

DISCUSSION

Caribbean and Estuarine Session

Discussion Leader: EDWARD KLIMA

Discussion Panel: HAROLD BERKSON, JOHN B. LEWIS, JOHN MUNRO,
JOHN C. RAFTERY AND JOSE A. SUAREZ CAABRO

Review of the UNDP/FAO Caribbean Fisheries Development Project, Phase I, 1965 - 1969

JOHN L. DIBBS

- Q. Jose A. Suarez: How do Puerto Rican fisheries compare with those of other Caribbean countries?
- A. John L. Dibbs: The pattern of the in-shore fisheries as they exist at present is similar throughout the Greater and Lesser Antilles. The island fisheries are mostly at the subsistence level, and their chances of development to major industrial fisheries are unlikely. There is greater development off the northern coast of South America.
- Q. John Munro: Have you had any success in marketing sharks and processing sharks? No use is made of them in Jamaica.
- A. Dibbs: We started a program to evaluate the size of the shark resource in 1968. Shark catches with long-lines were not encouraging in the area between Trinidad and French Guiana. At that time we also initiated a program for shark utilization. We looked for a salt-dried shark product to replace some of the tremendous amount of salt-dried fish consumed in the Caribbean area. Initial experiments in product development have been quite rewarding; a good product has been produced. However, the economic soundness of it has not yet been proven. Salt-dried shark would probably be higher in price than the present imports. Fileted and frozen shark appear to be much more economical and could compete successfully with other frozen products. To overcome local prejudice against eating sharks, we called our product "Caribbean Sea Flake." Consumer acceptance has been good according to test marketing over a 6-month period.
- We also have a fish processing technologist on the job. He will be dealing with shark products and we hope to prove the resource is a valuable one to Caribbean people.
- Q. Dale Beaumariage: We found it virtually impossible to incorporate shark into Florida's fresh or frozen market because of the amount of spoilage attributable to the free urea in the blood. Have you considered this?
- A. Dibbs: So far, we have not had any trouble with urea. We did have an expert show us how to handle sharks correctly. I think I would be right in saying we have had shark aboard the vessel up to 8 or 10 days without any deterioration in the quality.
- Q. John Lewis: You remarked on the relative success of troll fishing and

longline fishing in your resource survey. Have you found any new in-shore fisheries resources which are amenable to exploitation by the smaller islands? What do you think the future holds for these smaller islands, keeping in view the limited capital available for fishery development and the limited resources and marketing facilities?

A. Dibbs:

This project is a survey of the off-shore resources, those not immediately available to the in-shore fisheries.

The peripheral benefits of our work to the in-shore fisheries are somewhat obscure. In particular, the trolling resources that we found are available to many of the smaller islands. In the next phase of the project we will conduct deep water trap fishing to which the in-shore fisheries may be able to adapt, but we will not be looking for in-shore resources. You are quite right when you suggest that the limited capital of these islands would probably preclude them from entering off-shore fisheries. This then becomes a government policy decision of whether or not they will make an attempt to feed the people of these islands. The available animal protein is very limited. They don't have cattle industries, so fish is obviously wanted. Developing these fisheries is a matter of regional grouping. Perhaps the smaller islands can be supplied by a fleet of vessels either run by themselves or run by one of the bigger countries.

A recent development in the Caribbean is CARIFTA, the Caribbean Free Trade Association. There is a free interchange of fish products between these islands. The smaller islands can, in the long term, benefit by obtaining extra protein which, at the present moment, is imported.

Q. Harvey
Wallace:

You mentioned that this program was set up as a pre-investment investigation. Are you seeing significant tangible signs of investment at this stage?

A. Dibbs:

Developing fisheries in this area appears to be a very sound investment. The trawl fisheries of the northern coast of South America, for example, could be a very important domestic resource to the countries of the Caribbean. There are indications of quite substantial resources of snapper and related species, but this work is not completed. We will certainly investigate investment possibilities when the results of this study are conclusive. We have a major program concerning tunas commencing next year. A concentrated effort will be made to harvest the skip jack resources existing in the area of the Lesser Antilles, principally between St. Lucia and the Grenadines. If we find a way of catching them, there will certainly be opportunities for investment.

Q. Wallace:

My question was a little bit more pointed. I was wondering about direct responses you had received from interested investment groups. I was trying to get a better idea of how much interest this program has generated among potential investors or companies that could take advantage of the results of this program.

- A. Dibbs: Inquiries from the United States and Canada are coming in at a rate between five and ten a week. I find that more time is now being devoted to potential investment interests.
- Q. Edward Klima: What do you anticipate as the potential yield of the area in the next 10 years?
- A. Dibbs: I think the figure approximates 300,000 tons per annum.

***Survey of the Commercial Fishery of the Virgin Islands
of the United States***

WAYNE E. SWINGLE, ARTHUR E. DAMMANN
AND JOHN A. YNTEMA

- Q. Suarez: You said some fish is imported from Puerto Rico. I understand all the Puerto Rican catches are consumed on the island. Please explain how you know that imported species are actually from Puerto Rico.
- A. Wayne E. Swingle: These imports are frozen fish. The fish may originate from Florida or other places. About 40% of the imports were frozen kingfish and the majority of that originated from a Florida fishery.
- Q. Munro: You gave a catch range of about 6.5 to 10.5 pounds per fish pot per haul. Does the abundance of reef fish in the islands differ in response to the amounts of pot fishing?
- A. Swingle: Not really, those figures were based on the assumption that the entire catch was from pots. This wasn't the case. The species were more or less the same in the catches from the American Virgin Islands and the British Virgin Islands.
- Q. Munro: Were there any significant differences in the percentage composition of the catch?
- A. Swingle: We really didn't determine the composition of the catches. We recorded them in one category as "pot reef fish," or, "pot fish."
- Q. Lewis: Is there any export of lobsters to the mainland market?
- A. Swingle: No. Actually, a large percentage of the imported frozen seafood is lobster tails. Fish normally command the price of \$0.50 in the raw and lobster \$0.85 live weight.
- Q. Harold Berkson: In many cases sport fishing is much more significant than commercial fishing. How is this being affected by the pollution problem that was referred to?
- A. Swingle: The primary sport fishery is for marlin. If the sportsmen do not catch marlin, the guides try to placate their customers with something else. The pollution of St. Croix is located along the southwest shore and is mainly a result of dredge operations. The fishing ground there is located on the east end of the island and there are occasional complaints of murky water from this dredging.
- Q. Berkson: What is the value of recreational fishing as opposed to commercial fishing?
- A. Swingle: The recreational fishing will become worth quite a bit more than the commercial fishing, but at the time I was there,

- there probably weren't over 15 charter boats operating out of the islands.
- Q. John C. Raftery:
A. Swingle: Is there any recreational spear fishing that is significant in the Virgin Islands economy?
Yes, particularly on St. Thomas. We don't know the exact amount, but the lobster obtained in this manner is sold on the market.
- Robert Brody:
(Comment) The sport fishery has more than doubled since Mr. Swingle left the island last year; there are now about 35 full-time charter boats.
Recently we discovered that the Hess and Harvey Complex has increased their pollution to a larger degree. In addition to murky water, there are secondary problems involved in their processing. Some sediments from their processing plant cause the precipitation of magnesium and other elements. This has decreased the marine flora in the immediate neighborhood. Sport fishing on the south and southwest coasts of St. Croix has been nearly eliminated in the last 2 years since that operation started. The majority of the fishermen have left the south side of St. Croix and are working only on the north. The two major continental people have also left the sport fishing business and are now working in other jobs; so there has been a distinct effect of the pollution in that area.
- Q. A. Taytaud: The Harvey-Hess Complex destroyed one of the largest mangrove swamp areas in St. Croix. Is there currently any concern or legislation designed to protect the few remaining mangrove areas in St. Croix?
- A. Swingle: There wasn't at the time I was there, but perhaps you should direct your question to Mr. Brody since he is more familiar with the current situation.
- Brody:
(Comment) Presently we are involved in a number of small research projects that include general and environmental surveys, inventories in various areas, bacteriology counts, etc. The mangrove areas are directly involved. The epiflora and epifauna have been almost eliminated in the Hess and Harvey Complex area.
In St. Thomas a bond issue was recently passed to finance a large jetport which will probably "wipe out" 90% of the mangrove area left on the island. To build this jetport, approximately 3 million cubic yards of volcanic rock will have to be moved, and in doing so a lot of fine sediments will be produced which will pretty well eliminate the marine flora of Jersey Bay.

The Red Grouper Fishery of Yucatan Peninsula, Mexico

MANUEL J. SOLIS

- Suarez:
(Comment) Since the last century, people from Cuba have fished in Campeche. Future research on the red grouper in Campeche should consider the Cuban boats and fishing effort.

- Q. Munro: I was interested in size limits in relation to the sex change. Is this minimum size related to the size at which the groupers change from females to males? Do you have any ideas on how to manage a fishery where all the larger fish are males? Theoretically if you fish it too hard you wind up with a monosexual population which becomes extinct.
- A. Solis: The minimum legal size has been established as 300 mm. At that length the grouper has spawned at least once and probably twice.
- Q. Lewis: You suggested that there was a need to look for new fisheries to take the place of this grouper fishery which you feel is being over-fished. Are there other resources in the area the grouper fishermen can move to?
- A. Solis: Yes. We have other species, but we need to modernize the coastal fishing fleet to exploit new resources.

The Contribution of Mangrove Swamps to Florida Fisheries

ERIC J. HEALD AND WILLIAM E. ODUM

- Q. Suarez: Do you find any species of oyster growing on the mangrove roots?
- A. Eric J. Heald: Yes. During the high saline period, above 5 to 8 parts per thousand (ppt), the oyster spat begins to set on the roots. They grow throughout the dry period when salinities remain above 8 ppt. This varies from year to year, approximately from November or December through June. When the rainy period arrives, there is a sudden drop in salinity and the oysters die.
- Q. Munro: How much of the 3 tons per year of litter is flushed out of the estuaries by tidal action and run-off?
- A. Heald: We estimate about 50% is actually transported outside the estuary.
- Q. Munro: Is it then lost or are there communities outside which could utilize it as efficiently as it is utilized in the swamp?
- A. Heald: I wouldn't like to comment on whether or not they could use it as efficiently. I'm certain it does support the adjacent off-shore waters to a considerable extent.
- Q. Munro: Then the estuaries are not only important from a nursery point of view, but also contribute to offshore areas.
- A. Heald: Exactly. In addition to maintaining their own community, they contribute to further production of the continental shelf.
- Q. Lewis: I'm also interested in the in-put and out-flow of the detritus in your estuary. It strikes me that the rate of decomposition of mangrove leaves takes so long. It is almost a whole year before there is a complete breakdown, therefore the loss-rate of nutrient material may be very high. I wonder how much of the actual detrital in-put comes from the mangrove leaves and how much comes from the watershed system.
- A. Heald: This varies with the time of the year. During the rainy season, the water level in the swamp rises and we get a

rapid flushing. The accumulated mangrove detritus is flushed rapidly into the main stream where most of the export occurs. Much of the year, decomposition occurs in inter-lacing streams and pool systems that do not have good connections with the main river, so we have a relatively slow rate of detrital transport.

- Q. Berkson: You said the mangrove leaves were not the direct energy in-put into the cycle but served as a substrate for the bacteria, protozoa and fungi. Do you have any information as to the energy content of these leaves which are directly utilized by the small amphipods or is it possible you really have a second level—the energy relationship of the leaf to bacteria to amphipods?
- A. Heald: Yes, this is true. The bacterial conversion is an essential part of the system. We could not determine whether the bacteria and fungi were deriving nutrient from their mangrove substrate directly, or whether they were using it merely as a physical substrate. The particle does become smaller as it ages and there is a successive enrichment in terms of total nitrogen and total caloric content. Whatever the mechanism, there is a particle enrichment process.
- Q. Berkson: Then, you could just as well start from sawdust?
- A. Heald: Yes, except that it might not be as easy to find bacteria which will rapidly colonize it. In a leaf you get residual proteins as well as refractive celluloses. These celluloses form the physical substrate, but at the same time there is a high fat content and a certain protein content in any dead leaf which is available to bacteria.
- Q. Raftery: You indicated you determined the rate of the breakdown in brackish and fresh water conditions. Did you also make similar studies in conditions of normal salinity?
- A. Heald: Leaves disappear from 2 mm mesh bags in about 3 or 4 months in normal sea water. Within 2 months the bags are full of amphipods—large *Melita* which literally rip the leaves to pieces. *Melita* becomes less abundant and other smaller amphipods take its place as you move to lower salinities.
- Q. Raftery: Is the brackish water condition the most desirable for the breakdown of the mangrove leaf?
- A. Heald: No, not for rapid breakdown of the leaf.
- Q. Raftery: But it is contributing to the environment?
- A. Heald: Yes.
- Q. Raftery: Does a reduction of fresh water in the estuarine area create a more rapid breakdown of the mangrove material and get a more rapid entry of this nutrient into the system?
- A. Heald: Yes, but at the same time, the system is dependent on a flushing of these marshes where much of the material accumulates during the year. If we don't have rapid ingress of fresh water from upstream, we won't get this flushing effect. We will get rapid deposition of material and low

oxygen, and the whole estuarine complex will fill up to become a buttonwood and willow complex. You cannot maintain your present productivity levels without this flushing.

- A. Raftery: In other words you would destroy your estuary without abundant supplies of fresh water?
- A. Heald: Yes, you destroy your generative system. Reduced fresh water may increase its efficiency at one stage, but ultimately you will destroy the process.
- William Odum:
(Comment) Mangroves are fixing energy in the form of carbon at a very high level per square meter. This carbon source, mainly celluloses, is utilized by the fungi and bacteria which easily break it down. Thus it is not only a substrate but also a source of energy. Consequently these fungi and bacteria are a great food source in themselves. We are not saying mangroves are a great source of dissolved nutrients but they are a source of organic carbon.
- Q. Don Wyler: Was this study solely on red mangroves or were black and white mangrove included?
- A. Heald: It was primarily red mangrove. The system contained a few white mangroves, perhaps 1%. Black mangrove was almost completely absent.
- Q. Wyler: What percent of the detritus from the mangrove was leaves and what percent would be seed pods or the plant parts?
- A. Heald: The seed pod and the generating fruit were not included as litter because they will grow. Of the leaf scales, flower scales, twigs and leaves—leaves were about 85% of the total dry weight. We had no measure of fruit-shedding. Neither could we devise a way to measure how much root the mangrove was losing, but most of this is bound up in the soil. It probably did not enter the aquatic system in quantity.
- Q. Donald Allen: Was the leaf fall essentially continuous throughout the year or is it seasonal?
- A. Heald: It is markedly seasonal. There is leaf fall all year round. The months of May, June and July were the peak leaf-fall periods. June alone accounted for about 60% of the leaf fall.

***The Effects of Thermal Additions on the Biota of
Southern Biscayne Bay, Florida***

MARTIN A. ROESSLER AND JOSEPH C. ZIEMAN, JR.

- Q. Suarez: Are there any species of algae that become dominant in areas of thermal pollution?
- A. Ziemann: Two common species of algae, *Acetabularia crenulata* and *Batophora oerstedii*, seem to be the most resistant to temperature. These often coexist in highly stressed areas with a blue-green filamentous algal mat. When the stress becomes severe, these two macro-algae disappear and only the mat remains.

- Q. Munro: The area of Biscayne Bay that is presently affected by the thermal pollution is relatively small; is that correct?
- A. Zieman: The area of almost total destruction was perhaps 70 acres in September 1969. Measurable damage covered approximately 300 to 325 acres. Compared with the total area of Biscayne Bay, approximately 143,000 acres, this is an extremely small percentage.
- Q. Lewis: What were the absolute temperatures reached in Biscayne Bay?
- A. Zieman: During the summer, daily high temperatures averaged 36 to 37°C, and occasionally peak high temperatures of 39-40° were reached.
- Q. Berkson: Have you been able to separate the temperature effects from the effects of copper or other materials?
- A. Zieman: Other scientists associated with this project collected data on temperature, salinity, oxygen, copper, iron, phosphates and other physio-chemical parameters. At this point, the amount of data collected is so small it is not possible to utilize complex analytical techniques which are required to determine the relative effects of each of these physio-chemical parameters. However, some preliminary analyses indicate that the correlation with the biological changes is far greater with temperature than with any other parameter.
- Q. Raftery: How long does it take the bay to absorb the heat and return to normal from the effect of the increased effluent?
- A. Zieman: It is quite easy to detect a gradient from the mouth of the effluent canal out to 0.5 mile. Slight effects, particularly in the northeasterly direction, are measurable 1 to 1.5 miles away.
- Norris Kincaid:
(Comment) I hope you don't leave here with the impression that when the Turkey Point nuclear units go into operation we anticipate increasing the discharge temperature 6 to 8°C. I assure you that the effluent temperatures will comply with the Dade County guidelines.
- Q. Tarzwell: Are you going to cool the effluent so you won't have as much heating with the future plant as you now have with your present plant?
- A. Kincaid: The rise over the condensers will be 6 to 8°, but we won't discharge the water into the bay at those temperatures. We will cool it prior to its entering the bay.
- Q. Tarzwell: The temperatures found now are as high as 104°F, and 100° seems to be quite common over certain areas. Do you intend to cool the effluent with your increased operation?
- A. Kincaid: We have a plan to completely revise the water cooling system when we put the two nuclear units on. The plan has been presented. It is public information now, and we think it is the most reasonable, sensible and logical thing to do. But the ultimate result is what the temperature of the water will be when it is discharged in the bay. It won't

- be anything comparable to what it is today and certainly won't be 6 to 8°C above the ambient.
- Q. Joe Carroll: Why was there a higher number of crustaceans in the transition zone you described?
- A. Zieman: The plants in this zone tend to recover in the winter and to be reduced in the summer. Most of the vegetation that dies off in the summer remains in the transition zone. This attracts detritus feeders. Some small crustacea are detritus feeders and others are there as predators.
- Q. Carroll: Do you consider the plankton that is passed over the condenser coils a possible source of this detritus?
- A. Zieman: There may be some plankton remains in there, but I tend to think it is primarily vegetation.
Dr. Michael Reeve is studying this effect. He finds, depending on the time of the year, an increase in the water temperature and varying amounts of dead plankton coming from the plant. Until his studies are completed, it will not be possible to quantitatively determine the amount of plankton in the intermediate area.

Estuarine Pesticide Research—Bureau of Commercial Fisheries

THOMAS W. DUKE

- Q. Suarez: Have you any information about the percent of pesticide retained at the plankton level?
- A. Thomas W. Duke: At one time in Santa Rosa Sound the pesticide level in the water was recorded at .01 parts per billion (ppb), but the level in the plankton was 0.5 parts per million (ppm).
- Q. Munro: There is evidence that calcification processes in higher animals are affected by DDT. Do you find anything similar in the oysters you use as control animals? Is there any decrease in shell thickness or is growth slowed?
- A. Duke: This has not been investigated enough to say "Yes" or "No," but from an examination that has been done, it has not shown up so far.
- Q. Lewis: It has been shown that DDT lowers the productive rates in birds and affects the calcification of their egg shells. Have you found any influence on the rate of reproduction in the oysters that you have examined?
- A. Duke: Dr. Butler has done some work on the concentration of DDT in oyster eggs but to my knowledge it has not affected reproduction.
Recently the Texas Fish and Game Commission showed that trout in one of their coastal areas contained relatively large amounts of DDT. The trout population in this area was much lower in comparison with trout populations in nearby areas that did not contain DDT.
- Q. Berkson: You mentioned testing many pesticides at your laboratory. What effect is the effluent from your laboratory having on ecology?

- A. Duke: When we are working with high concentrations of toxic materials, we run it through a charcoal filter which adsorbs most of this material. We have a 300 gallon per minute dilution but this is still effluent. We have cages of young oysters sitting off the effluent pipe. We monitor them to make sure we are not contributing to the accumulation of pesticides in the estuary.
- Q. Raftery: You reported few monitoring stations in South Florida. Is there any particular reason for this?
- A. Duke: Yes. In many places along the coast, state and other agencies are monitoring. Monitoring was not duplicated. They first started looking at the more concentrated areas. When the areas they monitored for 4 years revealed nothing, funds and personnel became a problem and monitoring stations were reduced.
- Q. Raftery: The northeast corner of Everglades National Park is receiving water from Conservation Area 3. The flow from one conservation area contains pesticides at a concentration of about 4 ppb. Samples of eagle eggs taken in the extreme southwestern corner of Florida Bay, which would seem to be the least affected, actually had some of the highest concentrations of DDT. We would be very interested in participating in some monitoring system along the coast.
- Q. John Bellinger: If the use of DDT is banned in the future, will industry go to an even more dangerous pesticide?
- A. Duke: Not if the Fish and Wildlife Service has anything to do with it.