I want to acknowledge in particular Dr. Wade Griffin for his splendid effort in this regard.

Plotting effort on the vertical axis and time on the horizontal axis, it is clear that there has been a very dramatic increase in total effort in the Gulf of Mexico (Fig. 2). A unit of effort, in this case, is an index based on a combination of various vessel and crew characteristics that produced the highest multiple correlation with productivity or catch.

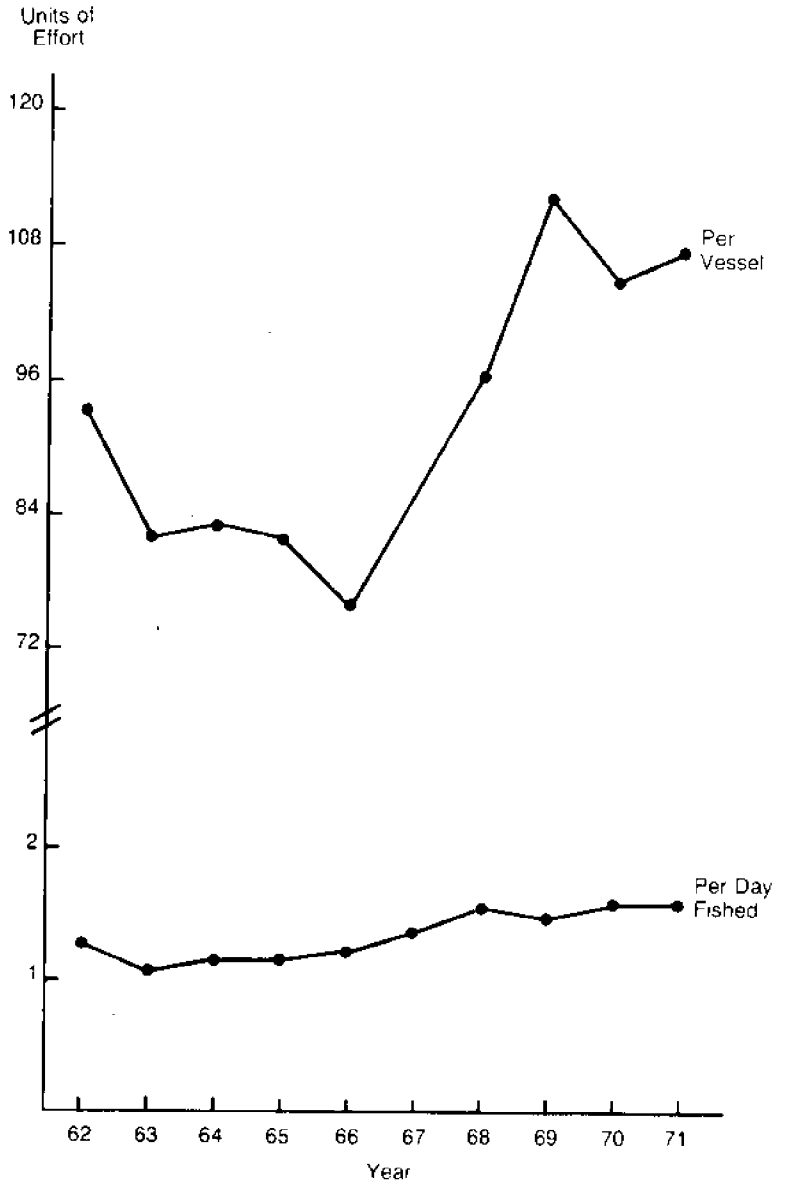

Fig. 4. Effort per day fished and annual effort per vessel for the years 1962-1971, Gulf of Mexico.

The most important source of increase in effort has been the increased fishing power of the newer trawlers (Fig. 3). This figure includes only vessels operating in the offshore fishery. It excludes the inshore, small boat fishery. The bayou fishery of Louisiana, for example, is not included. This is the offshore, high seas trawl fishery made up of vessels 50 feet and over in length. A large percentage of this fleet is less than 15 years old. This, more than anything else, explains the increase in horsepower, more efficient gear, and better vessel configuration generally. The result has been an increase in effort both per vessel and per day fished (Fig. 4).

The increase in effort has not resulted in higher aggregate landings in recent years, however (Fig. 5). For the period 1950 through 1972 the catch has remained essentially flat. Although this resource appears to be unaffected biologically from overfishing, we are experiencing higher cost per pound landed each year.

The effect of this decline in economic efficiency has not had the effect of discouraging additional investment in more trawlers.The return per unit of investment, although declining, has remained sufficiently high to compare favorably with other competing investment alternatives. Rising shrimp prices have helped retard the decline in earnings as demand increased rapidly with growing prosperity. As long as the return for the next dollar invested in a shrimp trawler exceeds the return from the investor's next best opportunity, it is rational to build more trawlers.

In late fall 1973 fuel prices suddenly began to soar. By spring 1974, the average diesel fuel price had doubled from the previous spring from 16¢ to 32¢ per gallon.

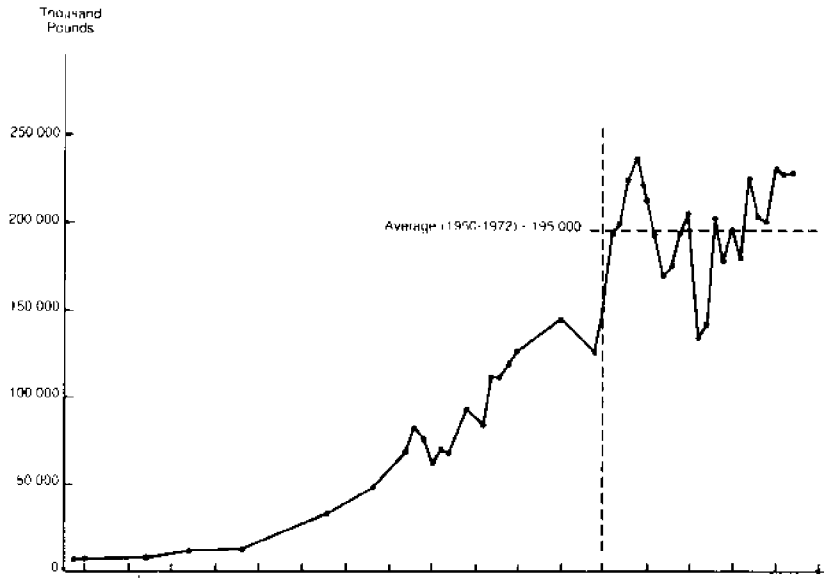

Fig. 5. Shrimp landings in five Gulf states from the Gulf of Mexico, heads-on, 1889-1972.

Table I. Net Return 1973 and 1974 by Vessel Class

Class	Construction and size	Net Return 1973	Net Return 1974
I	70-78′ Steel	$ −15,401	$ −32,580
II	63-69′ Steel	560	−13,222
III	63-69′ Wood	14,180	−17,413
IV	45-68′ Wood	− 8,313	
V	45-62′ Wood	− 3,033	− 9,909

Of almost equal significance, the cost of other supplies and services also rose over this same period by 20%, repairs, maintenance, nets, and the cost of new construction. Due to both fuel and other costs, the shrimp trawling industry experienced a rate of cost inflation far in excess of the general economy. Net return to the average shrimp trawler turned negative for the larger steel hulls and the smaller wooden hulls (Table I). This figure indicates the economic performance of five different classes of boats, the first two classes being steel and the latter three classes wood. These data are based on a sample of about 60 trawlers that provide detailed cost records to Texas A&M University on a confidential basis. There are no really large steel trawlers over 78 feet in the sample. Nor does the sample include smaller wooden hulls under 45 feet. These data classes illustrate with considerable clarity what is happening to the shrimp fishing firm today and explain why so many of the larger steel trawlers are idle. Although many trawlers were unprofitable in 1973, the larger wooden trawlers continued to show high net returns. The majority of these vessels were purchased at a time when initial construction costs were much less and interest on debt was at a lower rate. Although there were some 20 trawlers in the sample averaging a return of about $14 thousand in 1973, there will be no class of trawler in our sample averaging profitable operations in 1974. Projecting inflation to continue at a rate of about 12% annually in the last quarter of 1974 and no increase in fuel costs, the average trawler regardless of size class, will show a loss for 1974. It does not follow, however, that all vessels will find it rational to stop fishing. Class III trawlers, for example, showing a loss of $17 thousand in 1974 will still be earning $6 thousand above operating costs. Under these conditions, it is perfectly rational to continue operations and fish at a short term loss. As long as earnings exceed variable costs by any amount there is labor income for the captain and crew with something left over to apply to fixed costs. By their very nature, fixed costs such as debt amortization or major overhaul can be postponed. The owner of a vessel in Class III losing $17 thousand a year has $6 thousand above variable costs to apply to interest payments, repair or other fixed cost. There are questions with regard to how long one can operate under this kind of climate and how long this climate will continue, however.

The forces causing consumers to avoid the purchase of shrimp may be moderating already. Shrimp prices have firmed and apparently are bouncing back from their industry lows. Restaurants, where most shrimp are eaten, seem to be following a strategy of holding shrimp meal prices constant against rising prices for other meals. Although shrimp meals are not becoming less expensive in the absolute sense, they are already less expensive compared to other entrees. While gasoline prices have stabilized at much higher prices, vacation and business travel too have rebounded.

Barring a major deepening of the recession, there is hope for recovery in ex-vessel shrimp prices within the next year. Full recovery in real terms to 1972 levels may require another year or two.

On the supply side however, I am much more pessimistic. I would anticipate no future decline in fuel costs. I think that would be a dangerous planning assumption. On the other hand I do not expect significantly increased fuel costs. It appears that we will be facing, in the next year or two, the reality of many business failures in the trawling industry. One would expect these failures to be concentrated among the larger steel and smaller wood vessels, the least efficient ends of the spectrum. The majority, however, will be able to operate at a level that generates enough revenue to cover their variable costs and earn something to apply to debt servicing and other fixed costs. By putting off overhaul, some repairs, and with a moratorium on their mortgage, most will weather the economic storm and return to normal levels of return by the end of the 1977 season. The new fuel cost-shrimp price relationship will force the surviving trawler operations into a more fuel-efficient fishing strategy and to adopt fuel-saving technology such as twin, double-net trawls.

There will be some opportunity for those who cannot survive to sell their vessels, perhaps out of the U.S. fleet, perhaps to some other fishery, or to retire the vessel permanently. When the process is complete we may have witnessed a major reduction in the size of the fleet, by as much as 40%.

There is really little that can be done about the current situation beyond (1) implementing available cost reduction technology or strategy and (2) stimulating demand where it has been irrationally depressed. Most input costs are determined by policies of the Federal Energy Administration, the Arab states, and forces far beyond our control as an industry. There are some changes that can be made in fishing strategy that could improve fuel economy. More group or fleet fishing has always held potential cost savings. More likely, perhaps, is the adoption of double net, twin otter trawls already demonstrated to be much more power-efficient. The recent escalation in diesel fuel prices should markedly accelerate the rate of adoption of new technonology in the shrimp industry.

On the demand side, there is probably less opportunity for short term improvement. Normal industry promotion and federal-state government consumer education efforts may be successful in correcting misconceptions about the comparative cost of shrimp-based meals within a few months. Two to 3 years might be required however, for a full recovery of the shrimp price cycle to its 1972 level. Just recently some impounded S-K funds in the amount of $1 million, to be used over a 2-year period, have been released for consumer education regarding

shrimp and other fishery products. These funds will be used to develop materials and programs to encourage commercial firms to advertise and to generate cost free public relations-based promotion. These funds will be multiplied by creating a proliferation of unpaid media space as public relations activity through food editors. NMFS will work with states, industry groups, trade associations, restaurant chains, and food retailing chains, trying to use our limited funds to create a more favorable climate for shrimp and other seafoods. We are also devoting a larger portion of our own normal consumer education budget toward this objective. I think we must be realistic however, and recognize that this is not a really large promotional budget, on a multi-product, national scale. Our expectations in this regard should be modest. I do not know if you can agree with all of my analysis of causes, but I am confident that we agree on the serious state of the industry and the reality of a major adjustment through attrition. I am equally confident that efficient operators will weather the storm and a stronger, more efficient industry is already in the making.