Our next step would be to arrange for distribution of recipes through the Florida Restaurant Association to its members. Again, the cooperation of the educational media has whetted the appetite of the consumer to try Calico scallops in his or her favorite restaurant.

Through the U.S. Department of Agriculture, we would arrange for distribution of recipes to the various institutions which, of course, would find their way to such places here in Miami as hospitals, the University of Miami, sanitoriums, etc.

In the meantime, extension agents are also teaching the housewife how to prepare these scallops; they are promoting scallops on their radio and television shows, and they are writing about scallops in their newspaper columns.

We now can go to frozen food distributors and brokers and point out what is being done to promote Calico scallops. They, in turn, now are able to follow through and buy scallops with the knowledge that some of the groundwork has been laid to help them sell this item to retailers, institutions, and restaurants. And these brokers and distributors are the ones that bridge the gap between the producer and the retailer, and ultimately, the consumer. Industry, i.e., producers processors, brokers, distributors and retailers, are now in a position to form a coordinated advertising and promotional program for Calico scallops. The type of program developed by industry will determine the relative sales success of this item. Any efforts by U.S. Bureau of Commercial Fisheries personnel are meant *not* as a substitute, but rather to supplement and complement the efforts of industry.

As of this moment, we can sum up the history of the Calico scallop fishery in a very few words: discovery, technological development and some of the groundwork for a market development and market promotional program have all transpired in less than a year. Although a fishery with a short past, it is one with a long future.

A Progress Report on Experimental Fishing for Sardine-Like Fishes in the Gulf of Mexico

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THE GULF OF MEXICO pelagic schoolfish research, conducted by the U. S. Bureau of Commercial Fisheries, has been in progress for approximately three years. A summary of the first year of activities was presented to the Institute at the 11th annual session (Thompson 1958). Since that time, a number of interesting findings have been obtained, and it is the purpose of this paper to provide an interim report on the status of the research.

Midwater Trawling

A large share of the total effort expended on gear research throughout the world in the past ten years has been devoted to the development of commercially-operable midwater trawling gear. We have been able to profit

somewhat from the findings resulting from this considerable amount of work, but these findings have not been sufficient to solve our local problems. It has been necessary to depart from designs developed and successfully employed in other parts of the world including Canada (British Columbia), Europe, and elsewhere, to so much as "break the ice" in the capture of commercial-scale quantities of our pelagic species.

Gear modifications: To enumerate the research projects pertaining to mid-water trawling gear and methods that have been undertaken on the international scene during the past ten years is beyond the scope of this report. A great deal of theory has had to be employed because only the sketchiest information has been available on the behavior of pelagic fishes or their reactions to trawling gear. Parrish (1959) summarizes the general consensus that pelagic school fishes tend to flee downward in front of an approaching trawl. To this we add our theory that most of these pelagic fishes are alarmed to a much greater extent by attempts to move netting over them than by attempts to slip netting under them. This has been substantiated somewhat by observing the reactions of scaled sardines, menhaden, thread herring, and Spanish mackerel during experimental lampara seining and while near-surface trawling with the two boat Larsen midwater trawl.

At present, the basic modification embodies net construction principles derived from underwater observations of trawls by the diving team of the Gear Research Unit at Pascagoula. These observations of trawl configuration at varying towing speeds strongly indicate that there is a widespread misconception concerning the role of headropes and footropes, and that the importance of determining optimum towing speed is often underrated.

Briefly stated, headropes and footropes are merely lines or cables extending from otter board to otter board. To these lines the net is attached or "hung," and from these lines the net is towed. The strain of the trawl is transmitted to the headrope and footrope and thence to the doors. An increased trawl strain or "drag" resulting from increased towing speed creates a backward sag in the net, bowing the headrope and footrope and changing the net configuration. Changes in net configuration, in turn, change the distribution of strain along the hangings or in the body. The greatest strain runs backward through the webbing from the point of tow—not crosswise with the headrope and footrope. This has been observed constantly in shrimp trawls where the meshes in the wings are stretched into elongated narrow diamonds whereas meshes in the top and bottom body sections are wide open. Using conventional headropes and footropes to take the strain, therefore, is somewhat irrational as it ignores the points and directions of strain.

To counteract this adverse net-sag/water-speed reaction we have designed trawls, the netting components of which are hung to exaggerated rib lines which are aligned along the paths of longitudinal stress. The four sides of the net are virtually V-shaped. The top, bottom, and sides are merely filled in with netting hung to a light line, which, although positioned as normal or customary head and footropes, take only the minor drag of the fill-in netting.

In the models presently under study the two lower wings are considerably longer than the upper wings. The fill-in netting of the bottom V extends well ahead of the forward edge of the "pseudo-headrope." The side V's are filled in wing-tip to wing-tip and the final effect is to create, as it were, a "topless net."

The theoretical assumption here is that a floor and side walls of netting can be positioned around schools of some species before the top-body panel of the trawl creates an extreme flight reaction.

In this manner we hope to overcome the problem of drastic change in net configuration, especially with the increased speed necessary in midwater trawling. Forthcoming experiments will employ these design characteristics combined with the use of knotless nylon netting—a combination which should enable trawling speeds above the present feasible limits.

The trawls are designed to measure approximately 60 feet square at the mouth, which we consider quasi-commercial in size with large Gulf trawlers.

Our experience, compatible with all other findings, has been that reliable telemetry is basic to successful midwater fishing. The equipment developed by McNeely (1959) has been used exclusively to date and has been very effective; however, some operational problems have appeared. Most serious is the frequent breakage of electrical conductors within the trawl cable. Second, telemetry is for otter-board level only and a number of discrepancies of trawl vs. board depth have been noted. These are within a magnitude of five fathoms, which is beyond acceptable tolerances. Present tests are employing pressure-sensing elements embedded in plastic which can be positioned at optional points along either the headrope or footrope, with separate trawl-to-boat conductors. Leakage of the water-tight housing has been minimal and occurred only when units were used at depths greater than 150 fathoms.

However, depth telemetry in itself is not the entire answer. The recently concluded studies by the Institut für Netz und Materialforshung, Hamburg, Germany, using a modified Atlas-Werke recorder with the transducer mounted on the trawl headrope (as reported on by Schärfe, 1960) appear to hold excellent promise for our regional studies, and we hope to test this or similar equipment in the north Gulf this winter. In essence, the recorded tracing shows what passes through the mouth of the trawl and the distance of the bottom of the trawl from the sea bottom.

General results: Most of the test fishing has been conducted in the Mississippi Delta area where schools are quite abundant in all seasons in depths of 10 to 75 fathoms. Successions of species seem to move through the area, and although it is now possible to identify some schools as to genus and species from fathogram profiles, trial tows have not been intended to be selective.

Highest catches during the tests have consisted predominantly of bumpers, *Chloroscombrus chrysurus,* and harvestfish, *Peprilus alepidotus,* species that could be considered commercially utilizable only for petfood or fish meal at the present time. Catches of 3000 to 7000 pounds per 60 to 80 minute tow with relatively unrefined gear have been made on two cruises.

Other species which have been caught at the rates of 1000 pounds or more per hour include thread herring *(Opisthonema oglinum),* scaled sardines *(Harengula pensacolae),* pinfish *(Lagodon rhomboides),* menhaden *(Brevoortia patronus),* and butterfish *(Poronotus triacanthus).*

The future: In the future, more emphasis in the pelagic, sardine-like schoolfish research will be placed on behavior studies of the species of interest. Actually, this should have been a starting point some three years ago, but at that time we had few ideas of what species might be present in large numbers or where and when they might be found. The tool we are putting into operation now is an underwater housing with a television camera used as a sighting device for a

remote-controlled motion-picture camera. This instrument will be attached either to a paravane or a remote-controlled sled. Positioning it at various positions around the mouth of the net will permit the collection of reliable information on evasive movements of most species. Some motion-picture footage that has been obtained by diver-photographers working around bottom trawls indicates that several species have little to fear from conventional gear. A good example is the carangid group (schools of jacks) viewed by divers which commonly approached a trawl apparently out of curiosity; swam around the cod-end, the body, the wings, and down into the mouth—moving as far as the throat or entrance to the cod-end; and then easily swam back out of the mouth. Observations such as these conjure up disturbing thoughts of the interpretations placed on quantitative and qualitative trawl sampling with gear used to date.

Some method of evaluating the efficiency of midwater trawling gear is desperately needed. The only feasible method seems to be repetitive observations with TV and motion pictures on escape behavior. With this information in hand, the 1000- or 5000-pound catch rates which we have experienced so often will be much more meaningful and gear development greatly simplified.

Other Gear Studies

Other gear studies pertaining to capture of pelagic species have included night light attraction and trapping experiments, lampara seining, and surface trawling. Night-light attraction studies have produced no significantly new information to date. A large number of species have shown positive attraction response, but insufficient time has been spent to obtain commercially-useful information on production.

A surface trawl has been tested as a scale model, rigged for shallow trawling. It was developed at the request of, and with suggestions from, Leon Kenny and Heber Bell of the St. Petersburg area, who hope to apply this fishing method to Spanish mackerel when extremely murky water conditions are present in the Florida Bay. This project has been called off for the present, but the gear appears to have some promise for anchovy fishing in the northern Gulf and will be test fished next summer.

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