Biological Considerations and the Gulf of Mexico Menhaden Fishery

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I would like to discuss the kinds of biological data that are needed and also the research we have done over the years since the National Marine Fisheries established a Gulf Menhaden Research Program.

First what does management mean? In biological terms, management implies a certain amount of control and knowledge required to achieve a goal. In the case of the Gulf menhaden, management requires a tremendous amount of information about the resource, and it demands information as to what is best for man. That is, the social and personal impact on the fisherman. If the resource is in good shape, as we think the Gulf menhaden is, you have latitude and flexibility of maneuvering. If it is in a bad shape, which it is not, your options are reduced markedly.

Why manage a fishery? This is another question. Principally a fishery is managed to achieve the maximum poundage from the resource, at the same time not harming the resource for future years' production. In biological terms I have measured that maximum production by the way of catch, determining how many pounds should be caught. But, in the real world you have to relate catch to dollars and cents and social values.

What is needed in the way of biological information? Let me divide the data from menhaden resource and the environment into about three phases. The first phase is oceanic; the phase where the Gulf menhaden are during the winter and where the fish spawn. For Gulf menhaden, it is 40, 50 or 60 miles from the shoreline much of the year. Next is the coastal phase. This can be defined as along the area where fishing occurs in the summer and that is where the action is. Third is the estuarine phase. This is the brackish water area along the Gulf where the young fish, the larvae and the juveniles spend the first part of their life until about 1 year of age.

A number of questions are concerned with each phase or area. In the oceanic phase, we have to know the distribution of the fish. How far are they? Where are they? What water qualities are there? What are conditions in the water when they are spawning? How many fish are in the oceanic phase and what is going on? What are the water conditions? How many eggs are produced; that is, how good is the spawn of that year? What is the spawning season? How do the larvae survive? What do they eat? What eats them as well as the adult population that has just spawned? How many larvae are hatched and what are their chances of surviving to reaching the estuarine waters 6 or 8 weeks later? How do they

navigate? How many are there? How many will survive while moving through the coastal waters? How is the weather affecting them? What are the sea conditions? What chemical run-off is there that are either good aspects or bad aspects that will increase their chance of survival or decrease it. And it just goes on and on. You can ask almost any question, even about atmospheric conditions. How these half-inch larvae reach the coastal waters is a never ending question.

In the coastal phase what ages are represented in the commercial fishing area? How many of each age are there? Where are the catches made? Who is making the catches? Is there one fishery or a number of fisheries? Is there a bait fishery operating? What are the migrations of the fish? If the fish are one year old at point "A" and they move east or west, or if there is no movement, what will be the composition of the landing at point "B"? How does one company, or one area of fishing, affect another area of fishing? What predators are taking these fish in addition to the commercial fisherman? How fast are the fish growing? If they are not caught this year, will there be any around of that same year class the next year; if so, where will they be? Will they be at point "A" or point "B"? Or, if they are not caught this year, will they ever be caught? What is their life span? What are their needs and what are the aquatic conditions in which they are trying to survive?

In the estuarine phase where these juveniles spend their first year of life, what estuaries are important? How many acres are there? What is the quality of the water? If they are in Galveston Bay one year will they return to Galveston Bay the next year? Will they use the same estuary year after year? What is man doing to affect the water quality of run-off? What is happening in the way of physical or other chemical actions that are reducing or changing the quality of the water for the young fish? What other fish forms are in the estuaries that are reducing their numbers? What are their needs in the way of space? How many fish can an estuarine area support? What about the other fishes? What are these other fishes eating? What are the juveniles eating? What are their growth rates and how many will live that first year? Where will they go when they leave in the fall? Will they come back to that same area along the coast or will they show up in some other state jurisdictional area? How many juvenile fish are needed to replace those that are caught as young adults or adults in the commercial fisheries?

These are just, or course, a few of the questions that we are trying to solve. For the most part our program has been limited to the coastal phase. We are not now, and never have been able to muster the wherewithal to study the oceanic phase which lasts about 6 months of the year. In the estuarine phase, within the program we are not studying any of the other 6 months of the life span of the young fish. In a way, we are only covering about one-third of the total life span.

The program has been quite productive and I have told a number of you people about the different findings and discoveries we have made over the last few years. It has been an extremely cooperative program. Over these 10 years, we could never have completed the equivalent of what we have done in any amount of time if the industry had not furnished vital information. They have been extremely cooperative in many ways. I do not think the federal coffers are big enough to have supplanted or replaced the benefits of volunteered catch

records and all types of historical data. The fishery has been well documented since the end of World War II.

As I mentioned before, the fishery is in good shape. It appears to have an immediate healthy future. It is extremely productive. It is a renewable resource. The cooperation and assistance that we have gotten from every state in the Gulf has been very beneficial. We would like to see more participation; we need more participation; I think we are on the right track and I think we can look forward to more cooperation and further benefits as we go along.

DISCUSSION

Q. – J. Y. Christmas: The point that designation of these fisheries as priority items in the Technical Coordinating Committees does not necessarily mean that management is necessary or will be applied but that we determine whether it is needed. Rather than wait until it is too late, as has been done in some cases in other areas, we must acquire the necessary information in advance to know when management becomes necessary.

Is this a correct understanding of the whole program, Mr. Allen?

A. – Harold Allen: Yes, you stated it very accurately. The data on any of these fisheries are not complete enough to show whether or not they are in need of management. These are simply the fisheries on which the committee set a high priority as possible needing management or others that they sought to obtain additional information because there was a good possibility that data might be available.

Q. – J. Y. Christmas: Dr. Hooker, from your economic analysis can we define the points where on an average fishing is profitable? Are you able in your calculations to consider the variations and efficiency among companies? Would a point at which one company made money possibly be a point where another would lose and are we going to be able to take these differences into consideration?

A. – Paul Hooker: Given access to individual company records you could take into account variations in efficiency. The nature of an average is that someone is above it and someone is below it. By taking into account variations in efficiency, you could set seasons so that the least efficient firm is making money. That is, you could base your management decision on the characteristics of the least efficient firm.

However, in the menhaden industry, something that impressed me when we were visiting the plants was the uniformity of the industry and the minimal variations in efficiency between operations. I would not think that the variation and efficiency considerations would be great or require much modification from the average.

Q. – J. Y. Christmas: Although we know now very little about the source of food for menhaden especially in the estuaries, they are certainly among the most efficient users of basic productivity because they feed very near the bottom of the food chain. Consequently, by harvesting the resource at this trophic level, we obtain the highest yield available from the basic productivity of the area.

Q. – Earl Conrad: I first of all want to congratulate Jack Styron and, particularly, the State of Louisiana, in handling the management program this year in the establishment of the season. It worked to the economic benefit of all the producers in the State.

I think a fishing season based on economics is one measure that we can adopt. However the economics of a season while it applies to the State of Louisiana, might not apply to Florida or Mississippi or Texas, so we shall have to look at other measures. I think that the menhaden resource has the potential to be overfished as was the sardine fishery of California and the anchovy fishery of Peru. In Peru the resource has been studied by no less than the United Nations. In spite of all the research and biological information that was gathered for this fishery the resource has virtually collapsed. When you analyze this it occurred because there was an economic over-capitalization of the industry before Peru was able to react and manage the fishery wisely. This also happened in California. I think that we cannot afford to delay in determining proper management measures for menhaden and taking effective action. Such management could be accomplished by industry, the states or the federal authorities; but some management scheme must be devised to protect the resource.

From Bob Chapoton's talk about the need for biological information I got the distinct impression that we were going to study the menhaden resource to death, and while we were still studying the biology an economic collapse could occur. My question to Bob is: Just how much of what you outlined as needed research will be required in a time frame that will permit us to take effective management measures?

A. – Robert Chapoton: We have concentrated on the biological aspects of the Gulf menhaden fishery, that is, the vessels and the producing unit, the airplanes and certain physical aspects about the vessels and certain biological aspects about the catch, mostly the age, size, distribution and inter-relationship among various areas along the Gulf. We have conducted what is probably the most extensive sampling program anywhere in the United States since 1964. This sampling program attempted to measure the relative abundance; that is, not the absolute numbers, but the year-to-year changes in numbers of juveniles in the estuaries from Brownsville, Texas, to Tampa, Florida. This is the principal range of the Gulf menhaden. This survey included some 45 to 48 estuarine systems along the Gulf, proportional to the surface area of the streams or the estuaries throughout these five states. We attempted to relate those data to the age composition of the landings. We have tagged about 300,000 adult and juvenile menhaden since 1969 when we started to define the population. This work was supported by earlier information on the life history. That is, when do the fish spawn? Where do they spawn? Where are the larvae? Where are the eggs? Where do they spend the first summer of life? Much of that work was done by J. Y. Christmas and Gordon Gunter, here in the Gulf. To speed estuarine assessment we had to find out whether or not there were 10 year-classes of fish, or just one. We found that 90 or 95% of the annual catch consisted of 1- and 2-year-old fish. The Gulf menhaden has a short life span. This short life span necessarily produces large annual fluctuations in the real numbers of fish available to the

fishery. With this, we are faced immediately with the problem of finding out whether a reduction in landings is a real decrease in fish abundance or due to some other factor, like fishing effort. Was there more or less fishing effort?

In a purse seine fishery this effort is one of the most difficult problems to solve in that fishing is pursued from the airplanes as well as from the vessels. The purse seine is not set until the fish are sighted. So, the vessel may be pursuing the fish all day and not make a set, or it may make several sets just before sundown. You have trouble with the definition of fishing effort and this is a problem that any purse seine fishery research program encounters. We have had to devise a relative index of annual fishing efforts using vessel size as documented by the registered tonnage. The historical data indicated that big vessels unloaded more fish than the little vessels. From our results, we concluded that this was a good index figure. This permitted us to adjust for real or artificial changes in relative abundance from year to year. Then we were able to estimate the amount of annual effort, the real change in the population and the sustainable yield or catch of this fishery. This has given us a guideline which permits annual adjustments and gives a quantitative value as to the well-being of the fishery.

Jack Styron mentioned that 1971 was a year of maximum production. This was based mostly on the super abundance of 1-year-old fish. They helped support the fishery in 1972, but landings did decrease. Landings also decreased 4% in 1973 when compared to 1972. Juvenile abundance from Brownsville almost to Tampa was better in 1973 than in 1972. Indications were that there were more fish of zero age or juveniles than in 1972. We think that there should be some stability in 1974 and possibly some improvement in the catches. For the next year or two we are very optimistic, given all things are equal, weather and the desire to go fishing.

Three years ago there were 85 fishing vessels in the Gulf fleet. Last year there were only 75, and this year, there were only 66. That is a 22% reduction in the number of vessels going out to catch Gulf menhaden. Whatever the message is, we do not have a complete story now and I am sure we never will, but I think for the most part industry is learning with us and we are learning with industry and the states about this resource. But I think there are many signs, like the meeting today, that would indicate that we are trying our best and industry is trying their best in making genuine overtures to help to perpetuate the resources on which we all depend.

Q. – Terrance Leary: In Texas we shall have more flexibility this year in setting seasons than ever before. The commission will have the authority to set seasons rather than the legislature. In calculating average annual landings per vessel, was any consideration given to the proportion of the catch by year classes?

A. – R. Chapoton: The entire Gulf menhaden fishery consists predominately of 1- and 2-year-old fish. We need studies to determine the net gain if fish are not caught as 1-year-old fish, or certainly not as juveniles, the very small, 2- or 3-inch fish. If they are not caught at year one, how many are potentially available to the fishery the second year? Work has not progressed to the point where we have the answer, but it looks as if it would be physically impossible to

separate 1- and 2-year-old fish from the purse seine sets by controlling mesh size. The fish occur in common schools. There is some geographical separation of the distribution of fish along the Gulf. The Port of Cameron, adjacent to Texas, catches more 1-year-old fish than does Empire, Louisiana.

Q. – Terrance Leary: About a year ago, some new experimental pesticides were being used in the rice growing areas causing some large fish kills. Have you noticed any correlation in your juvenile samplings with the introduction of new pesticides in the rice fields?

A. – R. Chapoton: Not to my knowledge. We noticed more effect from reduction in acreage, by development of or physical change of the environment.

But data, both of what has happened on the land with farms and pesticides versus what has happened in the aquatic environment and the resulting net loss or change in population, are quite hard to get. We are attempting to study this along the Atlantic coast where we are able to be in the field any time of the day. We would very much like to see this type of work done. The menhaden are right at the back door of most of our drainage systems and they are very vulnerable.

Q. – Lyle St. Amant: Do you have enough information about relationships between juveniles and seasonal changes in environmental parameters? For example, this year we had high amounts of fresh water in the nursery areas in Louisiana; it was not a normal year. We also had some rather strange effects on survival rate and production of shrimp populations. We have been fortunate in developing a system for analyzing shrimp survival and growth rates and have had some success predicting what is going to happen to the shrimp larvae and juveniles. Do you think it is possible to relate the annual changes in environmental parameters to the growth and production for menhaden?

A. – R. Chapoton: Yes, but the answer to the question depends on availability of manpower and funds. Menhaden is an annual crop and several years of data are required for reliable answers. We find on the Atlantic coast that physical conditions are changing more quickly than biological ones.

Q. – St. Amant: Well, I do not know about the other states, but Louisiana has a rather detailed program directed at predicting shrimp abundance for which we obtain hydrographic information on a continuing basis. If it is recommended that this type of data would be beneficial for menhaden, there is no reason why we could not attempt to develop funding to start a sampling program on an annual basis in Louisiana.

Do you think we might get as good a relationship with menhaden as we do on shrimp, if we had the data?

A. – R. Chapoton: I think that would be helpful if enough manpower and enough representative estuaries were included in the sampling.

We have estimates that there may be 10 to perhaps 20 billion 5- to 6-month-old juvenile menhaden along the Gulf at any one time. When we survey three adjacent streams in three different years, often times we find the principal population has moved around. In year one, they were principally in stream one but in year two they had moved to stream three and then back in stream two or one the next year. We can not explain this distribution. All the physical features of these adjacent streams or estuaries appear to be the same. We do not understand a great deal of the behavioral patterns. We have never been able to muster

a year long continuous study on juveniles in the Gulf, thus far, so I think such work would be beneficial.

Q. – E. R. Pariser: The point that I would like to make is that the quantity of menhaden produced in a normal year represents several hundred billion calories of perfectly good food for the human consumption, even if only the oil were considered. Is it not time for us to plan to use menhaden as the most important single food resource that we have?

A. – Jack Styron: I am in wholehearted agreement with you that it is ridiculous to take this high quality protein and have to feed it to other animals to produce meat that can be consumed by humans. Quite a bit of work has been done on FPC, without favorable results to date, but I feel that eventually menhaden will be used for human consumption. I would like to ask Dr. Gunter to say something further on this subject.

Comment – Dr. Gordon Gunter: Back in the days of World War II there were at least two investigations of the edibility of menhaden. I tested them myself and found that they were delicious when fried in their own oil. They were quite boney, but no more so than the shad on the East Coast. I wrote the Fish and Wildlife Service about this and they conducted a survey. At that time they needed food in Great Britain and our fishery people responded by sending different kinds of canned fish there. The British wrote that they did not like the shark but they liked the thing called "silver herring" which was menhaden. Several factories started canning operations expecting to continue after the War, but they were stopped by a peculiar little quirk of folk knowledge. People who know menhaden very often equate it with fertilizer. The Food and Drug Administration would not permit menhaden to be sold under the name of "silver herring" – It has to be sold as menhaden. I think that if you would really want to sell it, and can it and try it, you could make a very good product out of it.

Now, may I say one more thing. You know, there are four kinds of menhaden in the Gulf and in the Atlantic. The Atlantic coast has a large scale, very slimy species and it also has a fine scale, yellowish species which is not slimy. In the Atlantic these fine scaled menhaden are specifically saved for food by the fishermen, while here we do not eat them at all. We do not actually know how many of them there are. I would like to suggest that biologists study these animals, because they may be in very large abundance.

Comment – Jackson Davis: I would like to comment on Earl Conrad's question earlier in the session of whether it is necessary to sit and study the menhaden to death while the fishery may be worsening in the interim. It appears to me that the biological information necessary for a management program of the Gulf menhaden is in hand, if we presume that management programs must be started on an experimental basis. We are not going to have a perfect program when we start.

It seems to me that there is a fundamental lack of well defined goals for management. We cannot approach a management program with a goal stated in the motherhood terms of, "The greatest good for the most of society and best use of resources." We have got to have a carefully spelled out statement of goals; and, secondly, the major thing that is lacking is a governmental agency capable of executing the steps necessary to obtain this goal.

We have involved in our fishery regulations, states, counties, health departments, and a total mish-mash, none of which have sufficient geographic authority. This is our major difficulty. No single governmental agency has control over the entire geographic area of the menhaden fishery, or even the Gulf menhaden fishery, to execute a management program even if we knew what goals we were attempting to obtain.

These are the things we need to work on and we need stronger industry participation than we have had to assist in defining the goals of the program. This has been a major weakness. I fully sympathize with industry's suspicion of the management programs that have occurred to date. I will have to admit that the record of fisheries management is pretty poor largely because it has been approached by special interest groups and enforcement authorities that do not have adequate geographic powers or responsibilities. What is needed at this time is not so much further biological investigation, but a statement of goals in which industry should take the lead. Then we need the formation of a unit which can execute the action necessary to obtain these goals.

Q. – Wm. Herke: How old are 1- and 2-year-old fish in terms of days and months from the date of hatching?

A. – R. Chapoton: The answer on ages is much like our own age in the U.S. A 1-year-old child is anywhere between one year and one day old to one day less than his second birthday. That is the same as with our Gulf menhaden terminology. With the peak spawn in January and if you assume most of the fish are caught a year and a half later, that is in July, a 1-year-old fish, on the average, in the Gulf is actually 18 months old. A 2-year-old fish is 12 months plus 18 months old, on the average. Just keep in mind our own age system and that will solve it.

Q. – Wm. Herke: A published summary on the Atlantic menhaden was written by John Reintjes for FAO. Are we able to write a summary of the biological knowledge of the Gulf menhaden or is it, as you seem to be intimating in your address, largely a matter of thousands of questions but not many answers?

A. – R. Chapoton: We do have some answers in individual articles. The synopsis on the Atlantic menhaden was based on 12 to 14 years of study summarizing over 100 articles reported from the Fisheries Center at Beaufort, North Carolina.

Research is moving fast here in the Gulf as elsewhere in the world fisheries so a publication does not mean an end-point. It is only an intermediate and we have been trying our hardest to get information to industry and to the various commissions as often as we can. In 1972, we met with industry six times on both the Gulf and Atlantic to tell them what we were finding. The menhaden industry has a good working group, the National Fishmeal and Oil Association. We meet with them two or three times a year and we visit their plants. I do not believe any fishery has a government agency working more diligently or kept better informed of research progress than the Gulf menhaden fishery. So, I would not put too much importance on one publication. It is important to us, but there are

many other interim reports and information data banks filed with industry and with the various commissions.

Q. – Wm. Herke: How does someone not closely allied with you obtain this information? If, for instance, I wanted to start a project to do some study on menhaden, how do I bring myself up-to-date?

A. – R. Chapoton: Well, you can give us a phone call or write and we will send you all that we do have published and in report form. If need be, we will come see you.

We have been gathering information for about 10 years in the Gulf and in April 1973, we made our first formal quantitative forecast of the menhaden landings for the Gulf of Mexico in 1973. In 1972 the catch totaled a little over 500 metric tons or about 25% of the total U.S. catch of marine and freshwater fishery products. This is the magnitude of the catch we are studying. We made a forecast based on units of effort that I defined before and while we have refinements to make in that area, our forecast appears to be only 4% off. This is a pelagic fish. I do not believe any previous forecast for any pelagic fishery in the United States has been within 4%. Our forecast on the Atlantic fishery is distinctively different because of different species and different operations. It is only about 5% off at this time. We are very optimistic about this forecasting method and the methods can be made available to anyone interested.