

PROCEEDINGS OF WORKSHOP ON THE SNAPPER/GROUPER
RESOURCES OF THE SOUTH ATLANTIC BIGHT

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PREFACE

The Workshop on the Snapper/Grouper Resources of the South Atlantic Bight was held on March 23-24, 1977 at the Marine Resources Center of the South Carolina Wildlife and Marine Resources Department in Charleston, South Carolina.

The purposes of the Workshop were to describe current research and development activities concerning snapper/grouper stocks of the South Atlantic Bight, to discuss and familiarize interested individuals with information available on these stocks, and to prepare an informal document outlining information gaps and needs relevant to future management and development of the snapper/grouper resources.

Since the South Atlantic Fishery Management Council has designated the snapper/grouper fishery as a high priority fishery and intends to undertake the development of a management plan for this fishery in the near future, the convening of this workshop was felt to be an appropriate and timely activity. It is anticipated that these proceedings will be useful to the South Atlantic Fishery Management Council in their formulation of a snapper/grouper management plan. In addition, these proceedings should be helpful in familiarizing individuals with the snapper/grouper resources

of the South Atlantic Bight and should serve to document current activities and needs relative to the future development and management of these important resources.

We wish to express our appreciation to those individuals and agencies whose participation made the workshop a success. We especially wish to acknowledge the following: Mr. Beverly Snow, Executive Director of the Coastal Plains Center for Marine Development Services, and his staff, especially Mr. Robert Hines, for their support of the workshop as part of the Cooperative Projects Program of the Coastal Plains Regional Commission; the staff at the Marine Resources Center who contributed in various capacities; the speakers who gave presentations at the first general session; those individuals who chaired the sectional meetings during the special sessions and who also presented reports on their respective sectional meetings at the second general session; and to all participants who contributed to the workshop planning, discussions, and reports presented.

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INTRODUCTORY REMARKS

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The Snapper/Grouper resources of the South Atlantic Bight (Cape Hatteras to Cape Canaveral) form the basis of an important fishery which has both recreational and commercial components. Despite the importance of these resources to the economic and social well being of the region, only a limited amount of research has been conducted to date in studying and defining them.

Prior to this year, a mechanism did not exist whereby these resources could be effectively managed or protected from over-exploitation, since the major fishing grounds are located in waters outside of State and Federal jurisdiction. With the passage of the Fishery Conservation and Management Act of 1976 (Public Law 94-265), which became effective March 1, 1977, a mechanism has been established whereby U. S. fishery resources within a 200 mile Fishery Conservation Zone can be rationally developed and managed.

I feel that a few comments concerning some of the provisions of this recent legislation are appropriate and pertinent to this workshop. While I realize that many of you are quite familiar with Public Law 94-265, others may not be cognizant of some of its provisions which are germane to the activities of this workshop.

One of the provisions contained in this piece of landmark legislation provides for the establishment of regional fishery management councils. In our region the South Atlantic Fishery Management Council has been established consisting of the States of North Carolina, South Carolina, Georgia and Florida (east coast). One of the primary functions of the Council is to prepare and submit to the Secretary of Commerce a fishery management plan for each fishery in its geographical area and to amend and refine these plans as necessary.

A decision has been made by the South Atlantic Fishery Management Council that the snapper/grouper fishery is a high priority fishery and that development of a fishery management plan will soon be undertaken.

It is now generally recognized that the traditional concept of maximum sustained yield (MSY) is seldom attainable for single species fisheries and its application is

not particularly feasible when dealing with a multi-species fishery such as the snapper-grouper fishery. In addition, the concept of a MSY fails to recognize and take into consideration species interdependencies and relationships. For these and a number of other reasons which are discussed in a recent paper by Larkin entitled "An Epitaph for Maximum Sustained Yield" (Trans. Amer. Fish. Soc. 106(1): 1-11), it is apparent that the concept of MSY will not be sufficient for future management strategies. Recently in fishery management a new concept has evolved - the concept of optimum yield.

It is the concept of optimum yield which is specified as the basis for management under the Fishery Conservation and Management Act of 1976. There will be a number of national standards which must be incorporated in fishery management plans promulgated under this legislation. One of these is to prevent overfishing while achieving, on a continuous basis, an optimum yield from each fishery.

The eclectic concept of optimum yield has been defined by Philip Roedel (American Fisheries Society Symposium on Optimum Sustainable Yield, 1975) as "a deliberate melding of biological, economic, social and political values designed to produce the maximum benefit to society from a given stock of fish". According to the Fishery Conservation and Management Act of 1976, optimum yield is defined as "the amount of fish which will provide the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities; and which is prescribed as such on the basis of the maximum sustainable yield from such fishery, as modified by any economic, social or ecological factor."

It is readily apparent that in addition to traditional biological data fishery managers will also have to consider economic and social data in future management formulae developed under this legislation. Problems will arise in trying to apply definitions of optimum yield, to "real world" situations. To date, no guidelines or criteria have been established for formulating a management plan under the concept of optimum yield. Indeed as one begins to consider the concept, it soon becomes apparent that optimum yield is capable of being many things to many people; and that any criteria developed will surely depend in part on the fishery being considered

and the individuals formulating the management regime.

Developing a management plan based on optimum yield for any fishery will be a difficult and complex task. This will be especially true for the snapper/grouper resources in our region because much of the basic biological data needed are simply not available, even for the more important and common species. The amount and quality of social and economic data available to use in any snapper/grouper management plan is even more limited. Also, fishery managers will be dealing with a multi-species fishery and not a directed fishery in which there is a single target species. Similarly, it is a multi-gear fishery; one in which there will be allocation problems between U. S. recreational and commercial interests as well as between foreign nationals and American fishermen. These are but a few of the problems which will be encountered by fishery managers and decision makers in formulating a fishery management plan for snapper/grouper resources of the region.

The workshop has two primary objectives. The first is to acquaint persons in the region having an interest in snapper/grouper resources with one another and with current research and development activities. This will be accomplished during this morning's general session. The second objective is to obtain input from knowledgeable and interested individuals and to exchange ideas on what types of information are needed concerning future management and development of the snapper/grouper resources. These informational needs will be addressed during the special sessions and the second general session.

GENERAL SESSION I

CURRENT RESEARCH AND DEVELOPMENT ACTIVITIES RELATIVE TO THE SNAPPER/GROUPER RESOURCES OF THE SOUTH ATLANTIC BIGHT

SAMPLING PROGRAM FOR THE COMMERCIAL SNAPPER/GROUPER FISHERY IN SOUTH CAROLINA

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South Carolina Wildlife and Marine Resources Department

Objective(s) of the Activity

To collect size composition, species composition, and catch and effort data on the commercial snapper and grouper fishery in South Carolina.

Brief Description of Activity

Port sampling to obtain species and size composition of the offshore demersal catch and total landings have been conducted since February of 1976. Vessel captains are interviewed after each trip to determine area fished, duration of trip (total and actual fishing days) and size of crew. Scale samples of red snapper are collected for age and growth studies by the Marine Resources Research Institute.

Presentation

Prior to 1976, commercial exploitation of snapper and grouper stocks on the South Carolina shelf was primarily conducted by transient boats landing catches in Florida ports. Only two or three local boats fished for snappers and groupers prior to 1976. Local shrimpers fishing sea bass traps in the off season for shrimp also did occasional hand lining for snapper and groupers. In early 1976, the success of a Sea Grant demonstration examining the feasibility of offshore trawling for snappers and groupers stimulated interest in commercial production of these species. In April of 1976, with the encouragement of a local seafood company, the first Florida handline vessel relocated in Charleston, South Carolina. Apparently the success of initial trips as well as favorable prices caused additional vessels to relocate in this area. Twelve hand line vessels (electric reels) were based in South Carolina during the summer of 1976.

It was initially expected that handline boats would return to Florida during winter months. However, six vessels remained and fished throughout the winter. Three additional vessels arrived in early 1977 increasing the number of handline vessels operating in the state to nine. Additional vessels may locate here later this year. We've also determined by interviews that at least four Florida based vessels regularly fished South Carolina waters during the spring, summer and fall months.

Commercial landings of snapper, groupers and porgies in South Carolina averaged 43,500 pounds during 1970-1974. In 1976, landings of these species increased to approximately 450,000 pounds. Roller-rigged trawlers operating during February through May 1976 accounted for an estimated 66,000 pounds. In addition to the 450,000 pounds landed in South Carolina, it is conservatively estimated that an additional 180,000 pounds of snapper/- grouper and associated species were taken off the Carolinas and landed in Florida during 1976.

The rapid increase in commercial landings focused attention on the need for a sampling program to collect information necessary for management of these stocks. In response to this need the Marine Resources Division initiated a sampling program to monitor offshore commercial catches. When handline vessels began landing fish here, sampling was expanded to cover them. The present port sampling program is a cooperative effort between the Office of Conservation and Management (Fish Management Unit) and the Marine Resources Research Institute (MARMAP Program).

Sampling teams collect data on the area and depth strata fished through personal interviews with fishermen. This information is usually supplied in terms of a heading off Charleston or some other prominent coastal landmark with a range of depths fished; for example, 25 to 30 fathoms, 110 degrees off

the Charleston Sea Buoy. Asking more specific questions about the location usually makes the fisherman uneasy. Data concerning total trip length, actual fishing days to include search time, crew size and the number of reels and number of hooks fished are also collected. A current file on vessels fishing South Carolina waters which includes vessel length, power, navigational and fish location equipment, etc. is maintained which allows us to identify changes in relative fishing success.

Catch sampling is conducted as fish are unloaded. Species composition data is reported for each trip. The poundage by species is recorded from payment records kept by the fish company for each vessel. This information is collected at the end of each month. Then, we take the data collected at the time of unloading and match it with catch data to calculate monthly catch totals and nominal catch per unit effort.

Port sampling personnel are responsible for identification of fish and must know the market names used for a particular species. In contrast to the Gulf of Mexico snapper fishery (reviewed by Carpenter) where as many as eleven species were marketed as red snappers, the fish company where we sample does not mix species. Thus, their records appear to reflect catches accurately by species.

I would like to present some of the data on species composition for handline vessels from our sampling efforts to date. Red snapper, *Lutjanus campechanus*, averaged 17.2 percent of the catch by weight during the period of May 1976 through February of 1977. It ranged from a low of 5.7 percent in August to a high of 29.8 percent in February of 1977. The silk snapper, *Lutjanus vivanus*, averaged 2.3 percent ranging from 9.9 percent in September to 0.4 percent in June. No silk snapper were landed from November 1976 through February 1977. The reason for this is unknown, but it seemed that when boats fished the Frying Pan Shoal area they caught most of their silk or "yellow eye" snapper. Perhaps the absence of silk snapper in catches indicates that vessels are not fishing in the Frying Pan Shoal area due to inclement weather. Vermilion snapper, *Thrombapites aurorubans*, averaged 13.2 percent of the catch, ranging from a low of 3.0 percent in February 1977 to a high of 35 percent in September of 1976. The gag grouper, *Mycteroperca microlepis*, averaged 30 percent of the catch, ranging from a low of 15.8 percent in February 1977 to 44.3 percent in June 1976. The scamp grouper, *Mycteroperca phenax*, averaged 10.0 percent of the catch by weight, ranging from a low of 1.2 in May 1976 to 20.3 percent in July 1976. Scamp have been very scarce in catches since December of last year. They were scarce in January and none were reported in February of 1977. Again, the reason for this is unknown. Speckled hind, *Epinaphelus drummondhayi*, averaged 3.4 percent of the catch, ranging from a low of 1.3 in May to 6.2 percent in July. The red porgy, *Pagrus sedicim*, averaged

23.2 percent by weight, a minimum of 12.9 in September and a maximum of 35.5 percent in February of this year.

Length composition of the catch is also determined at dockside. A random sample of 50 individuals or the entire catch, whichever is less, from each species is measured. In addition to length measurements taken at the fish house, red snapper scales are collected for age and growth studies. Otoliths from groupers and snappers are not presently being collected because traditional collection methods deform the fish for marketing and the present sampling arrangement requires that we complete all samples and measurements without impeding the work of packing fish.

MARMAP personnel are working on a technique which will allow us to collect otoliths without disfiguring fish. Then we can work out some agreement where we can set fish aside, collect samples, and return them for packing.

Comments, Questions and Answers

- Q. You point out that an additional failing of commercial fishery statistics is the fact that when you're not present, everything is called groupers. Now, apparently, processors separate catches to gag, scamp and speckled hind. However, if the catches become more diversified, through the addition of snowy and yellowedge grouper as a result of deeper fishing, they will continue to separate by species?
- A. We've got people in the fish house, sampling personnel, who definitely know what is being packed and what market name is associated with it.
- Q. If they aren't there, will the fish house follow through on their record keeping?
- A. I found them to be very consistent in keeping records and surprisingly, they pack species by species. I haven't seen mixed species yet.
- Q. Do they get the same price for each of those species?
- A. Initially they were paying boats the same price for gag and scamp grouper although they were packing and shipping them separately. Now, they are paying a premium for scamp which is five cents a pound higher.
- Q. Does the fish house that handles it get the same price?
- A. I suspect not. I don't know what price the fish house is getting but from what I'm told

scamp commands a premium price and I suspect that they are getting a higher price for this fish.

C. You may find, particularly with some snappers since they look similar to each other, that if red snapper is getting a better price, they'll start grouping everything under red snapper; thus, you may have some difficulty with your record keeping.

C. That may be the case when it actually hits the New York market. I'm sure there's a number of species that are going for red snapper. As far as packing in the fish house at the time we get our records, they pay fishermen different prices for different species so they're always careful to know exactly what poundage they've got for each species. I suspect that when they actually hit the retail market the dealer may be getting red snapper price for all of them.

Q. Does the availability of fish house payment records to you result from strictly a cooperative arrangement?

A. Strictly a cooperative agreement.

Q. You didn't mention Warsaw or red grouper and I would like to know if they are being caught?

A. Warsaw is not one of the major species. I've got some figures on Warsaw. In February of 1977, it made up 13.0 percent of the catch by weight but for the rest of the year, it's been around 1.0 and 1.4 percent of the catch. Red grouper is very seldom encountered in the commercial catch.

Q. One of the predominant groupers in our area (Georgia) is the gray. Did you see any of those?

A. I believe the gray is what I'm calling the gag.

Q. Do you have any figures for price per pound for mixed groupers?

A. Yes, scamp now is 65c per pound to the boat and 60c for gag or gray snapper and 55c for speckled hind. Warsaw I'm not sure; I think Warsaw is about 45c.

Q. Is this the present price this month?

A. Yes. This is what boats have been paid. It's been pretty consistent throughout the year. I suspect it's somewhat higher on the New York market but this is what boats that we have been working with in this area are receiving for fish now.

Q. Are the fishermen that have moved here the better fishermen from Florida or are they just ones that are trying to scout a new area?

A. That's hard to say. We seem to have a range of fishermen.

Publications Resulting from Activity

Ulrich, G. F., R. J. Rhodes and K. J. Roberts. 1976. Status report on the commercial snapper-grouper fisheries in South Carolina. In Proceedings of the Twenty-ninth Annual Gulf and Caribbean Fisheries Institute, pp. 102-125.

SOUTH CAROLINA MARMAP PROGRAM: PRESENT AND FUTURE

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and
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Objective(s) of the Activity

Stock Assessment

Brief Description of Activity

The present MARMAP program includes efforts to:

- 1) validate aging techniques
- 2) identify and describe larval and juvenile stages
- 3) describe areas of "live bottom" habitat
- 4) develop sampling gear for stock assessment over untrawlable bottom areas

The future MARMAP program should include efforts to:

- 1) monitor population age structure from commercial fisheries and virgin stocks
- 2) define stocks as single or multiple through tagging, larval drift and recruitment studies
- 3) empirically determine potential yields in local areas
- 4) routinely monitor stocks over untrawlable bottom areas.

Presentation

I would like to present a brief introduction to the South Carolina MARMAP Program. MARMAP, for those of you who aren't familiar with the acronym, means Marine Resources Monitoring Assessment and Prediction. Our MARMAP Program is a cooperative effort between the National Marine Fishery Service and the Marine Resources Center here in Charleston. We like to think of the program as an integration of research efforts on adult fish stocks and ichthyoplankton. We conduct two major cruises annually between Cape Fear, North Carolina and Cape Canaveral, Florida on the R/V DOLPHIN to survey groundfish populations between 10 and 366 meters (Figure 1). Recently, we have computerized all data for rapid access and

retrieval. My presentation will be a brief overview of the groundfish program. Howard Powles will discuss some of the results in ichthyoplankton research on the snapper-grouper complex.

First, our groundfish program has been evaluating techniques for assessing fish stocks, such as snappers and groupers, that are not adequately sampled by the standard MARMAP 3/4 version of a Yankee No. 36 trawl that we normally use offshore. With our sampling techniques, we are attempting to make rough estimates of relative abundance of species found in inshore sponge-coral habitats and offshore rocky outcrop habitats within the region between Cape Fear and Cape Canaveral. The gear and techniques that we have been investigating include: fishing with traps, trawls, snapper reels, and observations with TV and cameras. We have looked at the effectiveness of the local blackfish trap and a "mini-S" trap. Several local fishermen have taken blackfish pots offshore and occasionally filled them with red snapper. The "mini-S" trap is a small modification of the larger antilean "S" trap and is more easily transported and handled offshore. We have observed underwater transects with television and motion picture cameras in an attempt to enumerate fish species seen near the bottom in sponge-coral habitats. We heard this morning that good commercial fishermen have the ability to set on or near a small rocky outcrop area, do some fancy jockeying with their small boat and pull up their trawl with a sizeable catch. When we use the MARMAP half-hour trawl procedure in a rocky area, we usually leave the trawl on the bottom or pull it up ripped to pieces. We have examined the possibility of doing some site specific, short duration trawls with a URI highrise trawl. Even that may not be feasible in offshore rocky outcrop habitats. We may also conduct hook and line (snapper reel) sampling in untrawlable areas.

The study of gear for assessment of the snapper-grouper complex was initiated in June 1976. At that time, we conducted SCUBA dives to observe the response of fish populations of inshore sponge-coral habitats to several sampling methods. This work was limited to

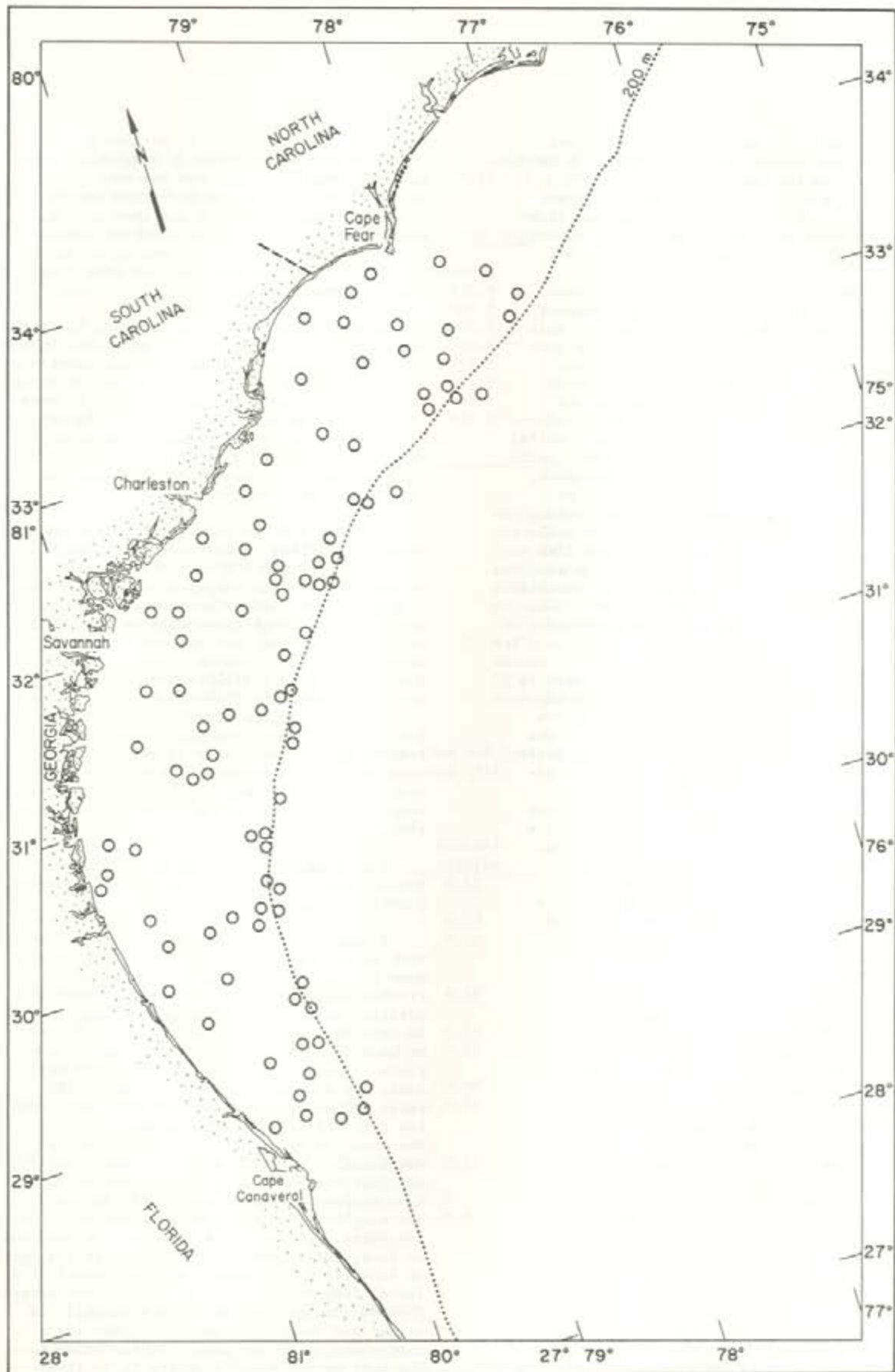


FIGURE 1. The location of bottom trawl stations of MARMAP Cruise DP7701 conducted between January and February, 1977.

depths of 20 to 30 meters. We did not see snappers, and caught only a few groupers during the highrise trawling. In May 1977 we hope to move further offshore into areas that are fished regularly by commercial fishermen in order to find snappers and groupers and other species of rough bottom habitat.

Another aspect of the program is investigation of the life history of red snapper from the Carolina Bight. Specimens and data have been obtained through sampling the commercial catch. We hope to obtain further samples of gonads, stomachs and age-growth material by accompanying fishermen in the field. Presently, we have preliminary information on maturity, fecundity and food habits. We are attempting to validate age-growth techniques for red snapper and several groupers. We have just obtained a small Isomet slow speed saw and hope to begin thin sectioning of grouper otoliths in the near future. Obtaining large numbers of otoliths from fish species of the commercial catch will necessitate development of a technique for removal of otoliths from below the skull without disfiguring the fish or reducing its market value.

Many of the fish species that we catch in large numbers during routine monitoring may serve as food sources for offshore groupers and snappers (Table 1). Descriptions of the distribution and relative abundance and estimates of biomass and potential yield are almost complete for approximately twenty groundfish species commonly collected by the standard 3/4 Yankee trawl. Many species are of ecological importance in the shelf area, especially over sand bottom habitats where the MARMAP trawl samples effectively. Information on the distribution and abundance of forage species correlated with the food habits of snapper-grouper species may help explain the distribution and abundance of the latter.

We intend to monitor population age structures of the snapper-grouper complex by sampling commercial catches and by independent sampling of the snapper-grouper stocks with several types of gear. We hope to investigate stock relationships, define whether or not stocks offshore are single or multiple units, whether each rock outcropping has its own adult population, and the degree to which there may be movement between various areas. Complimentary information from studies of seasonal movements, larvae drift, and recruitment data from commercial catches, as well as independent sampling should help define unit stocks of priority species.

An interesting point is that in 3 1/2 years of trawling between Cape Fear and Cape Canaveral, we have seldom taken juvenile snappers or groupers. Juveniles are commonly collect-

ed in the Gulf of Mexico by shrimpers. Although we collected juvenile vermilion snapper and porgies, we did not see many young snappers or any groupers in bottom trawls. I don't believe shrimpers see them either. Recruitment to the fishery is still unknown. Is recruitment from local spawning or are larvae or juveniles entering our area from another area?

We hope to estimate the carrying capacity of rocky outcrop habitats and potential yields of priority species in local areas, especially small relatively virgin local areas, by intensively fishing a given area with one or more gears, and then by estimating the original population size by using the Leslie-DeLury method. Monitoring a heavily fished area may also indicate the rate of replenishment of stocks to these habitats.

We would like to routinely monitor and assess groundfish stocks over untrawlable areas which presents a difficult problem. Present methods and sampling gears are relatively old and inefficient compared to this country's space age technology and the technological advances that are occurring in other fields. We believe, to some extent, that hardware is available for obtaining better estimates of fish abundance. Hardware might include underwater TV with lowlight level intensifiers, improved types of side scan sonar and bioacoustical methods; all have been used experimentally but few are used routinely. Presently this type of hardware is either top secret or extremely expensive.

Now, I would like to introduce Howard Powles, who will describe the MARMAP ichthyoplankton work.

I want to briefly describe some of the work we've been doing on ichthyoplankton and some of the management questions plankton studies may be able to address. As mentioned earlier, we've been sampling from Cape Fear to Cape Canaveral since spring of 1973, and we have 1973 and 1974 plankton samples completely sorted by cruises covering all seasons. We use bongo nets which sample the water column from surface to bottom and neuston nets which sample the surface layer of the sea. We're examining distribution and abundance of all groups that we can identify, not just snappers and groupers, but we do have snapper, grouper, and sparid larvae in our samples. We have some baseline data for two years, 1973 and 1974. One of the problems we face, really the basic problem, is taxonomy of larvae. It's always a problem identifying larval fish and the only species of the snapper-grouper complex that we can now identify as larvae are vermilion snapper, *Rhomboplites aurorbens*, and red porgy, *Pagrus sedecim*. The best we can do with others is to treat them at family or subfamily level. Groupers

Table 1. Species of possible forage value commonly collected by MARMAP trawling between Capes Fear and Canaveral during four seasons (Fall, 1973; Spring and Summer, 1974; and Winter, 1975).

Name		Total Catch (kg)	Average Catch/30 Minute Tow
Southern porgy	<i>Stenotomus</i> sp.	2,285.3	6.0
Round scad	<i>Decapterus punctatus</i>	528.8	1.4
Tomtate	<i>Haemulon aurolineatum</i>	307.7	0.8
Butterfish	<i>Porrius triacanthus</i>	285.8	0.8
Spanish sardine	<i>Sardinella anchovia</i>	260.8	0.7
Round herring	<i>Etrumeus teres</i>	257.2	0.7
Inshore lizardfish	<i>Synodus foetans</i>	225.6	0.6
Sand perch	<i>Diplecistrum formosum</i>	183.6	0.5
Spotted hake	<i>Urophycis regia</i>	148.3	0.4

represent the subfamily Epinephelinae of the family Serranidae and we can identify them to subfamily. Snappers (Lutjanidae) and porgies (other than red porgy) can be identified to family, grunts also. Porgies (Sparidae) and grunts (Pomadasyidae) seem to be more important in the sport fishery than in the commercial fishery.

One of the main questions we hope to address is whether assessment of snapper

and grouper stocks is feasible using ichthyoplankton surveys. This technique has been developed in California mainly for sardines and anchovies. We wish to determine if this can be done for snappers and groupers. The answer to this question is "no", because we get so few larval snappers and groupers that the amount of sampling needed to catch enough to give a statistically reliable population estimate would not be economically feasible (Table 2). For example,

Table 2. Numbers of larval Lutjanidae, Serranidae and Sparidae taken in neuston and bongo sampler tows in South Atlantic Bight in 1973 and 1974.

	BONGO		NEUSTON	
	Number caught	Number/station	Number caught	Number/station
LUTJANIDAE	<u>135</u>	<u>0.61</u>	<u>103</u>	<u>0.42</u>
<i>Rhomboplites aurorubens</i>	51	0.23	60	0.24
Unclassified	84	0.38	43	0.18
SERRANIDAE	<u>1354</u>	<u>6.19</u>	<u>1876</u>	<u>7.65</u>
Anthiinae	170	0.78	55	0.22
Epinephelinae	39	0.18	67	0.27
Liopropominae	1		0	
Serraninae	1114	5.09	906	3.70
Unclassified	30	0.14	848	3.46
SPARIDAE	<u>38</u>	<u>0.17</u>	<u>805</u>	<u>3.29</u>
<i>Pagrus sedecim</i>	0	0	12	0.05
Unclassified	38	0.17	793 (89)*	3.24 (0.36)*
NUMBER OF STATIONS	219		245	

*Excluding single large catch of 704 specimens.

in 1973 and 1974, we got 135 snapper larvae in the bongo net and 103 in the neuston net. This is out of a total of some tens of thousands of fish larvae. Less than 1 percent of our total catch was snapper larvae. We got 39 grouper larvae in the bongo net and 67 in the neuston net during 1973 and 1974. Larvae of these groups are not abundant enough to obtain a population estimate. One interesting thing is that sparid larvae are extremely rare even though adults of these fishes are quite abundant. We wonder whether these larvae are not planktonic, or go to the bottom very early in their larval lives. It would be an interesting subject for some further work.

Another question we've been trying to address is that of stock identity. Are South Atlantic snappers and groupers endemic or are they an extension of Caribbean and Gulf of Mexico stocks? We can obtain some insight into this question by examining the sizes of larvae. Figure 2 represents the size distributions of larvae of the three groups that are most important; the epinephelinae, unclassified lutjanids and vermillion snapper. This demonstrates that small larvae occur in our area.

If you look at the distribution of the unclassified lutjanid larvae sampled within the South Atlantic Bight (Figure 3), it is apparent that they are distributed throughout this area. The same general distribution pattern is found for grouper and vermillion snapper larvae. Two to 3 mm larvae are about three or four days post-spawning, considering the time for the egg to hatch and larvae to grow to this size. A rough average velocity for the Gulf Stream is about two knots (from Sverdrup, Johnson and Fleming); this is the velocity at the Florida Straits, not somewhat further north. We estimate that at this speed, larvae would drift about 200 nautical miles in four days. The north-south extent of the South Atlantic Bight from Cape Canaveral to Cape Fear is about 350 nautical miles. Thus, larvae in the northern end of our area probably were spawned within our area. It appears we have some spawning within the South Atlantic Bight and it seems that at least as a first approximation we can treat this as a unit stock rather than as an extended stock. We still have to decide the extent of inward drift of larvae from the Caribbean and Gulf of Mexico, and whether we have northward loss of larvae from our stocks.

Comments, Questions and Answers

C. I believe we must be very careful in use of the term and concept "unit

stock" in respect to the snapper-grouper resources. The "unit stock" concept as it is used in North Atlantic fisheries does not apply well to reef fishes in that we do not have a fairly large population of fishes generally occupying a large tract of ocean and existing, for practical purposes, in genetic isolation from other populations or unit stocks. Instead we must consider the snapper-grouper resources at two levels, that of the adult stocks and, at a genetic, or larval, level.

The "unit stocks" of adult fishes may be isolated groups of fishes which do not necessarily reproduce themselves and which are attached to individual reefs and rocks. So sedentary are these fishes believed to be, that individual groups may be managed successfully under different schemes (on a yield per recruit basis) even though they are isolated by only a few kilometers. On the other hand, from the genetic point of view, I venture there is but one western Atlantic unit stock for each of many reef species. Given that most species have pelagic larvae and given the existence of the Gulf Stream, and various gyres and countercurrents, etc. it seems likely that there is relatively free genetic exchange between many small population units in the Caribbean, Gulf and South Atlantic area. Moreover, the same currents responsible for this exchange may, at least in some years, completely dissipate larvae from a local spawning site replacing them with larvae from elsewhere. Consequently, the determination that we have spawning populations of reef fishes off the South Atlantic states does not necessarily mean that we have unit stocks of those species here.

- C. I should have been more conservative in describing what conditions may be here. I do think you're quite right, that we do have incoming larval drift from south of here, and I'm sure we have larval loss from our population to the north; but I think preliminary information indicates that there is probably some retention of larvae within our area. There are good hydrographic mechanisms for keeping some larvae within the area. I think we need to design a sampling program to examine what's coming into the area and what's going out to determine the extent of ingress and egress of larvae. Your point is well taken.

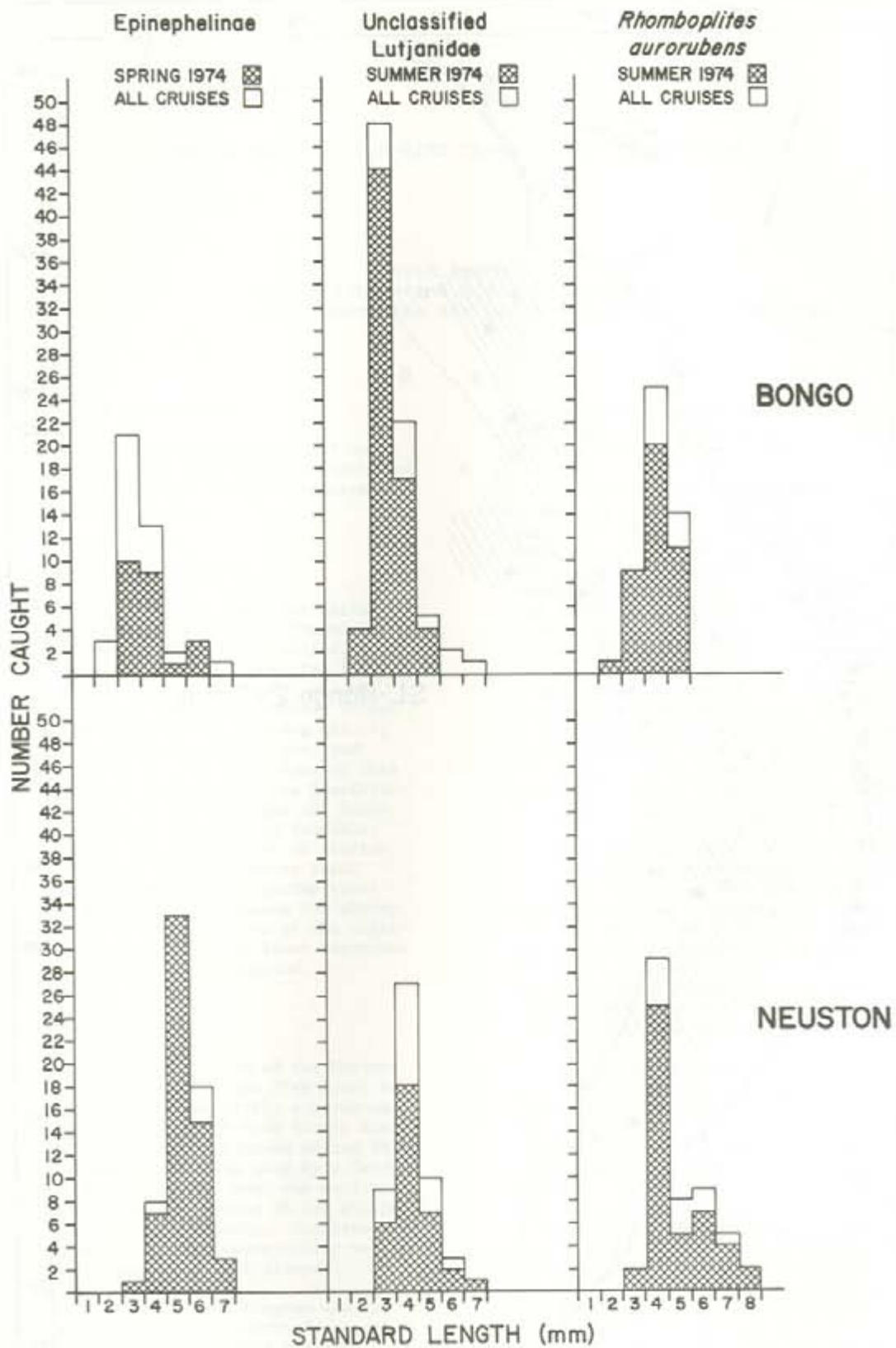


FIGURE 2. Size distributions of larvae of groupers (*Epinephelinae*), snappers (*Lutjanidae*) and vermilion snappers (*Rhomboplites aurorubens*) in the South Atlantic Bight.

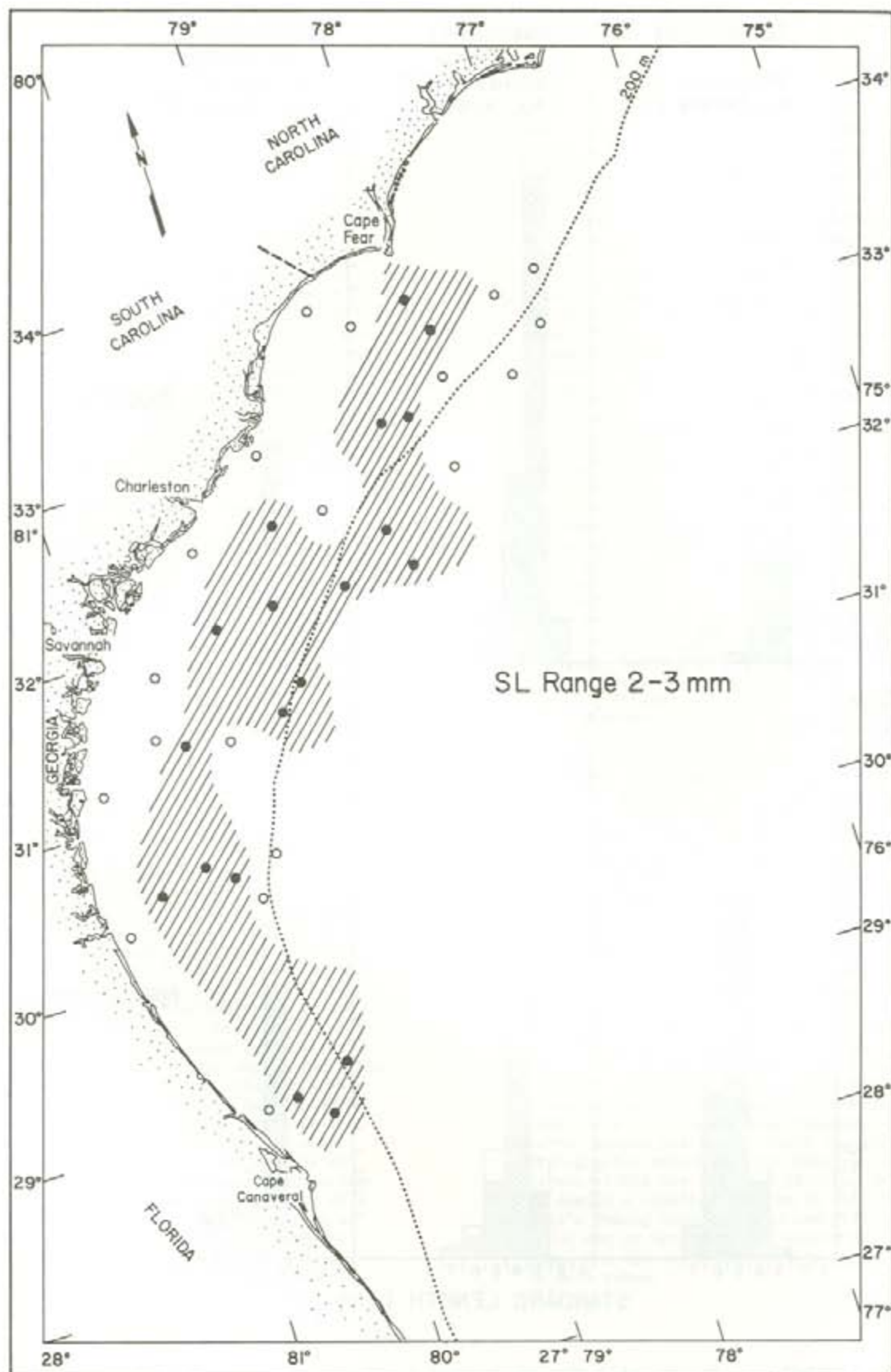


FIGURE 3. Distributions of smallest larvae of snappers (other than vermilion snapper) in the South Atlantic Bight, summer, 1974.

USE OF THE URI HIGH-RISE TRAWL OFF SOUTH CAROLINA

David Smith
Sea Grant Marine Advisory Program
South Carolina Sea Grant Program

Objective(s) of the Activity

To determine the feasibility of using the URI high-rise trawl off South Carolina to fish for demersal finfish resources on "live-bottom" areas.

Brief Description of Activity

The South Carolina Sea Grant Marine Advisory Program purchased a URI 60/80 high-rise trawl which was provided, on a loan basis, to a local commercial fisherman. In return for the use of the net, the commercial fisherman provided information on areas fished, fishing effort, composition and size of catches, and operating costs. The objectives of this activity were to determine the feasibility of using this type of gear off South Carolina and, if found to be feasible, to encourage the development of finfish trawl fishery. Such a fishery could support components of the shrimp trawl fishery during the off-season for shrimp, thereby utilizing a portion of the significant latent capital and labor resources which exist during this period.

Presentation

Prior to the introduction of the University of Rhode Island high-rise fish trawl in South Carolina, there was little experience with and very little use of fish trawls here before 1973. There was a program during 1974 in which a Yankee 36 net was used by a Georgetown shrimp trawler. This boat was outfitted with a net reel and the Yankee 36 net equipped with "cookie" type rollers. Unfortunately, it never caught very many commercially valuable fish including snapper or grouper.

Last year the Sea Grant Program was approached by a group of Charleston fishermen who were interested in trawling for fish. These fishermen came to us seeking advice as to what type of gear might be better than the Yankee net. We were aware of work being done at the University of Rhode Island, primarily by Bert Hillier, in development of a high-rise trawl which has a greater vertical opening than the standard Yankee net. We con-

tacted Bert and, after talking with local fishermen, Bert modified his net somewhat for our conditions and boats.

Sea Grant purchased a URI60/80 net and loaned it to a Sham Creek fisherman. This particular net had a 60 foot headrope, 80 foot sweep and 8 inch mesh in the wings dropping down to a 3 inch mesh in the bag. The twine was 42 thread except for 36 thread in the 3 inch mesh sections. The sweep on the purchased net used 6 inch "cookies" - rubber discs punched out of truck tires - and was strung on 1/2 inch steel wire and 3/8 inch chain. The net came with standard 7"x42" Westerbeke bracket hung doors. That was quite a heavy rig. The doors weighed 750 pounds each and the nets around 1000 pounds. The Sea Grant net was fished from the 65 foot trawler "Dixiana" powered by a V-12-71 G.M. on a 5.16 to 1 gear.

When we rigged the boat, one of the main considerations was to see if we could convert a shrimp trawler to fish trawling with minimum modifications. Rather than using gallows the boat was rigged with a heavy towing block on the port outrigger just inboard of the try-net block. Extra stays were added to take the increased strain from the fish net. While this may not have been the ideal rig, it was simple and it did work.

The net was fished with 20 foot bridles and 20 foot leg lines which were attached directly to the doors shrimper style, and this was somewhat different from the way Hillier designed the net to be used. Bert recommended 20 fathom leg lines based on his modeling of the net and was predicting 20 feet of vertical opening with the long leg lines. In New England they use the Danleno rig in which they hook wings to bridles and then to leg lines which are attached to doors by means of a backstrap. Shrimpers hook up the fish trawl the same way they do shrimp nets and put the leg line from the head rope to the top of the door and the one from the sweep to the bottom of the door. As you can see this will give you more head rope height with much shorter guard cables.

The fisherman using the URI high-rise trawl had a great deal of experience hand lining and pot fishing before he tried trawl-

ing and a lot of knowledge of offshore fishing grounds. When the fathometer indicated numerous fish, a buoy would be thrown over and a drag made around it. The best towing speed for the vessel was 1450 RPM. Most of the tows made earlier in the season were one half hour. Toward the end of the season he increased this to an hour.

When the net was hauled aboard at the end of the drag, the doors were pulled up to the towing block. The lazy line was used to pull the bag alongside the boat the same as in shrimping. The URI net was equipped with a splitting strap, but about the only time it was needed was with one 40 box drag.

There was one thing apparent with fish trawling offshore that was quite different from shrimping. When a shrimper goes out, he is going on a day trip and is very close to the dock. If something breaks or gets fouled in the gear, the shrimper can just come back to the dock, get on the telephone and have someone repair the net. Trawling offshore is a different matter. If a cable pops or something, the fisherman has to splice it himself or repair his nets at sea. Our captains and crews must learn these skills if they are going to be successful offshore dragger captains. We have observed that the shrimpers that are going into fish trawling are the most progressive captains who are more willing to learn new skills and do those tasks which shrimpers traditionally have not done. In fish trawling you find that hanging up and tearing the net are the rule rather than the exception.

What makes it all worthwhile is what comes across the back deck. Last year the "Dixiana" in 17 days away from the dock, caught about 35,000 pounds of marketable fish, of which approximately 30% were red snapper, 25% vermilion snapper, and 15% groupers.

In a typical drag there was very little trash and almost no bottom growth. Occasionally a large loggerhead sponge would be brought aboard. Most dragging was done during daylight hours with little success at night. At sunset and sunrise one or two drags could be made that would yield predominately vermilions.

Fishing this year has been hampered by poor weather and boats have gotten off to a slow start. Last year we had several 100 box trips and 110 boxes on a two day trip. This year I don't think anyone has gotten 100 boxes on a trip. Most trips this year have been 30-35 boxes.

This year, as a result of the success of the initial vessel, we have 11 boats which have high-rise nets. Of these, one is the net which belongs to the Sea Grant Program which we've loaned to a Beaufort

boat to try there. The other nets were made locally either in Charleston or Beaufort. Fishermen themselves are investing money and effort to get nets built. It's about \$2,500 for a net. A local shop in Charleston is making the doors, copying those from New England. As more people enter the fishery, new ways of rigging are being developed. In some fishing operations, both doors are towed from one outrigger and one block. Now some boats are pulling both doors from one outrigger with two towing blocks using two tow wires and both drums on the winch. Also, some boats are pulling one door from each outrigger and using two wires. There are several boats that are rigged like old single rig boats, going from the winch to a towing block on the outrigger and then back to either a chain or what the shrimpers call a roll bar - a structure on the back that goes across the stern of the boat from which they tow.

One problem has been maneuvering the boat once it gets on the grounds. There is a very small area in which one can fish. Pulling nets from one outrigger has not been as much of a maneuvering problem as it seemed at first because boats are almost constantly in a turn the whole time they are dragging because they fish in very, very small areas.

Another problem that the fishermen have had was that the bracket door tended to snag in areas of rough bottom. In fact, the doors have been hanging up even more than the belly of the net or the sweep. The Chinese Vee door may solve this problem. We purchased a set of these doors which have been used in North Carolina. The Chinese Vee door comes to a 15 degree angle which helps it to deflect obstacles. There is a semicircular brail instead of a bracket which is hinged to tow from. The brail tends to deflect and is not as apt to be caught on the bottom as the standard New England bracket door. While spreading of the net with Vee doors is not as great as that with the flat bracket door, I think it is probably going to work better for our bottom due to the fact that it can fish a much rougher bottom. You are not as likely to get caught. Now we have a boat that is using our URI net and is fishing alongside another boat which is using his net but our Vee doors. Already a couple of Charleston boats have built Vee doors using our plans.

Another thing fishermen have gone to, are big rollers instead of cookies. In this area, we've been calling nets with little rubber disc roller nets, but true rollers are about 24 inches in diameter. The ones we're using now are 24 inch rollers. Rollers on the wings of the net are cone shaped rather than cylindrical. We found that we can drag a much harder bottom with these rollers, bottoms that couldn't have been trawled last year without hanging or really tugging. One can go right over it with these rollers. Thus, I expect

as time progresses, boats that do stay in the snapper/grouper fishery will probably go to rollers of one sort or another. Some people in Charleston have fabricated home made rollers out of big pieces of oak that work better than nothing. Manufactured rollers cost about \$34.00 each, which are quite expensive.

A major problem for fishermen is marketing. When fishermen come in, they must unload and pack fish themselves. Also, fishing time is limited in the winter due to weather. Finally, most fish are put on consignment to New York and it may be 10 days to 2 weeks before they know the price they're going to receive.

Comments, Questions and Answers

Q. Are trawl caught fish graded or sorted by species before being placed in the ice hold of the vessel?

A. No, the catch is usually sorted and prepared for shipping after it has been unloaded.

Q. Are small red snapper and vermilion snapper culled and thrown overboard?

A. Generally they aren't and in fact, I know of at least one time this year when small vermilion snappers were bringing a very good price.

Q. What is the general condition of trawl caught fish?

A. They are usually in very good condition.

Q. Very good relative to living or relative to being eaten?

A. Relative to being eaten.

Q. Are there many discards during the trawling operation?

A. No, there are very few fish thrown back overboard. Of the boats fishing last year, most fish caught were marketable. There were very few under-size fish and very few non-market species.

Q. Are fish going primarily to the New York market?

A. Primarily.

Q. And in what form are they going? Are they dressed or shipped in the round?

A. Generally only grouper and large snapper are eviscerated.

Q. Are there any indications that roller trawls are damaging "live-bottom" areas?

A. The only indications that I have are what they bring up in bottom growth. The catches usually contain very little bottom growth but I have no way of definitely assessing what the damages are, if any.

Publications Resulting from Activity

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BOTTOMFISH RESEARCH AT BEAUFORT, N. C. LABORATORY, 1972-1977

Gene R. Huntsman
Beaufort Laboratory
Southeast Fisheries Center
National Marine Fisheries Service, NOAA

Objective(s) of the Activity

To investigate the fishes and fisheries of the subtropical outer continental shelf of the South Atlantic Bight to determine the ultimate productivity of resident stocks.

Brief Description of Activity

Our research program which operated in North and South Carolina from 1972 through 1975 and was extended to include Georgia and Florida in 1976, consists of three major activities.

- 1) Monitoring of catch and effort in the headboat fishery.
- 2) Description of life histories and population dynamics of fish species important to the fishery. Utilizing a catch sampling program that collects data on about 9500 individual fish annually (10,000 in 1975; 9,000 in 1976), we have completed studies of foods, reproduction, age and growth, mortality, and/or have constructed yield per recruit models for red porgy, vermilion snapper, gag, red snapper and white grunt.
- 3) Measurement of standing stocks of fishes on a selected reef. We are conducting studies of reef fish biomass on a reef 35 miles SSE of Beaufort, N. C., through both visual assessment by divers and by mark-recapture techniques in order to guide future studies of standing stocks in the entire South Atlantic Bight. Additionally, our diving studies furnish valuable information on the ecology of these northernmost tropical reefs.

Presentation

In response to increasing interest in marine recreational fisheries and to awareness of our ignorance of demersal fish resources of the South Atlantic Bight (Cape Hatteras to Cape Canaveral), the Beaufort Laboratory of the Southeast Fisheries Center, National Marine Fisheries Service, in

January 1972 began a study of the headboat fishery of the South Atlantic Bight. Despite the original recreational orientation of the study, it has evolved into a comprehensive examination of the snapper-grouper resource of the South Atlantic Bight with implications for management of reef fisheries throughout the tropical western Atlantic.

Our research program contains three sub-programs: 1) a headboat survey; 2) life history studies; and 3) population and community ecology studies.

The headboat survey involves measurement of catch and effort of all headboats in the South Atlantic Bight. Reasoning that headboats represented the principal fishery on snapper-grouper stocks off the South Atlantic states, we instituted the survey to determine the magnitude and species composition of the catch, and to establish a series of annual catch per unit effort measurements to be used as an index of stock abundance. The survey covered only North Carolina and South Carolina in 1972, 1973, 1974, and 1975 but was extended to include Georgia and the coast of Florida north of Cape Canaveral in 1976.

Our measurement procedure has two phases. First, we have a member of the crew from each vessel maintain a daily record of the catch, by number of each species, number of anglers, and location of fishing. Second, port samplers weigh and measure fish during vessel unloadings to provide information on the mean size of fish caught. Multiplying the number of each species caught by the mean weight per species estimates the weight caught of each species. These catches by species are presented by time and area strata along with summaries of effort expressed in angler days.

While the headboat fishery is probably the most important snapper-grouper fishery over the entire Bight, considerable participation by private vessels in Florida, and an increase in commercial fishing in the late 1970's indicate the need for expansion of survey efforts to maintain useful information on changes in fish stock sizes, in fishing success and in their probable causes.

Even though the fish species that support the South Atlantic Bight headboat fishery have supported indigenous native fisheries for cen-

turies throughout the Caribbean region, and in the United States, and have sustained an important commercial fishery for nearly a century, we had reasonably complete life history information for only two of the thirty or more fishes important in catches. We have undertaken a series of life history studies of those fishes important to the headboat fishery. Taking species in approximate order in which they are important (by weight caught), we are attempting first to determine those life history parameters requisite to management of the fishery, such as growth rates, mortality rates, and reproductive characteristics. Secondarily, we have conducted studies of foods when we were able. To this date we have conducted life history research on red porgy, *Pagrus auratus*; vermilion snapper, *Rhomboplites aurorubens*; white grunt, *Haemulon plumieri*; gag, *Mycteroperca microlophus*; tomtate, *Haemulon aurolineatum*; and gray tilefish, *Caulolatilus microps*. Currently research is underway on speckled hind, *Epinephelus drummondhayi*; and snowy grouper, *E. niveus*.

Materials for life history studies are collected from all major species in the headboat fishery by port samplers, and substantial collections are available for future study. The scamp, *Mycteroperca phenax*, and the whitebone porgy, *Calamia leucosteus*, are candidates for study in the immediate future.

The third facet of our research is an attempt to understand the sizes, structure and movements of reef fish populations. From 1972 through mid-1975 we tagged fish extensively from Cape Hatteras to Savannah, releasing about 5,000 tags in a search for gross estimates of population movements and sizes. The effort was, in general, unsuccessful because of a very low return rate resulting from tag loss and relatively low exploitation rates on sites where we tagged. We adjudged that we did not have the resources to conduct extensive tagging programs successfully, and that our efforts would best be expended in an intensive study of a well defined site. Accordingly we chose a reef area, the "210 rock" 28 miles SSE of Beaufort Inlet in Onslow Bay and began simultaneous tagging experiments and visual transect estimations in order to estimate seasonal populations of these reefs. This work begun in September 1975, has been successful. Tag return rates are sufficiently high for use, and our bi-weekly diving transects are offering new insights into behavior of reef fish populations.

A final portion of our research is the synthesis of results of our and other's research into a management philosophy for reef fishes (the snapper-grouper complex). Using yield per recruit models, we have

estimated a preliminary maximum sustained yield for reef fishes of the South Atlantic Bight and presented the consequences of some alternate management schemes.

Publications Resulting from Activity

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FISH TRAWLING ACTIVITIES OFF THE GEORGIA COAST, 1976 and 1977

Danny Smith
and
Jack B. Rivers
Marine Extension Service
University of Georgia

Objective(s) of the Activity

Development of Finfishery

Brief Description of Activity

Combined efforts with commercial fishermen, using our vessel and theirs, to locate fish stocks, delineate grounds and test various types of nets, and equipment, to determine if the finfishery is economically feasible. Acquire biological data to determine if fish stocks can take fishing pressure.

Presentation

I will discuss the role which the University of Georgia Marine Extension Service is taking in finfishing activities off the Georgia coast. Our effort to develop a finfishing program in Georgia is part of a joint activity between the University of Georgia and commercial fishermen. We have committed ourselves to the project at the request of commercial fishermen for obvious reasons. Georgia's historical fishery is based around a six months operation, the shrimping industry. Consequently, boat owners and boat captains receive an income only over a six-month period. In order to expand this operation during the off-season, boats must travel south during the winter or enter other local fisheries. The alternative is to remain idle.

After several years of trapping, hook and line fishing, and trawling, the potential for offshore commercial fishing looks very promising.

Last year, a number of local fishermen from Sunbury, Georgia with no previous offshore experience, asked for assistance in rigging shrimp vessels for trawling offshore. Also, they needed help in locating and maintaining productive fishing grounds which could be trawled with a minimum of gear loss. We, and I refer to we as the University of Georgia, began fishing operations with one commercial fisherman. Now, there are several boats fishing off the Georgia coast suc-

cessfully. Interest was heightened because of good catches by the initial vessel. The best one day catch by this vessel was 5,000 pounds, which brought an average of 62¢ per pound. In 1976, the total landing of fish was 130,000 pounds, which brought an average of 65¢ per pound. The average catch was 4,400 pounds, with length of trips averaging 1.7 days.

The success of the new fishery was overshadowed somewhat, however, by the enormous expense of gear loss. Also, it was difficult to locate fish. Local fishermen requested assistance to overcome both problems.

I would like to discuss the trends of our current studies. We really do not have enough information or enough data to show anything definite at present. However, we do have some data on species composition of catches.

The predominant species along the two hundred foot contour is pink porgy. The numbers available to trawling are highly variable during the months of January and February. Trawl catches can exceed three thousand pounds per hour, predominantly pink porgy. Hook and line catches seem to be more consistent. Present data indicate catch rates of about thirty pounds per man/hour for hook and line catches. Again, catches consist mainly of pink porgy. Data also indicate that in terms of weight, half of the hook and line catches consist of grouper and snapper. In terms of numbers though, 80 percent of the catch consists of pink porgy. The mean size of pink porgy caught with hook and line is 33 cm standard length (SL). The mean size of pink porgy caught in trawl catches is about 23 cm SL. This is due to the fact that the trawl catches have a considerable number of unmarketable size pink porgy. We have not collected enough data on other species to present any information on sizes caught for these species.

Most trawling activities have been on areas of hard, "live bottom" (Figure 1). The highest rates of success with our trawling activities have been in depths of 35 to 40 fathoms. Vessels currently operating in this fishery range between 50 and 60 feet. Some are wooden hulled while the rest are fiberglass.

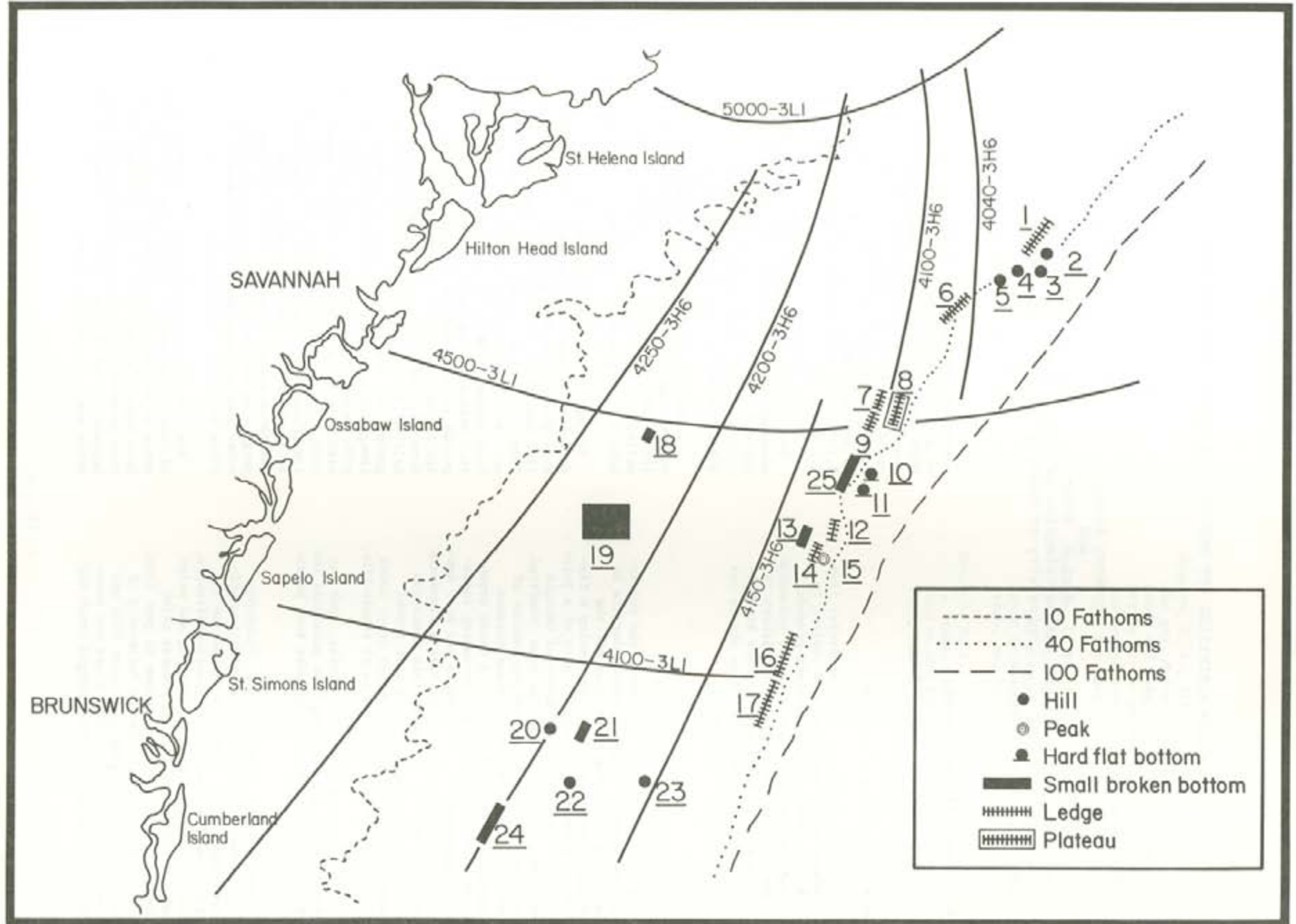


FIGURE I. Areas off the coasts of Georgia and South Carolina where the University of Georgia Marine Extension Service has been conducting exploratory fishing operations.

We are using conventional shrimp doors now, but what we're trying to do, is convert existing shrimp boats with a minimum amount of expense, so that fishermen can use their vessels without having to make major and expensive modifications. Apparently, we're not using nearly as many floats as South Carolina fishermen because we use different rollers. We use plastic mud rollers which aren't nearly as heavy as rubber or wood rollers being used by South Carolina fishermen. Consequently, the entire trawl is lighter and doesn't require as many floats. The greater number of floats used by the South Carolina fishermen may provide a larger vertical net opening which may account for larger number of snappers and groupers caught in their nets. This will be examined in future operations. We have a flapper in the net to keep fish from leaving the net. It's a funnel on top and bottom to let fish down the mouth of the net where they can't return to the top of the net. The net is also equipped with chafing gear to protect the bag from rough bottom and sharks.

We have been relatively successful with the gear which we are now using, but better and more expensive gear is needed to produce a constant marketable catch.

One of the toughest jobs we will have in developing the finfish fishery will be to get the dye-in-the-wool shrimper offshore. And how do we get competent and reliable people on the deck and in the pilothouses of the boats? You know, once you lose sight of land and prominent landmarks on the beach as navigational aides, you lose a certain feeling of security. Dave Harrington once made a memorable quote that I would like to repeat: "If one cuts down six pine trees and relocated three water towers and two motels and one bridge, one would immobilize the entire Georgia shrimp fleet". As the fisherman moves offshore, he's going to become more and more dependent upon electronic devices. He needs a LORAN for positioning in navigation and to provide him with the capability to return to productive fishing areas. He will need machines that have fish finding abilities. He may need sophisticated gear like sonar where he can see fish on the scope and track them into the net. For safety's sake, VHF radio, single side band and radar are required. All electronic equipment is quite expensive.

The stern trawler is probably the safest and most practical way to go in our area. One of the best stern trawling system utilizes a gallow on each quarter, net reel and ramp and hydraulic power. In addition, it incorporates a split winch system which provides a wire for each door so that if you have trouble, you do not lose the entire rig.

Another type of system utilizes the "yo-yo" rig that Dave Smith was talking about earlier. As you slack the net and bridles into the water it pulls the wire off the trynet drum and spools it onto the net reel. When it's time to retrieve the trawl, you take in on the trynet and it powers the net and bridle on the net reel. It's a less expensive system that lacks the fine control you'd enjoy with hydraulics.

A third type of system involves the use of quarter ropes. Here wings of the trawl are brought to each side of the boat. The quarter ropes pucker the belly section and bring belly rollers on the stern. The lazyline brings the bag over the stern for dumping. Some boats do not use quarter ropes. Instead, they whip the wings to the side and out of the way, then bring the bag over the stern and dump it on deck. One disadvantage is that the gear stays in the water and you don't know whether or not the net is torn. It's hard to use a rig which requires a visual check of the condition of your gear after each tow.

Another method involves bringing gear to the stern of the boat, but the bag is pulled around the side exactly the same way shrimpers do it. The side of the boat in the area of the gallow is sheathed with steel and wood in some cases which protects the hull against wear and tear of heavy bracket doors.

The trawling system they use off the Georgia coast is like playing Russian Roulette. You put 3 to 4 thousand dollars worth of fishing gear on a bridle and tow it on a single warp, usually one-half inch or seven sixteenths inches. It's light, quick and easy to handle like old single rig shrimp trawls, but if you part the single warp you lose the entire rig.

Fishermen must sever their dependency on commercial net shops for repairs and learn to repair at sea. Over 90% of all net work, either building or repairs, is done by a commercial net shop or a "shade-tree" netmaker.

Shrimp trawls are the simplest nets to construct. Netting is hung directly to framing lines without any additional supporting lines. Fish trawls are more complicated. The net is hung to a fishing line which supports heavy rollers in the bosom and "cookies" out on the wings. One completed trawl with associated gear requires over 40 handmade wire splices. At 8 dollars (\$8.00) per splice, you can see how much a fisherman can save once he learns how to splice. So for a successful operation the fishermen must learn to mend their gear on deck in port or at sea.

Another type of rig is the "zipper-rig" which is common to the New England area. The trawl has a rounded sweep for use on smooth bottom. Rollers can be attached quickly by lacing a chain alternately through a ring on the sweep and a hanger chain. Rollers can be attached or detached when moving from one type of bottom to another.

Georgia boats in the finfish fishery are using a real light rig for fishing around rough and broken bottom. Instead of "cookies" they lace a light three-sixteenth inch chain through plastic mud rollers spaced with PVC pipe and use it like a "Texas-tickler". A disadvantage with this is that with the first solid hang the chain stretches and rollers fall behind the headline, thus losing their efficiency.

Boats will have to go to heavier trawls and trawling gear and change their techniques. In addition, they will have to change from the standard shrimp chain door to either the heavier more durable bracket door or the steel V-shaped door as Dave Smith pointed out.

I don't think we will have to spend money developing gear at this point because we have our fishing cousins up North who are about 50 years ahead of us in fish trawling business. All we have to do is decide which fishing gear and technique is best suited for our purpose. Thus, most of our effort should be spent in teaching fishermen how to mend nets and maintain fishing gear.

Comments, Questions and Answers

Q. I was interested in one of your slides which showed a 5,000 pound drag. What depth of water was that in?

A. About 210 feet.

Q. What's the maximum relief you can work with a trawl? There must come a point at which some bottom is untrawlable, but how much vertical lift can you jump with those rollers?

A. Well, I've seen areas where on the depth recording machine you probably see just a small rise of say two or three feet and your door would get caught or you may have these long sweeps that could get caught on a lump. I've seen times when we've had 5 or 6 feet of relief yet we have gone right over it without a hang. It's hard to say whether a 14 inch roller is going to go over 6 feet or 6 inches. It's a hard question to

answer. It all depends on the type of bottom.

Q. Would you consider the shelf break habit trawlable? I really don't know what it looks like off Georgia, but is this area trawlable in any way with any gear?

A. Sharp breaks and peaks are what we have to avoid. Maybe some day they'll develop something like a one-boat mid-water trawler.

Q. Has Sea Grant already, or do they have any intentions of trying to video tape the action of this net as it's going over rough bottom in order to get a handle on what's happening in terms of discrepancies between your hook and line results and trawling results?

A. No, we don't have any plans.

C. We're getting Bob Taber from the University of Rhode Island to come down to South Carolina next month with his video tape and we're going to be looking at actions of URI nets.

C. There are movies available which show roller nets fishing on the bottom, but they were taken on smooth bottom and at slow trawling speeds.

Q. Does this film present any behavioral information in terms of fish reactions to the nets?

A. No, the only live fish in the film is a single flounder and a small skate.

MARINE REEF INVESTIGATIONS IN GEORGIA

C. Duane Harris
Coastal Fisheries Section
Georgia Department of Natural Resources

Objective(s) of the Activity

To obtain species composition, distribution, abundance, and migration data for fisheries resources inhabiting artificial and natural reefs in Georgia's offshore waters, and to gather catch composition and angler pressure data for the same.

Brief Description of Activity

Five artificial reefs ranging from 8 to 23 miles offshore and one natural live bottom area located 16 miles offshore have been the subjects of research studies during the past 3 years.

Data relating to species composition, abundance, and migration have been obtained using mark and recovery experiments. Additional species composition, abundance and distribution data have been collected by visual methods using SCUBA.

Recently a Creel Survey has been implemented using two creel clerks to interview fishermen returning from offshore waters to gather data related to catch size, and angler origin. Also, twice weekly counts of fishing boats utilizing selected artificial and natural reefs are made using aerial observation.

Presentation

Since the beginning of offshore artificial reef construction in Georgia about 5 years ago, fishery research has been conducted by scientists associated with the Artificial Reef Program along the length of the Georgia coast in an area from 8-23 miles offshore.

Five artificial reefs, composed of 15,000 units (each made up of 8 tires) and five vessels, and one natural area called the Sapelo Live Bottom have been the subjects of these studies. These artificial reefs are located in depths ranging from 6-12 fathoms.

Three studies have generated data on fishery resources in the study area. Two of these, a migration study and a standing stock study utilize mark and recapture methods. The third, a fishery resource assessment study is conducted using SCUBA to make visual counts.

From November 1974 to the present, 2,414 fish representing 15 species have been tagged and 521 tags have been returned for a return rate of 21.6%. Over 80% of fish we have caught using hook and line and tagged have been black sea bass and about 95% of recaptures have been black sea bass. Less than 0.3% of fish recaptured were caught at locations other than reefs where they were tagged. One recaptured black sea bass was out for 307 days, but the average was 55 days.

Sixty-seven fishery resource assessment dives have been made since August 1973. Most of this work has been concentrated in waters surrounding reefs which are at least 16 miles offshore since very turbid conditions usually exist on the two nearshore reefs.

Grouper weighing up to 5 pounds have frequently been observed on tire units. At times, grouper weighing 1 pound or less have been noted in abundance on tire units. Larger grouper, up to 30 pounds, have been noted on most dives on vessels, but the only place large grouper have been observed consistently and in large numbers has been on a terraced ledge, providing about 10 feet of relief on the Sapelo Live Bottom.

Red snapper have been observed on all reefs, but have been seen in abundance (25 or more fish) only on vessels and live bottom. Those observed on vessels are usually larger than those found on tires, but the largest (15-20 pounds) have been seen consistently only on the Sapelo Live Bottom.

Vermilion snapper have been observed in abundance on virtually every dive at reef "C" which is 23 miles offshore of Cumberland Island in 12 fathoms. Vermilion have rarely been sighted in the other study areas. Dog snapper, lane and gray snapper have been sighted occasionally on reefs.

Porgy have been observed on many dives, but are usually scarce. The only place they have been noted in abundance has been on the Sapelo Live Bottom and the largest observed was about 5 pounds.

Black sea bass have been observed in great abundance on most dives. They appear to prefer the lower profile tire units to vessels when tires are present. Three to four pounders are not uncommon.

The standing stock study began this fiscal year and while a fair amount of data have been collected, they have not been analyzed as yet.

On February 1 this year we began a combination creel survey/angler use study. We have employed two creel clerks who work 4 days a week (2 weekdays and 2 weekend days) interviewing offshore fishermen when they return from a day's fishing. Additionally, we are making twice weekly flights over all artificial reefs and the Sapelo Live Bottom. Hopefully, this study will generate much needed data regarding fishing pressure, catch composition and size, catch rates, fishermen origin, vessel size, etc.

As far as we know, very few commercial fishermen are fishing artificial reefs or the Sapelo Live Bottom. If they are, they are not returning tags they should be getting. Only one head boat operates out of Georgia and it appears to be simply a hobby for the owner. Therefore study areas I've been discussing seem to be subject to fishing pressure at this time mainly by private sport fishermen.

Georgia does have an active commercial fishery for bottomfish, however. Combined landings for snapper and grouper from 1966-1976 ranged from a high of 147,000 pounds in 1967 to a low of 26,000 pounds in 1969, with an annual average of 75,100 pounds. In 1976, combined landings of scup, porgy and sea bass were reported totaling 66,400 pounds.

Talks with commercial and sport fishermen as well as our few sightings indicate that the bulk of commercial fishing activity occurs in the area from about 40 miles offshore to the edge of the shelf. As I'm sure is the case with other states, landings reported are questionable with respect to actual numbers caught in Georgia waters since many, if not a majority, of vessels that fish these waters are transient. If this is the case, these numbers most likely represent an underestimate of fish caught in Georgia waters.

THE SOUTHEASTERN ATLANTIC SNAPPER/GROUPER
FISHERY - SOME RESEARCH UNDERWAY

J. E. Easley, Jr.
Department of Economics and Business
North Carolina State University

Objective(s) of the Activity

1. To profile the snapper/grouper fishery.
2. To survey bioeconomic models - applicability, data requirements, etc.

Brief Description of Activity

Collect and organize descriptive data; prepare annotated bibliography of previous studies related to the fishery; and survey existing bioeconomic models. The latter phase will attempt to identify data requirements, etc., associated with applying bioeconomic models. Some attention will be devoted to identifying modifications of models and data requirements for the snapper/grouper fishery, but will stop short of actually modeling the fishery.

Presentation

Future management of the snapper/grouper fishery under extended jurisdiction has been alluded to several times this morning. It is the common theme of this meeting. It is clear in achieving management goals that social and economic objectives as well as biological factors must be considered. The effects of management decisions must also be evaluated.

When incorporating economic issues into management decision making, we frequently hear reference to bioeconomic modeling. I suspect that we will see more of this under extended jurisdiction. This leads us into the project that I am involved in with the snapper/grouper fishery.

This project will not actually attempt to model the fishery per se, but will survey existing studies and data pertinent to the snapper/grouper fishery. A major element in this work will be to examine bioeconomic modeling that has already taken place.

Let me outline briefly the objectives of the study and then offer a few qualifying comments on each. The objectives are to:
1) profile the fishery as best we can from

information currently available; 2) prepare a bibliography of studies that have been reported; 3) survey bioeconomic models in the literature; and 4) compare existing data with those usually used in models and form some ideas as to additional data requirements for modeling.

Management plans will require a good bit of background, descriptive material. The first objective - the profile - will be aimed at assembling what is now available in different locations and forms. If time permits, we will attempt to examine product utilization channels. This could be helpful in estimating the value that might be attached to a predominantly sports fishery. We also need better information on commercial vessels operating in this fishery. Management plans may well face the problems of allocating stocks (or rights to fish stocks) between recreational and commercial fishermen. As you are aware, this is a complicated issue at best. Valuing the resource in a recreational fishery is complex because there is more being purchased than simply pounds of fish.

The second objective - the bibliography of existing studies - is for background information and will not require further discussion. The third objective - surveying existing bioeconomic models - is perhaps the most important one. A great deal of knowledge and data are required before modeling a given fishery. Included in the pool of required knowledge are important biological and economic relationships. Given these, we still need to know how to put these into equations, which parameters are most important, etc. We need a good bit of information on what types of models have been developed and which ones produce reasonable predictions. An understanding of models will also aid in identifying needed data. Hence, I view the third objective as an important one. We want to take a hard look at those models which have been constructed and the data used. We can then begin to formulate ideas as to where we need to go in terms of future modeling of this fishery (the final objective).

Some unique problems that may be encountered with managing this fishery stem from the presence of both recreational and commercial participants. We may have currently (or possibly evolving) what looks like a two-tiered commercial fishery: the hand line and the developing trawl fishery. And we must add to these existing recreational effort. What then does management maximize? Units of effort from different vessels may not be comparable. If we postulated a management objective of maximizing net economic yield, we might eventually have only one type of vessel in the fishery. The point of this discussion is that we may not be able to directly compare costs per pound harvested (or per unit effort) in recreational fleets with commercial fleets because expected output or results of that effort may not be identical. Hence, in modeling we need to account for these differences. Add to these problems the many species in the fishery with different growth characteristics as has been discussed earlier and indeed modeling becomes difficult.

This project will not answer all the questions. What it will do is hopefully, lay the ground work for getting into more complicated issues, and perhaps point out some meaningful directions.

Comments, Questions and Answers

Q. Are you also considering other services and businesses that are associated with both recreational and commercial fisheries in the socioeconomic survey that you have described?

A. I do not know how much time we will have to actually survey existing boats and firms to the extent that they may have already been surveyed in some states, or to the extent that they might eventually have to be. One of the main things we are doing is trying to identify where data are, the kinds of studies that have been done, what is contained in them and what the conclusions are. We may not have time to incorporate vessel-level surveying into the project. However, some vessel-specific information is currently available. Field officials and state agencies can probably already identify where most vessels are located, sizes, types of gear, etc. This we do hope to summarize.

REPORTS OF SECTIONAL MEETINGS ON INFORMATION NEEDS RELATIVE TO THE
FUTURE MANAGEMENT AND DEVELOPMENT OF THE SNAPPER/GROUPER RESOURCES
OF THE SOUTH ATLANTIC BIGHT

LIFE HISTORY AND ECOLOGY SECTIONAL MEETING

Chairman: Dr. Frederick A. Kalber, Director
Marine Laboratory
Florida Department of Natural Resources

Participants: William D. Anderson
T. J. Costello
Walter R. Courtenay, Jr.
Richard Dawson
Churchill Grimes
Norris Jeffrey
Richard Keiser, Jr.
Chris Koenig, Jr.
Charles Manooch
David Miller

Eugene Nakamura
R. O. Parker, Jr.
Howard Powles
Ed Richardson
William Rickards
Frank Schwartz
Larry Smith
Bruce Stender
Glenn Ulrich
Maury Wolff

Discussion

I'll admit, first, to some extension of our authority as a committee. Biologists don't find it easy to think of only one or two species groups at a time and this time was no exception. So we have a little bit to say about some other species or species groups that are associated naturally and regularly with snapper and grouper from Hatteras around to the northern Gulf, and I'll try to bring these into focus.

We found, not surprisingly, that grouper and snapper have a great deal of similarity in terms of ecological preferences, life histories, and so forth. Thus, we elected to put a general statement together that would apply for both groups of species and then make exceptions as necessary.

We started, as biologists are wont to do, with either the chicken or the egg, and went around life cycles considering problems and topics along the way. We began with larvae, took a look at larval characteristics of both groups, and decided that the literature and our experience shows that both are relatively long-lived in the plankton; grouper perhaps longer than snapper. Because of long life, larval distribution patterns are sometimes unusual and quixotic and require much more study. In any case, they, especially grouper, apparently metamorphose from plankton in shallow water and in some rather unique habitats with a timing that may depend on detection of suitable habitat.

We recommend, therefore, that a look be taken at long-term distributions of larvae together with hydrographic information available on computers or in literature, to conduct some very carefully designed hydrographic observations, especially dealing with current and drift patterns in the South Atlantic Bight and the Gulf. This will indicate what recruitment should occur theoretically, which can be compared to what actually happens. To do this, we must decide where we should look based on hydrographic features and sample accordingly.

In addition to this, short-term monitoring of larval distributions needs to be done on a scheduled basis over a time frame determined by what we know of seasonality of spawning. This should be started well before the spawning season and ended well after it, in order to obtain annual and regional recruitment estimates which might be used for year class estimations. Larval studies should also help to locate spawning areas. With this information, we can determine where spawning occurs in order to recommend to resource managers what should be done to preserve spawning locations so that brood stocks may remain adequate and healthy.

The taxonomists among us brought out an important issue which we've heard many times before. There is an urgent need for complete laboratory efforts to grow out larvae, perhaps in relatively simple systems, to identify grouper and snapper larvae in plank-

ton. Hopefully this can extend to eggs also; which is not quite so important because of the short incubation period in both species groups, but which will probably be important when spawning grounds are located. The major goal is to give plankton sorters a way to identify grouper and snapper larvae to genus and species.

We then considered postlarvae and juvenile stages where we thought it was necessary to first locate areas where postlarvae settle from the plankton, about which very little is known. Residence locations and residence periods of juveniles was discussed with emphasis on groupers. Their distributions over a wide range of inshore habitats in the Gulf and Caribbean, and offshore along the Carolinas, is related to ecological factors we don't understand. In both snappers and groupers we need to follow all stages of juveniles to understand and map their apparent tendencies to move off into reefs or deeper water areas as they age. There is a large void in information about the relationship of movements to age and growth; and particularly between settling and when they move off to occupy "young adult" sites. The taxonomists asked again for help in identification of juveniles. If biologists can raise eggs and larvae to identifiable stages, then juvenile keys can be constructed which would be extremely useful.

As young adults approach sexual maturity we find an important distinction between snappers and groupers. As I think you all know, groupers are protogynous hermaphrodites, a fact that probably delights supporters of ERA. They are ladies, or at least females, at birth, and some convert to males as development continues. There is considerable confusion about identification of sexes during or shortly after the transition period. We need improved use of histological methods for application to transitional gonad samples, and behavior and morphological observations after transition to make sex determinations precise.

Also, we need more thorough hydrographic and general environmental examinations at times and in areas where groupers undergo sexual metamorphosis. The literature, sparse as it is, suggests that there are many possible factors that trigger, control and influence metamorphosis. Factors that may affect this process could include proximity of adults, physical hydrographic features such as temperatures, or photoperiod. We just don't know.

Behavior and food selectivity were suggested as areas in which to spend some experimental time trying to determine whether there are habitat and food selectivity fac-

tors important to growth and development of juveniles and young adult groupers and snappers. If so, these will need detailed descriptions for the purpose of determining what sorts of environments should be maintained and encouraged to supply the type of housing and food or foods necessary to growth, maturation and welfare.

Age and growth studies were big features discussed for both species groups. Agreement was reached that growth is apparently rapid during the first three years of life and quite slow thereafter. We spent a good deal of time discussing the needs for technological improvements and standardization of data reporting in this area, especially where otoliths are used for the purpose of age determinations. This technique has a great deal of promise, and has been used effectively by those who have refined their procedures. Because many methods for otolith preparation are being used, some with no apparent success, it appears desirable to standardize methods for preservation and processing of otoliths as well as interpretation of otolith readings. Taxonomists also suggested that we might look to accessory characteristics, especially osteological ones such as fin spines, vertebrae and caudal bones, to support scale and otolith age estimates.

Fecundity has been examined for some species, but we feel that more should be done on a lower priority basis, especially in groupers.

There has been considerable work done in the past on movement and migration of both groups, particularly groupers. Many tagging studies have been only marginally successful, principally because of technical problems in developing and using the right sorts of tags. We spent a good deal of time talking about tag designs that might be suitable. Some new varieties are now available. What it came down to, in the feeling of the group, is that we should redo a substantial amount if not all the tagging work that's been done with groupers.

Tagging has indicated after groupers establish an adult niche on a reef or hard bottom they seldom move except for short spawning migrations. We'd like to see that conclusion re-examined.

We also considered rates of adult population development on reefs in terms of colonization, the stability of colonies, and what regulates the degree of stability we find. What kinds of ecological features, physical and otherwise, cause a single species or a multi-species community to persist in established territories on reefs, and what does it take to unseat them? We

just don't know. Past behavioral work suggests that there are a great many subtle ecological factors that need to be examined. We see a way to get this information by increasing quantity and quality of underwater observations and supplementing them with laboratory experiences. Large tank observations probably will not be suitable for this purpose, for reasons that I think are obvious.

We also discussed artificial vs. natural reefs for both groups. A good deal of work has been done in some places on rates of colonization of artificial reefs including top level predators such as snappers and groupers, and the outlook is favorable if the reef is properly sited and constructed. Thus in many areas in the Caribbean, in the eastern Gulf and in the South Atlantic Bight, it appears that the same kinds of populations of both species groups build up on some kinds of artificial reefs as one finds on immediately adjacent natural reefs. There is, therefore, promise for expanding the standing crop on such reefs, certainly for sports purposes. We recommend that we get as much of this information as possible with the idea in mind of projecting such pilot studies into construction of large scale, and very large scale, offshore reefs that might be suitable for commercial purposes in both species groups providing this is economically feasible.

We suggest that habitat surveys, especially for snapper, be conducted by transects from inshore outward, because there are indications that there are tightly formed, narrowly-bounded species populations or multi-species communities, as one goes from the beach into deep and very deep water. If such territories are real, what determines their establishment, what's necessary to maintain them, and how important are they to the regional standing crop? We just don't know. Certainly, we must learn more about them in order to make forecasts of their value to the fishery.

There are also indications of the formation of snapper spawning schools, which many groupers do not seem to do. We feel it important to learn what causes formation of schools in order to be able to predict what sorts of conditions should be maintained to sustain this behavior. Also, how do aggregations relate to potential overfishing because of vulnerability to gear during spawning periods.

Toxicity came up during the discussion. There was general consensus that louder and more frequent calls for information about offshore and nearshore man-made environmental modifications, such as runoff, were just around the corner for most of us. We feel, therefore, that acute and chronic toxicity studies with drilling muds and other sub-

stances likely to impact the environment should be done on larvae and juveniles in particular because early life history stages are usually more sensitive than adults in most organisms.

We developed a priority listing of those species of both groups by region that we would suggest be examined initially because they are more prominent in the market and also in the sports fishery. We put our rating system together and came up, for grouper, with gag, scamp, speckled hind, and snowy in that order of priority as the most prominent species from Hatteras to Cape Canaveral or a little more southerly in Florida. From there through the subtropical transition around South Florida and the Keys, red and Nassau grouper take over in prominence in that order. We feel that people in the southeastern Gulf and from there north should look at red grouper, gag and snowy because catch statistics seem to indicate that rank of prominence. For snapper it seemed to us that vermilion and red snapper are the most popular recreationally and on dinner plates from the Carolinas to mid-Atlantic Florida, with silky (yellow) and black fin following third and fourth. Again, going around and through the Keys, yellow eye, red and mahogany snappers seem to be the most popular to and into the southeastern Gulf. Toward the central and northern Gulf, red, silky and vermilion provide the largest catches in most years.

Then we considered, as I mentioned first, what we call associated fishes; those that are commonly found with both grouper and snapper. These may represent fisheries that are lightly exploited. We also feel they are worth examining more thoroughly because we may be able to learn more about snappers and groupers by investigations of the ecology and life history of associated species.

We talked about sparids, notably porgies, which in North Carolina for instance, often represent 40 percent of the catch by weight. Larvae of these animals drew our attention because they have an apparent peculiarity of moving up and down in the water column as they develop. In early life they are pelagic and then seem to move deeper and may return to the epipelankton as development continues. There is also some suggestion that they suddenly become epibenthic in late larval or early postlarval life. Thus, we need to know more about what characteristics an epibenthic environment must have if larvae are going to settle to it when they should. More research programs on epibenthic ecology in and around areas where sparids are prominent in the fishery are recommended.

Juveniles of this group may also be epibenthic in their preferences, perhaps like snappers. We need more emphasis on field

surveys of nearshore, near-reef and hard-bottom habitats for that reason. We then considered their later life, talking about maturation, spawning and fecundity, and found that several species are hermaphroditic. This suggests that accurate sex determinations in this group can be made only by histological techniques.

Little is known about sparid migrations. Tagging programs are recommended to determine their movements. There is also a problem of identification in this group that can affect port sampling. The smallest juveniles and the biggest adults differ from key descriptions as adult characters change with age, or don't appear early enough in the life of some species. Help from taxonomists is requested.

There was a general emphasis for all recommendations to be applied from south of Hatteras to the Gulf where much less is known of sparid populations than in the Hatteras region where the fishery is substantial. Not much, therefore, can be said about species priority but we felt at least that through the Carolinas and Georgia the red (pink) porgy and the whitebone porgy could be ranked in that order.

We discussed pomadasysids (grunts) and tilefishes as others associated with some snapper and grouper fisheries. White grunt and tomtate are abundant and popular species in this and other areas. We know less about these species than we do for most snappers, groupers or porgies. Recommendations for those species apply equally here. Knowledge about white grunt is contained in a dissertation by Will Davis.

Tilefishes, which support marginal fisheries in deeper water areas of both the south Atlantic and the Gulf may be able to sustain increased exploitation. Black sea bass, which is popular in the South Atlantic region, needs more attention to determine its present stock condition.

Summary and Recommendations

In summary, we see the following needs to improve our biological understanding of all groups considered:

1. General help in taxonomy will assist those working on each group, not only for larval or early juvenile identifications, but also for older adults. Taxonomists also asked for whatever help they could obtain from biochemists and geneticists since there are some very promising techniques available for isozyme and other forms of electrophoretic separation, and also karyotypic methods to separate closely related

species when physical characters fail.

2. Ecological control of community structure including species interactions must be better understood.
3. Interpretation of landing statistics for as many years as possible together with available hydrographic records. This may allow investigators to relate changes in species abundance to one or a few critical environmental factors.
4. We should identify areas that contain large and well-defined spawning populations and established nurseries. We should set aside some as preserves for resource supplementation and as research-only regions where commercial or sports fishing might be eliminated.
5. Transport and distribution of larvae should be determined, especially as they relate to environmental factors.
6. Measurements should be made that could relate potential habitat damage due to fishing near reefs and hard bottoms.
7. Developing new and less damaging sampling techniques in and around reef areas was discussed and is an obvious necessity.
8. Man-made underwater insertions such as drilling platforms should be evaluated for usefulness in establishing and holding new populations. If we can, we should determine how such structures should look below the water line in order to serve that purpose, much in the way that artificial reefs are now designed.
9. The subject of migrations and movements of snappers, groupers, and associated species should be clarified by appropriate tagging experiments.

STOCK ASSESSMENT SECTIONAL MEETING

Chairman: Dr. Peter J. Eldridge
Associate Marine Scientist
Marine Resources Research Institute
South Carolina Wildlife and Marine Resources Department

Participants: Charles Barans
Gene Huntsman
Richard Roe
Bruce Stender

Jim Sykes
Joseph Tashiro
Lamar Trotter

Discussion

This session restricted its comments primarily to subjects of interest to the management of the snapper-grouper fishery. Furthermore, comments were directed mainly toward biological aspects of management because economic and sociological aspects were discussed in other sections.

The general nature of the snapper-grouper resource and associated fishery can be described as complex and one that is little understood in several key respects. The complexity of the fishery is illustrated by the fact that at least ten to twelve species are exploited by four user groups which can be classified as (1) recreational hook and line, (2) commercial hook and line, (3) commercial pot (primarily black sea bass), and (4) commercial trawl. In addition, several exploited species exhibit sex reversal (apparently partly in response to population density) and most species are at the northern edge of their geographic range. The question of recruitment is complicated because several species may obtain recruits by currents from the Caribbean region and it is possible that the extent of the inshore sponge-coral and offshore rocky outcrop habitats, "live-bottom", may in itself be a limiting factor on recruitment.

The question of stock identity also poses difficulties because it is not known if species belong to one South Atlantic unit stock or a number of stocklets in which adults are associated with individual reefs. Similarly, it is not known whether species remain more or less in a restricted area or make migrations in response to seasonal or spawning activities. However, in this case, some scientists believe that adults of several species may restrict their movements to a particular reef or reefs. This may be true for scamp, *Mycteroperca phenax*, and snowy grouper, *Epinephelus niveatus*. However, this question should be considered unresolved until more is learned about migration of all life stages.

Species Identification

Session members discussed at length those species that should be identified as belonging to the snapper-grouper fishery. In particular, much discussion was centered on whether black sea bass, red porgy, and white-bone porgy should be included. It was decided that these species should be included for several reasons. Among these are (1) the three species are important components of both recreational and commercial catches and it is important to know the amount of total fishing effort directed toward these species as well as that directed toward snappers and groupers, (2) these species are ecologically similar and tend to share the same or similar habitat, and (3) there may be species interaction such as predator-prey relationships or competition for space between these species and snapper-groupers.

Other species included in the snapper-grouper fishery are shown in Table 1 and include, white grunt, vermilion snapper, red snapper, silk snapper, blackfin snapper, speckled hind, snowy grouper, gag and scamp, (important north of Cape Canaveral); and lane snapper, gray snapper, mutton snapper, yellow-tail snapper, misty grouper and yellowedge grouper which are important south of Cape Canaveral.

Stock Identity

The consensus of the group was that black sea bass for management purposes could be considered a unit stock although it was recognized that sea bass north and south of Cape Hatteras may or may not mix.

Stock identities of other species are unknown although it is believed that very little mixing occurs between the Gulf of Mexico and the South Atlantic region. Several species including vermilion snapper, red snapper, and snowy grouper may receive recruits from the Caribbean area. It was also noted that every species appears to spawn in

Table 1. Species Included in Snapper-Grouper Fishery.

<u>Scientific Name</u>	<u>Common Name</u>
<i>Centropristis striata</i>	Black sea bass
<i>Pagrus sedicim</i>	Red porgy
<i>Calamus leucosteus</i>	Whitebone porgy
<i>Haemulon plumieri</i>	White grunt
<i>Lutjanus campechanus</i>	Red snapper
<i>L. vivanus</i>	Silk snapper
<i>L. buccanella</i>	Blackfin snapper
<i>L. synagris</i>	Lane snapper
<i>L. griseus</i>	Gray (Mangrove) snapper
<i>L. analis</i>	Mutton snapper
<i>Rhomboplites aurorubens</i>	Vermilion snapper
<i>Ocyurus chrysurus</i>	Yellowtail snapper
<i>Epinaphilus drummondhayi</i>	Speckled hind
<i>E. niveatus</i>	Snowy grouper
<i>E. mystacinus</i>	Misty grouper
<i>E. flavolimbatus</i>	Yellowedge grouper
<i>Mycteroperca microlepis</i>	Gag
<i>M. phanaz</i>	Scamp

region although the effect of local spawning upon recruitment is unknown. It appears, given the present state of knowledge, managers can initially assume that species can be considered as unit stocks with the proviso that significant recruitment for some species may be contributed by the Caribbean region. Also, adults may restrict their movements to particular reefs where their abundance could be severely depleted by concentrated fishing. In the latter case, it may be appropriate to consider species in particular areas as stocklets and manage them individually through the designation of fishing zones.

The apparent absence of large numbers of juvenile snappers and groupers was noted although it was pointed out that little effort has been expended to sample these life stages. Also, one catch of 29 *L. campechanus* of 12 to 38 cm fork length was collected by the South Carolina MARMAP Program in April, 1974. In addition, juvenile lane, gray and mahogany snappers (*L. synagris*, *L. griseus*, *L. mahogoni*) are fairly commonly found in estuaries in North Carolina, whereas adults of these species are quite sparsely distributed. Gear selectivity (hook and mesh size) may account partially for the apparent absence of juveniles.

Population Parameters

Population parameters of interest were age, growth, age of sexual maturity, natural and fishing mortality rates, parent-progeny relationships, and species interactions. It was the consensus of the group that species interactions and parent-progeny relationships were unknown. In addition, estimates of fishing and natural mortality rates were generally lacking and some species have not been aged. However, National Marine Fisheries Service (NMFS) personnel at the Beaufort

Laboratory have developed techniques to age red porgy, vermilion snapper, gag and white grunt. Preliminary work on aging of red snapper at the Beaufort Laboratory and Marine Resources Center in Charleston are currently underway. Moreover, red snapper, gag and red grouper (*L. campechanus*, *M. microlepis*, and *E. morio*) have been aged in the Gulf of Mexico. Table 2 shows available information for selected species. The reader should note that preliminary yield-per-recruit models utilizing the Von Bertalanffy growth curve have been developed for red porgy, red snapper, vermilion snapper, white grunt, *Epinaphilus* sp., and *Mycteroperca* sp. by the Beaufort Laboratory of NMFS.

Present Status of Stocks

The present status of stocks for all species is unknown. It is believed that exploitation of snapper-groupers off the East Coast of Florida until recent years may have been more intense than further north, but this remains uncertain. It is believed that fishing pressure is increasing particularly in northern areas. Also, black sea bass may be fully exploited in some areas, but this is also unknown.

It is estimated that commercial and recreational fishing effort will increase significantly for snapper-groupers if the fishery remains unregulated. Such an event might result in either growth or recruitment overfishing which may or may not be the case for some species in the Gulf of Mexico.

In summary, the fishery does not appear to be overexploited at the present time, but such an event could occur in the future. It was also agreed that there was no surplus production available for a foreign fishery.

Table 2. Present State of Knowledge for Species in the Snapper-Grouper Fishery.

SPECIES	CAN BE AGED	AGE AT SEXUAL MATURITY	INSTANTANEOUS FISHING MORTALITY ESTIMATE	INSTANTANEOUS NATURAL MORTALITY RATE	INSTANTANEOUS TOTAL MORTALITY RATE	GROWTH RATE	SEX REVERSAL	STOCK IDENTITY	PARENT PROGENY RELATIONSHIP	SPECIES INTERACTION	YIELD-PER RECRUIT MODEL	PRESENT STATUS OF STOCK
Black sea bass	P	P				P	X	P				
Red porgy	X	X	P	P	P	X	G				P	
Whitebone porgy							M					
White grunt	X	X	P	P	P	X					P	
Vermilion snapper	X	X	P	P	P	X					P	
Red snapper	P&G	P&G				G					P	
Silk snapper												
Blackfin snapper												
Speckled hind							X					
Snowy grouper							X					
Gag	X	X				X	M					
Scamp							M					
<i>Epinephelus</i>	G	G									P	
<i>Myeteroperca</i>	G	G									P	

P = preliminary estimate available

X = estimate known or event occurs

G = estimate available from Gulf of Mexico or Caribbean

M = maybe

Ongoing Investigations

The NMFS Laboratory in Beaufort, North Carolina has a group, the Offshore Bottom Fishery Task, that is investigating the recreational snapper-grouper fishery in the South Atlantic region. The group is primarily concerned with determining basic population parameters for selected species and monitoring the recreational fishery for these species. Work has been underway since 1972.

The Marine Resources Division of the South Carolina Wildlife and Marine Resources Department has been sampling commercial trawl and hook and line catches in an attempt to monitor the commercial fishery.

The MARMAP Program conducted by the Marine Resources Division in cooperation with NMFS is doing preliminary work on developing assessment techniques for the snapper-grouper resources. Future work in MARMAP and other programs will depend primarily on the level of resources committed to these tasks.

The NMFS and South Carolina fishery statistics program are collecting some data on commercial snapper-grouper catches. Effort data are generally not being collected except in South Carolina where the Marine Resources Center is sampling as much of the commercial fishing effort as is possible with limited resources.

The discussion at this time revealed the need for close coordination between agencies and disciplines to exchange information, avoid duplication, and assist one another whenever appropriate. This need is particularly relevant when one considers the low level of resources devoted to fishery management in waters off the southeastern United States despite the fact that some of the nation's largest and most valuable fishery resources are found here.

Miscellaneous Topics

During the session it was noted that snapper-groupers were not taken as a bycatch of the South Atlantic shrimp fishery. Also, little is known concerning discarded fish by the commercial snapper-grouper fishery except that hook and line fishermen do not appear to have a discard problem. It was agreed that estimates of fish discarded at sea should be obtained, especially for the trawl fishery. The present fishery statistical program was also discussed and all agreed that it should be strengthened.

Participants also discussed the difficulty in developing gear to satisfactorily sample the snapper-grouper resource. This is due in part to difficult terrain that snapper-grouper inhabit and also to the fact that most commonly used gears appear selective for larger individuals.

Another basic problem to the management of

the snapper-grouper resources is the fact that the extent and location of "live-bottom areas" on which snapper-groupers congregate is largely unknown in the South Atlantic.

The difficulty in obtaining live, healthy snappers and groupers for tagging experiments was discussed and it was noted that tagging experiments provide minimal information when fishing effort is undocumented.

The subject of repopulation of a fishing area after it had experienced high levels of fishing pressure was also discussed, but no one had any estimates concerning time of recovery in such a case.

Summary and Recommendations

All agreed that fishery managers must determine the location and extent of "live-bottom" habitat as soon as possible. Similarly, it was agreed there was a great need to develop quantitative sampling techniques for stock assessment of live bottom species.

There was unanimous agreement that fishery statistics for both the recreational and commercial fishery must be strengthened and expanded as soon as possible. Specifically, detailed commercial effort data concerning total trip length, actual fishing time, fishing location as close as can be reasonably obtained from fishermen, landings by gear type and gear number, bait used if hook and line, number and species discarded at sea, depth, and crew size should be collected. Standard vessel information including electronic equipment used to locate fish should be obtained. Biological samples including length-weight data, size composition of catch, stomach contents, hard parts for aging, and gonadal condition should be obtained as required. A similar set of data including angler days and angler preferences should be collected for the recreational fishery. All categories of recreational fishermen should be sampled whether they use charter, headboat, or private water craft.

Table 2 illustrates that little is known concerning the snapper-grouper resource. Primary information gaps and needs roughly in order of descending importance are (1) ignorance of parent-progeny relationships, (2) lack of good estimates for growth and mortality rates for several species and in particular how these rates may respond to changes in abundance induced by fishing and other stresses, (3) ignorance of stock identity (4) species interaction, and (5) role of environment upon recruitment.

Management Recommendations

1. All available evidence indicates that the snapper-grouper resource is relatively limited and domestic fishing effort, commercial and recreational, is increasing. This strongly indicates that there is no surplus available for a foreign fishery.
2. Fishery managers, because of the apparently limited extent of the resource and recent experiences in the Gulf of Mexico, should seek to stabilize the level of catches as soon as possible. This can probably be accomplished best by establishing separate quotas for commercial and recreational catches which should be adjusted annually depending upon the state of the resource.
3. Fishery managers must have an adequate fishery statistical program in order to monitor trends in the fishery and allow them to evaluate the effects of management decisions. Such a system would appear to require a mandatory reporting system and a vessel license program. A salt water license or permit system may also be required in order to obtain adequate recreational fishery statistics.
4. Fishery managers must evolve a flexible management system with appropriate public input that can respond in a timely manner to changes in the biological condition of the resource and/or the economic-social-political realities confronting the fishing industry both commercial and recreational.
9. The relationship between amount of available reef habitat and recruitment must be documented.

Biological Research Goals

1. Stock identities must be confirmed.
2. Parent-progeny relationships must be clarified for important species.
3. Species interactions must be understood.
4. The extent and location of live bottom areas must be documented.
5. Appropriate quantitative sampling techniques for live bottom species must be developed.
6. All important species must be aged.
7. Accurate growth and mortality estimates for important species must be determined and appropriate yield-per-recruit analyses completed in order to provide fishery managers with alternative harvesting strategies.
8. The role of the environment upon recruitment must be determined.

ECONOMIC AND SOCIAL CONSIDERATIONS SECTIONAL MEETING

Chairman: Dr. Kenneth J. Roberts
Associate Professor
Department of Agricultural Economics and
Rural Sociology
Clemson University

Participants:	James Gato	Jay Lowe
	Orville Cunningham	Charles Moore
	Robert Dixon	Tom Murray
	Jim Easley, Jr.	Harold Mix
	Davis Palsom	Fred Prochaska
	Steve Goldstein	Larry Smith
	Jack Keener	Ronald Stover
	David Liao	

Discussion

The participants in this session included social scientists by necessity and biologists. The mixture produced the lively exchange essential to the realization of workshop objectives. There being considerable displeasure with the term "socio-economics", the group sought to make explicit elements of fishery management important to individual users, industries, and the public sector. A concise and hopefully factual account of the general points agreed to precedes the recounting of the group's treatment of the session assignment. The group went through the process of describing existing data sources, the need for time series data, and that which was needed yet absent.

"Socio-Economics"

Socio-economics is a term with no clearly identified origin. Perhaps its appeal as an all inclusive term is also its weakness. The problem hinges on the fact that it is difficult to make any sense of it operationally. It serves a useful purpose when general discussion is underway but appears to be unsatisfactory for organizing investigations and reaching conclusions. Certainly, socio-economics encompasses many professions. Without an understanding of the focus of sociology, anthropology, economics, and political science, individuals in the professions will be laboring forever under the burden that socio-economics is a home for topics which do not fit elsewhere and a symbol of the user's ignorance. The terminology of PL 94-265 is somewhat of an improvement in that social and economic factors are separate components of optimum yield. Sociological and anthropological professions can provide insight to preferences, traditions, values, and lifestyles of individuals

and groups utilizing fish resources. Political science and law may be logical additions to professions with a role to play in determining social considerations of optimum yield. The "economic factors" in optimum yield are not the exclusive domain of the economics profession. While economic studies provide information dealing with allocation of resources among competing users and uses in relation to an objective function, the preferences of individuals and groups along with insight to societal changes arising from management will impact conclusions from economic studies in an iterative fashions.

Social sciences fared better than biological sciences in PL 94-265 because it lumps all biological considerations into the term ecological factors. Perhaps there is a reference point here for social scientists. Just as ecological factors refer to relationships among living organisms and between them and habitats, social sciences deal with relationships between individuals, business entities, and the institutional environment created to buffer individual actions. A significant increase in performance will require effective use of professions within the social sciences.

Production and Value

The magnitude of the commercial fishing harvest was thought to be acceptably depicted in annual statistical reports. However, some improvement in terms of shortening the delay in releasing statistics is necessary. Annual statistics on commercial harvest would be more useful if production were reported by gear type, site of harvest, and port landed. It was reasoned that such additions to production data would provide insight to the economic activities of harvesters in addition to the resource itself. The harvest of commercial sport-fishing vessels is as adequately reported as funds going

to this effort will allow. This task performed by the Beaufort Lab of the National Marine Fisheries Service warrants the continued support of the scientific community. Perhaps because of scale the data are readily available. A void in production figures requiring systematic attention is the harvest of privately operated recreational vessels. A fundamental approach to developing a sampling scheme to reveal this harvest will require definition of the population, establishment of methods to secure accurate weight and species reports, and assurance of timely reporting of data. The harvest of private recreational vessels is the deficiency in the production data base which needs regional attention to correct. Other deficiencies known to be real but of lesser importance are the harvest of recreational and commercial divers and the crossover from a recreational to commercial fishing operation (i.e., the sale of recreationally caught fish). The latter was hypothesized to be of more significance in Florida.

Ex-vessel value data for commercial fishing operations are reported with the same regularity and delay as production figures. Most participants could recall occasions where marketing agreements may mask real values but on the whole it was felt the significant value aberrations originate with inaccurate production data. This arises when commercial catch is unreported and/or when production is not reported by fish size. Several species are graded prior to sale. Two or three prices may be received. Commercial production data should be reported by grade in order to correct the situation. Value by gear type and location is desirable. The same comments hold for this case as were offered for production data.

Value estimates from commercial sportfishing and private vessel recreationist are not available. The Beaufort Lab's work with the commercial sportfishing fleet provides the building block of value estimation - participation data. Social scientists need more detailed participation data, if net value of sportfishing on head and private boats is to be estimated. Gross expenditure data are useful in depicting the distribution of sportfishing revenues throughout an economy and identifying its impact but it can not serve as the desired measure of net value. This requires demand analyses with explicit treatment of catch rates and species composition of the catch. Insight to the motivations of recreational fishermen is something social scientists can provide. This is essential to the estimation of values and their interpretation. Implicit in any value estimate is a catch rate, species composition, fish size, and other factors which social scientists are capable of making explicit as a means of assuring proper interpretations of research results.

Social and Economic Characteristics

Both quantitative and qualitative elements are involved in this type of information. A partial list of components of social and economic information is presented in Table. 1.

Regarding commercial fisheries, information on job alternatives within and outside the industry is needed. Some insight to the mobility of effort and families in the South Atlantic Bight would help guide social science investigations. A regional study of shrimper mobility is underway by David Liao of the Marine Resources Research Institute. More efforts are needed in terms of finfishermen. Motivational studies of commercial fishermen would help determine such fundamental things as the fisherman's viewpoint on income, time off, what he perceives to be the value of his effort, and what he is actually pursuing. Incomplete data are available on the level of commercial fishing capital investment. This needs to be refined. Insight into the experience or investment of career time in the commercial fishery is needed.

In terms of the recreational resource, fundamental information on who uses the resource, how far they travel, the nature of other activities they pursue while on the coast, expenditures made on the way to the site and at the site, and which expenditures are related to sportfishing. Accurate interpretation of such data presupposes knowledge of the participants income class, their frequency of participation, and their motivation.

The group emphasized that the social and economic information needs do not represent a shopping list. To do this would invite others to ignore the statements. The information needs portrayed in this section are the minimum needed to shape coherent statements about commercial and sportfishing aspects of the resource.

Costs and Returns

Better data and analyses are available on this topic than any other the group was assigned. The commercial fishing aspect is under study in Florida and South Carolina. The previously mentioned mobility study of the region's shrimpers will generate cost and return data for 1976. The shrimp fleet represents latent effort capable of further developing offshore resources. A study by Tom Jones at Clemson University will yield five years of data on each of forty shrimp trawlers. The analysis will be completed in 1977. Some improvements are necessary in terms of information on hook and line commercial fishermen.

Table 1. A partial listing of the components of social and economic information.

<u>Socio-demographic</u>	<u>Socio-psychological</u>	<u>Economic</u>
age	motivation	mobility
sex	goals	marketing
education	methods	costs
occupation	participation rate	revenue
income	experience	efficiency
family size		investment

David Liao also has a study underway to be completed in 1978 which includes a survey of approximately twenty head and charter boats. While this is a good start, it is not nearly enough. One of the needs is a continuing commitment to this topic. This would generate time series data in order to determine changes over time. Just as biologists use annual data to secure insight to the biological status of a resource, social scientists seek time series data to reveal relationships not possible through the use of cross section data. The purpose is to delineate in a scientific manner the impact of extreme and marginal alterations in current fishery use.

Social and Economic Aspects of Marketing and Processing

Information needed here concerns the market structure of the processing industry. More specifically, data needs include economic concentration of firms handling the product, number of firms, employment, and other similar forces. Extensive work in this field is underway for Florida by Fred Prochaska at the University of Florida. Margin information would include gross margins, net margins between the vessel and wholesale, and between wholesale and the consumer. It is beneficial to have the type of use or the market channel into which commercial products are moving and insight to the import of snapper-grouper. There is a natural link between social science and the development of markets for underutilized species caught incidental to the pursuit of other species. To create or enhance markets one endeavors to persuade consumers through various communication techniques. Social and psychological factors can have a significant bearing on the success of market development programs.

Resource Allocation

The workshop chairman encouraged the development of a list of resource allocation considerations. The group decided to do two things in this regard. First, the group proposes that when the topic of resource allocation is discussed that people reference their comments to the particular user groups involved. The following user groups are particu-

larly important. The commercial fishery was divided into five sub-categories: foreign fishermen, domestic pot or trap fishermen, domestic hook and line fishermen, domestic trawlers, and domestic divers. The comment was made that in Georgia a small commercial spear fishery for grouper exists. The sportfishing category can be divided into commercial sportfishing vessels (head and charter), private boat recreational fishermen, and divers. Three other categories of people affected by allocation decisions are processors, intermediates in the marketing chain, and the final consumer. Discussions of resource allocation devoid of reference to the impacted group invites confusion, error, and inefficiency.

The second point is the actual list of criteria pertinent to resource allocation. In no particular order of importance, suggested criteria are:

1. management and the regulatory cost of an allocation scheme.
2. economic efficiency,
3. income impact,
4. employment impact,
5. impacts on fishing communities and coastal communities dependent on recreational fishing,
6. the impact on food supply,
7. the impact on the price of food products which reach the consumer and the cost of recreational fishing,
8. the impact on the number and geographic availability of fishing experiences.

The last criterion was judged important to highlight because of differences between the range (access) that commercial fishermen have over a week or ten day cruise in the bight as opposed to commercial and private sportfishing vessels. The latter are basically day-trip and are confined to a narrower range if they are going to work the fishery effectively. In general allocators must focus attention on the diversity of opportunities provided in a geographic area to the above listed user groups.

Summary and Recommendations

Based upon discussions held during the sectional meeting on economic and social

considerations relevant to the future management and utilization of the South Atlantic Bight snapper/grouper resources, the meeting participants want to emphasize the following informational needs and recommendations.

In the areas of production and value:

1. To obtain annual production statistics on the commercial harvest by gear type, harvest area, and port landed in order to provide insight into the economic activities of harvesters.
2. To obtain data on the production of privately operated recreational vessels.
3. More detailed participation data to estimate the net value of recreational fisheries.
4. Information on the motivations of recreational fishermen is needed for the estimation of values and their interpretation.
5. To obtain data on the production of recreational and commercial divers and on the crossover from a recreational to a commercial fishing operation (i.e., the sale of recreationally caught fish).
6. To improve the accuracy of commercial harvest data, by obtaining unreported data and production by fish size, in order to be able to generate more meaningful and useful ex-vessel catch value data. Value information by gear type and location is also desirable.

In terms of social and economic characteristics, data on the following elements are needed relative to both commercial and recreational aspects of the resource:

1. Socio-demographic: age, sex, education, occupation, income, and family size.
2. Socio-psychological: motivation, goals, methods, participation rates, and experience.
3. Economic: mobility, marketing, costs, revenue, efficiency, and investments.

In the area of costs and returns:

1. Better information is needed on the commercial hook and line fishery.
2. A continuing commitment should be made to allow the generation of time series data in order to de-

termine changes over time.

In the areas of marketing and processing:

1. Information is needed relative to the market structure of the processing industry to include such aspects as the economic concentration of firms handling the product, the number of firms, and employment.
2. Information is needed on operating margins, such as gross and net margins between the vessel and wholesale levels and between wholesale and the consumer.
3. It would be useful to have information on the market channels into which the commercial products are moving and insight to the import of snapper/grouper products.

In the area of resource allocation:

1. All discussions should be referenced to the particular groups involved when discussing resource allocation in order to avoid confusion, error and inefficiency. The following groups were identified for this purpose: commercial fishery - foreign fishermen, domestic pot or trap fishermen, domestic hook and line fishermen, domestic trawlers, and domestic divers; recreational fisheries - commercial sportfishing party boats, private boat recreational fishermen, and divers; other categories - processors, intermediates in the marketing chain, and consumers.
2. The following items should be considered in any list of criteria pertinent to resource allocation: the management and regulatory cost of an allocation scheme, economic efficiency, income impact on fishing communities and coastal communities dependent on recreational fishing, the impact on food supply, the impact on the price of food products which reach the consumer and the cost of recreational fishing, and the impact on the number and geographic availability of fishing experiences.

FISHERY DEVELOPMENT SECTIONAL MEETING

Chairman: Dr. Roger D. Anderson, Executive Director
Gulf & South Atlantic Fisheries Development Foundation
Tampa, Florida

Participants: Stan Beebe
Doug Elvers
Gunnar Finne
Bob Hines
Ed Mackin
Bob Mahood
Mike McKenzie

Dewitt Myatt
Jim Payne
Tony Reisinger
Jack Rivers
David Smith
Dale Theiling
Larry Trodd

Discussion

In discussing the development of the snapper-grouper fishery, our panel first identified basic concerns. First, we recognized that it was imperative that management agencies address the importance of the snapper-grouper fishery, both in the Carolinas, as well as in neighboring areas. Second, we felt it was critical to have stocks promptly assessed. Without this information, and without the ongoing concern of management personnel, we believed that this small, but important fishery, would not be constructively developed or managed. Third, we recognized potential conflicts between sport and commercial interests. We noted that such issues should be promptly and realistically addressed. Fourth, we recognized technological advances within the commercial industry, i.e., sophisticated gear, which will require management attention.

Realizing that these matters were beyond our immediate control, we went on to identify other areas that could receive immediate local attention, i.e., quality control, modernization and marketing.

Regarding quality control, we noted conditions on vessels. It was pointed out that catches are being jeopardized, particularly when held onboard during long or warm weather trips. Further, once such product reaches the dock, it is not being well cared for. Present handling, particularly manual off-loading and existing dockside facilities, are inadequate. A distinct need for modernization was thus identified. Improved refrigerated transportation was encouraged, a further step to insure quality control. We went on to observe the need for product standards, labeling and inspection. For overall industry protection, we felt the latter issues, while controversial, must be promptly addressed. While it was not our position to advocate, we did acknowledge a serious need to guarantee wholesomeness.

As pointed out, this area, South Carolina and Georgia in particular, needs to improve its marketing and transportation systems. From an overall finfish development perspective, the snapper-grouper fishery provides an excellent conduit.

We recognized that much of the region's future fisheries development hinges on construction of modern seafood industrial parks. Whether or not industrial parks will include the full range of services, i.e., fuel, ice, processing or freezer space, all must be considered as part of needed modernization. Again, the snapper-grouper fishery may serve to stimulate this type of modernization and centralization.

We looked at selling "the seafood concept" for the region. The acquisition of meaningful statistical and marketing information will be required, particularly in efforts to sell Southeast products outside the Fulton Fish Market. To encourage attention in new markets, a tremendous amount of cooperation, as well as joint industry-government support, will be needed. The fact that many groups are represented here today, and were represented on panels, is sufficient indication of the interest and need to move forward.

We also commented or dwelled on specific issues including:

1. The need for better education and training for fishing personnel, as well as improved recruitment for the fleet;
2. The need for continued support of extension programs. We were perplexed by assumptions that these programs will automatically continue. We strongly encourage the support and expansion of these activities, especially field service operations (advisory agents), as well as in-service activities, i.e., management and communication workshops;
3. The encouragement of selected artificial

reef programs. Beyond habitat development, we felt that reefs provide relief to sportfishing interests. We had mixed feelings, however, as to need for development of reefs far offshore, particularly near live bottoms or commercially fished zones. With potential reef development further and further offshore, we felt conflict will be inevitable. We were, however, optimistic that federal agencies might map these bottoms, thus helping to locate appropriate reef sites. We encourage such work;

4. The support of Fishery Market News Report, along with development of related statistical programs. State statistical programs, like that in South Carolina, must be preserved. Further, we encourage broad dissemination of Southeastern fisheries information to all appropriate communication systems. Such programs must be supported at the current level, if not expanded; and,
5. The concern for state promotional activities, particularly since nearby states have aggressively involved themselves in such efforts. Using home economists and seafood marketing people, with technical support from the National Marine Fisheries Service, we felt that the Coastal Plains states should each, respectively, address their role in seafood promotion. Not only would this apply to marketing activities out of the region, but programs within states as well.

Summary and Recommendations

In summary, we viewed the snapper-grouper fishery as being an excellent development opportunity. We noted tremendous market potential; opportunity for improved quality control; need for logistic and existing facility improvement; encouragement of capitalization; involvement of management issues; and concern for greater cooperation between industry and government. Overall, we sensed a growing interest for promoting fisheries and seafood development in the entire Southeast. The snapper-grouper fishery, to us, seemed to be a unique focus.

Finally, it should be noted that this consensus report was prepared by the entire fishery development panel. Not being a finfish biologist, I much appreciate the groups help in preparing and editing this overview. Further, I'd like to note, on behalf of our panel, that the introductory presentations were very useful, particularly in preparing our assessment.

WORKSHOP PARTICIPANTS AND THEIR AREAS OF EXPERTISE, RESEARCH
AND/OR INTEREST IN SNAPPER/GROUPER STOCKS

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new industry development and
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Anderson, William D.
Grice Marine Biological Laboratory
205 Fort Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Systematics of snappers.

Barans, Charles
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Evaluation of gear for assess-
ment of species from untrawlable areas;
life history of snapper/grouper stocks,
routine monitoring of demersal fish stocks.

Bearden, Charles M.
S. C. Wildlife & Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Fisheries management and
development of marine fisheries.

Beebe, Stan
Coastal Plains Regional Commission
215 East Bay Street
Charleston, S. C. 29401
Expertise, Research and/or
Interest: Seafood park development,
new market development and promotion
of marine fisheries.

Burrell, Vic
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Fishery biology.

Cato, James C.
Department of Food and Resource Economics
1170 McCarty Hall
University of Florida
Gainesville, Florida 32511
Expertise, Research and/or
Interest: Member of scientific and sta-
tistical committees of both the South At-
lantic and Gulf of Mexico Fishery Manage-
ment Councils; economics of snapper/grouper
fishery.

Costello, T. J.
South East Fisheries Center (NMFS)
75 Virginia Beach Drive
Miami, Florida 33149
Expertise, Research and/or
Interest: Aquaculture of marine fish; eco-
logy of reefs; possibilities of a "put-take"
sports fishery for marine fish.

Courtenay, Walter R., Jr.
500 N.W. 20th Street
Florida Atlantic University
Boca Raton, Florida 33431
Expertise, Research and/or
Interest: Life history studies; identifi-
cation of juvenile snappers and groupers.

Cunningham, Orville
Department of Sociology
Clemson University
20-B Tillman Hall
Expertise, Research and/or
Interest: Sociological studies of marine
fisheries.

Cupka, David M.
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, South Carolina 29412
Expertise, Research and/or
Interest: Fisheries management.

Davis, William P.
Environmental Control Agency
Bears Bluff Laboratories, Inc.
Johns Island, S. C. 29455

Dawson, Richard
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Ecology of offshore snapper/
grouper habitats and communities.

Dixon, Robert L.
National Marine Fisheries Service
Beaufort, North Carolina 28516
Expertise, Research and/or
Interest: Recreational catch and effort data; live bottom community structure; life histories of reef fishes.

Easley, J. E., Jr.
Department of Economic & Business
and Agricultural Extension Services
N. C. State University
Raleigh, North Carolina 27607
Expertise, Research and/or
Interest: Marine economics and bio-economic models.

Eldridge, Peter
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
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Charleston, South Carolina 29412
Expertise, Research and/or
Interest: Population dynamics and fisheries management.

Elvers, Doug
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500 Camp Street
New Orleans, Louisiana 70130

Finne, Gunnar
Clemson University
P. O. Box 3158
Charleston, S. C. 29407
Expertise, Research and/or
Interest: Fisheries technology and seafood extension.

Florio, Donna
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Folsom, Davis
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Marine extension activities.

Goldstein, Steve
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Planning for the development and management of the snapper/grouper fishery.

Grimes, Churchill B.
Ft. Fisher Marine Resources Center
1910 Arendell St.
N. C. Marine Resources Center
Morehead City, N. C. 28557
Expertise, Research and/or
Interest: Vermilion snapper and porgy life histories and population dynamics; community ecology of continental shelf reef and rock outcropping areas.

Harris, C. Duane
Ga. Dept. of Natural Resources
Coastal Fisheries
P. O. Box 1676
Brunswick, Georgia 31520
Expertise, Research and/or
Interest: Standing stock assessment of artificial reefs; sportfishing catch composition and catch per unit effort.

Hines, Robert J.
Coastal Plains Center for Marine
Development Services
1518 Harbour Drive
Wilmington, North Carolina 28401
Expertise, Research and/or
Interest: Fishery development in conjunction with economic development mission of Coastal Plains Regional Commission.

Huntsman, Gene R.
National Marine Fisheries Service
Atlantic Estuarine Fisheries Center
Beaufort, North Carolina 28516
Expertise, Research and/or
Interest: South Atlantic Bight offshore bottomfish-populations, life histories and recreational fishery.

Jeffrey, Norris
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Marine Resources Division
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Charleston, S. C. 29412

Kalber, Fred
Florida Department of Natural Resources
Marine Laboratory
100-8th Avenue, S. E.
St. Petersburg, Florida 33701

Keener, Jack
S. C. Sea Grant
Clemson University
P. O. Drawer 1100
Georgetown, S. C. 29440
Expertise, Research and/or
Interest: Trawl gear and methods; extension work.

Keiser, Richard K., Jr.
S. C. Wildlife & Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Rd.
Charleston, S.C. 29412
Expertise, Research and/or
Interest: Fisheries biology and resource
assessment.

Koenig, Chris
Department of Biology
College of Charleston
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Charleston, S. C. 29401

Liao, David S.
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Economics of marine fisheries.

Lowe, Jay
Dept. of Sociology
Clemson University, 102 Tillman Hall
Clemson, South Carolina 29631
Expertise, Research and/or
Interest: Social factors in management of
snapper/grouper fishery; determination of
management techniques that will work and be
acceptable to the fishermen.

Mackin, Ed.
Olympus Research Corporation
Jersey Lane
Manchester by the Sea, Ma. 01944

Mahood, Robert K.
Georgia Dept. of Natural Resources
Coastal Fisheries Office
P. O. Box 1676
Brunswick, Georgia 31520
Expertise, Research and/or
Interest: Marine fisheries management and
development of a commercial and recreational
fishery for snapper/grouper.

Manooch, Charles S., III
National Marine Fisheries Service
Beaufort, North Carolina 28516
Expertise, Research and/or
Interest: Life history and population
dynamics.

McKenzie, Michael D.
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S.C. 29412
Expertise, Research and/or
Interest: Fisheries management and
development of marine fisheries.

Miller, David
Marine Extension Center
University of Georgia
P. O. Drawer 13687
Savannah, Georgia 31406
Expertise, Research and/or
Interest: Commercial fishery potential
of Georgia outer shelf area.

Moore, Charles J.
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Utilization and potential of
snapper/grouper as a recreational fishery;
benefits and utilization of artificial reefs.

Murray, Tom
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
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Myatt, Dewitt O.
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
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Charleston, S.C. 29412
Expertise, Research and/or
Interest: Development of artificial reefs
as habitat for snapper/grouper stocks.

Nakamura, Eugene
National Marine Fisheries Service
Panama City Laboratory
P. O. Box 4218
Panama City, Florida 32401

Nix, Harold
Department of Sociology
University of Georgia
Athens, Ga. 30602

Parker, R. O., Jr.
National Marine Fisheries Service
Beaufort, North Carolina 28516
Expertise, Research and/or
Interest: Tagging, underwater studies,
population estimations, seasonal abundance
species composition and behavior of reef
fishes.

Payne, Jim
Southern Offshore Fisherman's Association
12781 Gulf Boulevard
St. Petersburg, Florida 33700
Expertise, Research and/or
Interest: Development of commercial off-
shore fisheries.

Powles, Howard
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, South Carolina 29412
Expertise, Research and/or
Interest: Distribution and abundance of
larvae by drift - recruitment studies in
South Atlantic Bight.

Prochaska, Fred J.
University of Florida
1170 McCarty Hall
Gainesville, Florida 32511
Expertise, Research and/or
Interest: Bio-economic modeling of the Gulf
grouper/snapper fishery; industrial seafood
port study; scientific advisory on grouper/
snapper fishery for the Gulf Council; social
and economic profiles of commercial fishermen.

Reisinger, Tony
Georgia Dept. of Natural Resources
Coastal Fisheries Office
P. O. Box 1676
Brunswick, Georgia 31520
Expertise, Research and/or
Interest: Artificial reef and natural
reef investigations.

Rhodes, Raymond J.
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, South Carolina 29412
Expertise, Research and/or
Interest: Fishery management and impact
of fishery development.

Richardson, Ed
S. C. Water Resources Commission
3830 Forest Drive
Columbia, South Carolina 29204
Expertise, Research and/or
Interest: Live-bottom areas and potential
effects of offshore hydrocarbons development
and activities on these resources.

Rickards, William L.
UNC Sea Grant Program
N. C. State University
Raleigh, North Carolina 27607
Expertise, Research and/or
Interest: Biology and ecology of fishes.

Rivers, Jack
University of Ga. Marine Extension Service
P. O. Box 517
Brunswick, Georgia 31520
Expertise, Research and/or
Interest: Promote finfishery off Georgia
coast.

Roberts, Kenneth
Marine Advisory Program Coordinator
Dept. of Agricultural Economics and
Rural Sociology
Clemson University
Clemson, S. C. 29631
Expertise, Research and/or
Interest: Economics and development of
marine fisheries.

Roe, Richard B.
National Marine Fisheries Service
3300 Whitehaven N. W.
Washington, D.C. 20235
Expertise, Research and/or
Interest: Management, distribution and
assessment of groundfish.

Sandifer, Paul
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412

Schwartz, N. Frank
Institute of Marine Science
University of North Carolina
P. O. Box 809
Morehead City, N. C. 29557
Expertise, Research and/or
Interest: Ichthyology, zoogeography
and ecology of western Atlantic fishes.

Smith, David C.
S. C. Sea Grant Marine Advisory Program
P. O. Box 537
Port Royal, S. C. 29935
Expertise, Research and/or
Interest: Fishing gear technology and
the managed utilization of fishery resources.

Smith, Larry D.
Georgia Dept. of Natural Resources
P. O. Box 1676
Brunswick, Georgia 31520
Expertise, Research and/or
Interest: Snapper/grouper as a source of
recreational opportunity along the Georgia
continental shelf.

Stender, Bruce
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Taxonomy and identifications of
larval fishes; distribution, abundance and
ecology of snapper/grouper.

Stover, Ronald G.
Sociology Department, Clemson University
Tillman Hall
Clemson, South Carolina 29631
Expertise, Research and/or
Interest: Socio-economic factors and social
organization relative to recreational and
commercial fisheries.

Sykes, James
Atlantic Estuarine Fisheries Center
National Marine Fisheries Service
Beaufort, North Carolina 28516
Expertise, Research and/or
Interest: Assessment of fish stocks.

Tashiro, Joseph
National Marine Fisheries Service
Miami Laboratory
75 Virginia Beach Drive
Miami, Florida 33149
Expertise, Research and/or
Interest: Monitor and evaluate commercial
snapper/grouper fisheries in the South At-
lantic, Gulf of Mexico and the Caribbean Sea.

Theiling, Dale
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Commercial fishery landings
data collection.

Trodd, Larry
Western Marine Elect.
2101 Conquistador Circle
Largo, Florida 33540
Expertise, Research and/or
Interest: Utilization of sonar in locating
snapper/grouper habitat.

Trott, Lamarr B.
National Marine Fisheries Service
3300 Whitehaven Street
Washington, D.C. 20235
Expertise, Research and/or
Interest: Ecology, assessment and manage-
ment of fish stocks.

Ulrich, Glenn
S. C. Wildlife and Marine Resources Dept.
Marine Resources Division
217 Ft. Johnson Road
Charleston, S. C. 29412
Expertise, Research and/or
Interest: Commercial snapper/grouper fishery
of South Carolina; stock assessment, life
history, ecology and management strategies.

Wolff, Maury
North Carolina Div. of Marine Fisheries
P. O. Box 769
Morehead City, N. C. 28557
Expertise, Research and/or
Interest: Assessment, biology and increased
utilization of snapper/grouper stocks off
North Carolina.