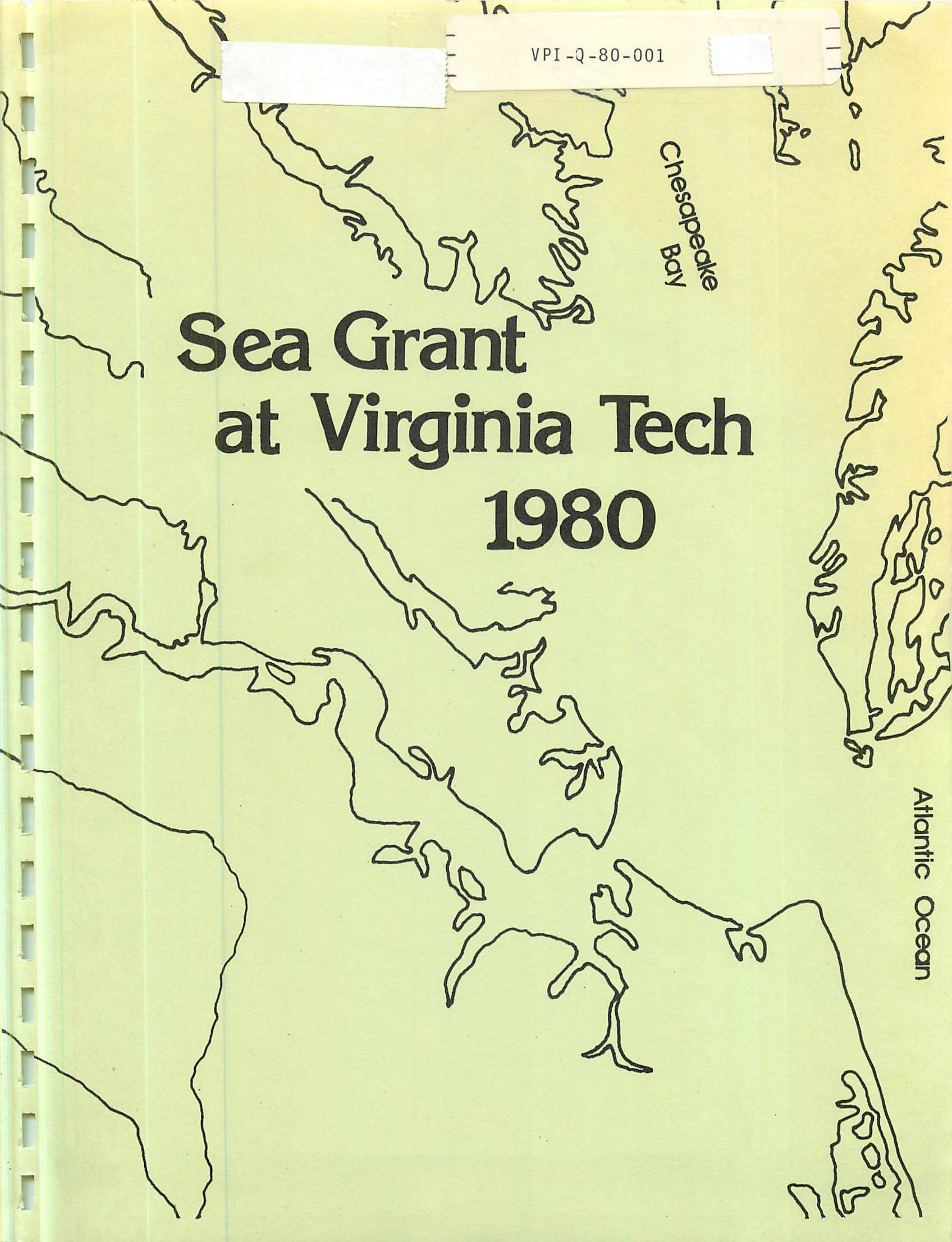
Sea Grant at Virginia Tech 1980



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INTRODUCTION

Virginia Polytechnic Institute and State University (Virginia Tech) has been active with the Sea Grant program since December 1, 1971. Virginia Tech's first three years were directed toward developing an effective and efficient Marine Advisory Project (MAP). In 1974, the university received its first research project and in 1977 its first education project. The program was evaluated to Coherent Area status in 1980.

While Virginia Tech has had a long association with Sea Grant, it is only recently that the program has developed multi- and interdisciplinary aspects. The Marine Advisory Program has matured rapidly and substantially during the past years and will play an important role in the identification of program areas and the transfer of Science and Technology to user groups.

Virginia Tech has always felt close to the needs of the communities. This is in accordance with the purpose of a land-grant university, which is to serve the needs of the state's citizens.

Marine resources are important to Virginia, which has the largest shipyard in the world and the second largest export port in the United States. During 1979, Virginia ranked fourth within the U.S. in total seafood production, supplying approximately ten percent of the nation's seafood.

Since Virginia Tech first received its grant, many problems of various users of marine resources in the state have been identified. As a land-grant school, Virginia Tech already had an efficient and effective Extension program that could be used as a functional tool for the Marine Advisory Service.

Virginia Tech receives help and cooperation from various seafood processors, seafood groups, and other organizations.

The Sea Grant program at Virginia Tech is administered under the President of the university, William E. Lavery. E. Neal Boyd serves as both the Director of Sea Grant and Associate Dean of College of Agriculture and Life Sciences.

It is anticipated that the university's Sea Grant program will continue to grow. Many projects are either national or regional in scope so the program is cost-effective and the results are easily transferable to other Sea Grant programs.

E. Neal Boyd
Sea Grant Director

Mineral Elements in Seafood

Professionals in medicine, dietetics, public health, and the food industry require the content of essential nutrients in all foods, including fish and other seafood. This information is important to human health and necessary to make critical decisions about nutrient intake. Specifically, food processors, as well as health professionals, require up-to-date information about the content of seafoods and the effects of usual preparation methods upon the content of key trace elements.

Another essential issue relevant to mineral elements is their availability from foods to the human. Many elements are not readily utilized from foods. The availability of that portion of the food which becomes available for use by the human, varies with many factors. The variances occur according to combinations of elements in a specific food, the presence of other components which may bind the mineral and the degree of processing and/or cooking and the biological availability of the elements.

On January 1, 1980, S.J. Ritchey, Professor of Human Nutrition and Foods, initiated a project designed to generate information about the nutritive value of seafood commonly consumed by the population in Virginia and the adjacent geographic region. Ritchey, along with his co-investigator L. Janette Taper, Assistant Professor of Human Nutrition and Foods, gathered information that will be useful to the seafood industry in complying with food labeling and other regulations, as well as in educational and advertising programs.

The objectives of the project were (1) to determine the proximate composition and mineral content, including calcium, phosphorus, magnesium, sodium, potassium, iron, zinc, copper, and manganese in raw and cooked seafood species, including bluefish, croaker, flounder, gray sea trout, black sea bass, spot, clams, crab, oysters, and scallops; and (2) to determine the bioavailability of calcium, iron, and zinc in raw and cooked seafood.

Ritchey and Taper obtained fish from markets in eastern Virginia. Samples of both raw and cooked fish were prepared and analyzed. The cooked fish were prepared by broiling. For both raw and cooked fish, the edible flesh was carefully separated from the bone, skin, scales, and other inedible portions. The samples were then ground and mixed well in utensils which would not contaminate the flesh and distort the analysis. Many samples were maintained in a frozen state

until the analysis was complete.

The samples were analyzed for protein, fat, moisture, and total ash. Most of the mineral analyses were completed in 1980, except for a few values which require checking and confirmation. Experiments on the bioavailability of zinc are in progress.

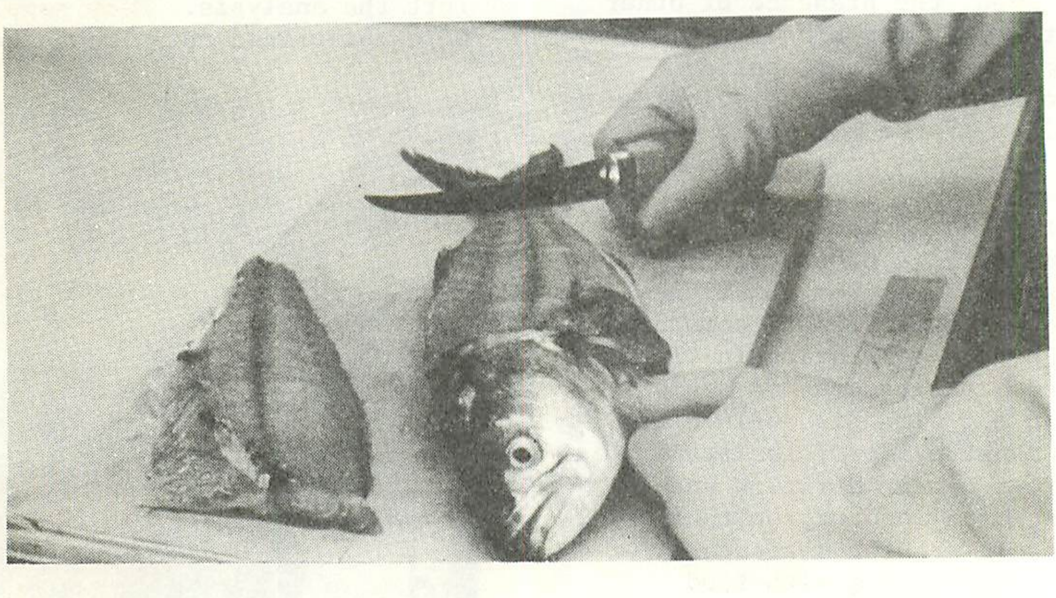
Test results show that the fish samples had a high moisture level and were low in fat. They were higher in protein when cooked than when raw. The ash content has not been determined for all of the samples, but preliminary data show that the ash levels are low.

The results of the moisture test showed that raw oyster samples were highest in moisture with 85.5 percent. Cooked oysters were also ranked high with 78.6 percent. Spot was found to have the least amount of moisture with 70.6 percent when raw and 60.9 percent when cooked.

Protein analysis showed that the samples had a higher percentage of protein when cooked than when raw because of the loss of moisture during cooling. Black sea bass were the highest in protein with 28.2 percent when cooked and 19.6 percent when raw. Oysters were shown to be lowest in protein with 12.7 percent when cooked and 9.8 percent when raw.

The samples were low in fat with spot containing the highest fat level at 13.6 percent when cooked and 9.5 percent when raw. Scallops were lowest in fat with 0.4 percent when cooked and 0.6 percent when raw. The proximate composition of fat in cooked clams has not been determined.

Future plans for the projects include completing the experiments on zinc. Ritchey and Taper will then summarize their information and prepare a publication on their findings.



Seafood Processing Production Systems

The consumption of seafood as an alternative to traditional meat sources has increased significantly in recent years. Improved processing and packaging technology, supported by effective marketing programs, have resulted due to this increased demand. The efficient production of seafood is therefore of major importance if seafood is to effectively compete as a primary food item. The State of Virginia, because of its geographic location, will play an important role in providing a continuous supply of seafood to meet this demand.

Virginia's seafood industry consists mostly of small, family-owned businesses and a few large corporations. The individual operators usually have a limited number of items. In-plant processing operations are often restricted to a single type of raw material, i.e. oysters, fish, or crabs. Due to this specialization, the physical configuration and the use of personnel and equipment in the individual facilities differ significantly, with each facility having its own unique characteristics.

The processing and handling operations, performed in many of these plants, have been performed for many years. The adaptation of new technology is fragmented and few. The acquisition of modern, mechanized equipment developed primarily for high-volume production has been viewed as inappropriate. In some instances, highly promising equipment has not performed adequately during field tests. Due to the uncertainties of implementing new technology, small processors are often reluctant to make the transition from present practices to an upgraded, but unfamiliar or untested, production technique. The new technology is too expensive, with the risks involved, for these processors. As a result, the industry has remained labor-intensive, operating with a highly unstable and dwindling work force.

In July 1979, Jose M.A. Tanchoco, Associate Professor of Industrial Engineering and Operations Research, began a study to develop generalized models for the analysis and design of production systems as they apply to seafood processing. Tanchoco divided his objective into two phases. Phase I was a comprehensive audit and a review of the current production methods used by fish and shellfish processors in Virginia. The audit identified priority areas where improvements could be made to achieve maximum production as well as economic efficiency. Tanchoco analyzed work simplification, mechanization, manpower allocation and leveling, quality inspection, production scheduling, materials handling, process flow, plant layout and design, and support services.

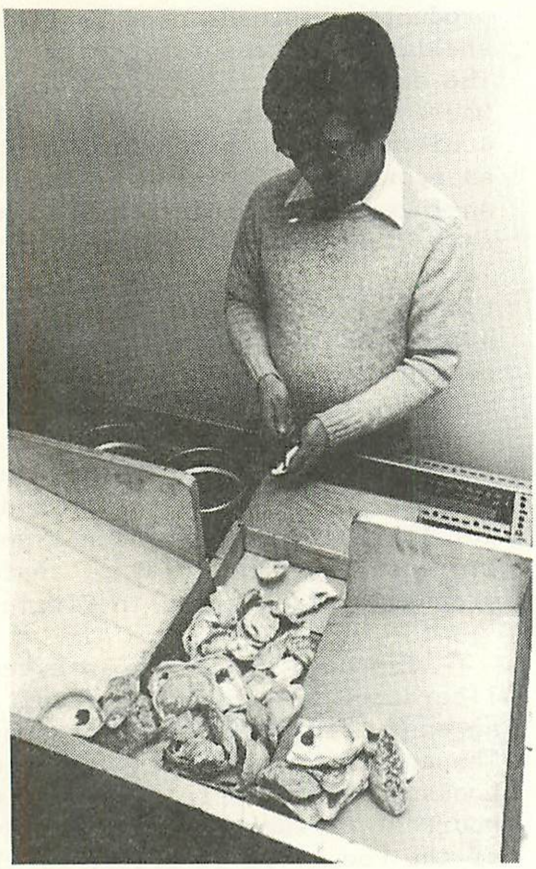
In Phase II, to be completed in 1981, Tanchoco plans to provide production analysis and design models for improving the efficiency and increasing productivity of seafood processing facilities in Virginia.

Tanchoco undertook an extensive literature search, which resulted in an easy-to-use form bibliography. The annotated bibliography includes books, journal sources, and patent sources. A summary is also provided of the countries of origin of the books, journal articles, and patents categorized by product groups.

An industry profile was prepared, based on company participation in the processing of different seafood species processed in Virginia. This chart provided the guideline in establishing priorities for the project. It is clear from these charts that the majority of processors in Virginia are engaged in the handling and processing of live, fresh or fresh-frozen seafood. These charts also indicate that high priority should be given to the processing of oyster products.

Detailed Product Flow charts were constructed for oysters, fish, crabs, and clams.

Based on the information provided in the industry profile and the Product Flow Charts, the oyster shuching operation was selected for more detailed analysis. A site visit of several oyster shucking houses indicated that some basic redesigning of work methods could



houses indicated that some basic redesigning of work methods could result in productivity improvements. The existing work station for shucking oysters was studied. Several designs have evolved from this analysis and protype modles were constructed in the Manufacturing Process Laboratory of the Industrial Engineering and Operations Research Department of Virginia Tech. The current protype can accomodate left-handed or right-handed shuckers and uses a maximum of four one-gallon pails for the various sizes (grades) of oyster meat. Further, the current design is based on the use of interchangeable modular components. Based on thirteen modular components, forty-eight configurations of the work station can be assembled ranging from a totally manned method to a fully mechanized handling operation. Each design configuration has a corresponding efficiency level, thereby allowing for the economic trade-off of adding components which increase productivity to labor savings resulting from the introduction of specific components. Individual processors may then assess their equipment requirements on the basis of their desired output level. A mathematical model of this economic trade-off problem has already been formulated. The model is a mixed-integer programming model.

The construction of an eight work station pilot processing line is currently underway. Tanchoco plans to locate this pilot processing line in one of the oyster processing facilities in Hampton, Virginia, for the purpose of obtaining actual measurements of the output rates provided by the different design configurations. A second purpose is to expose both the workers and the processors themselves on the potential cost savings and increased output that can be obtained through the use of the new improved processing line.

UTILIZATION OF WASTES

Pelleted Seafood Wastes as Fish Meal

The United States and the world supplies of high quality fish protein for animal feeds have been unstable throughout the 1970's. Peruvian anchovy catches sustained supplies at high levels throughout the 1960's, but severe drops in that industry have caused reduced and unstable supplies since about 1972. Fish meal imports in the U.S. doubled in 1979 over 1978 levels, so that all U.S. supplies of fish meal increased about one-third between 1978 and 1979.

The quality of the available fish meal is also variable. During the late 1970's, Canada became the largest supplier of U.S. fish meal imports. Canadian herring meals are produced from herring racks, since production economics prohibit the use of the whole herring. The resulting meals are lower in protein and higher in fat and ash than the previous herring meals produced from Peruvian anchovy catches.

Fish, in general, require two to four times higher dietary crude protein than warm-blooded animals. They rely heavily on high quality fish protein meals. The meals now available have definite differences in their effects on fish growth and production.

Many materials have shown promise as an alternative to the expensive fish meals. The most promising means of supplementing fish meal protein may be the use of scrap fish stocks and seafood wastes.

In September of 1978, Assistant Professor of Department of Fisheries and Wildlife Sciences, Donald L. Garling, Jr. undertook a study designed to solve, in part, two significant problems facing different sectors of the commercial fisheries industry:

(1) the shortage and irregular supply of high quality fish protein meals for animal feeds (aquaculture); and

(2) the disposal of seafood processing wastes (processors).

The project was continued in 1980 under the direction of Larry A. Nielsen, Assistant Professor of Department of Fisheries and Wildlife Sciences.

A questionnaire seeking information about the amount and nature of seafood processing wastes was sent to Virginia processors. The survey found that wastes produced were mostly from finfish during winter and spring and from blue crab during summer and fall. About 25 percent of the processors expressed present problems with waste disposal, and 50 percent expected problems in the near future.

A study of the questionnaire concluded that finfish wastes had the best potential for further processing into usable products. Because a large proportion of the fish is waste, future increases in finfish harvests will generate increased amounts of wastes. Crab wastes were also found to represent a potential area for product development because of the large quantities generated, the very large percentage waste, and the uncertain future of crab meal sales.

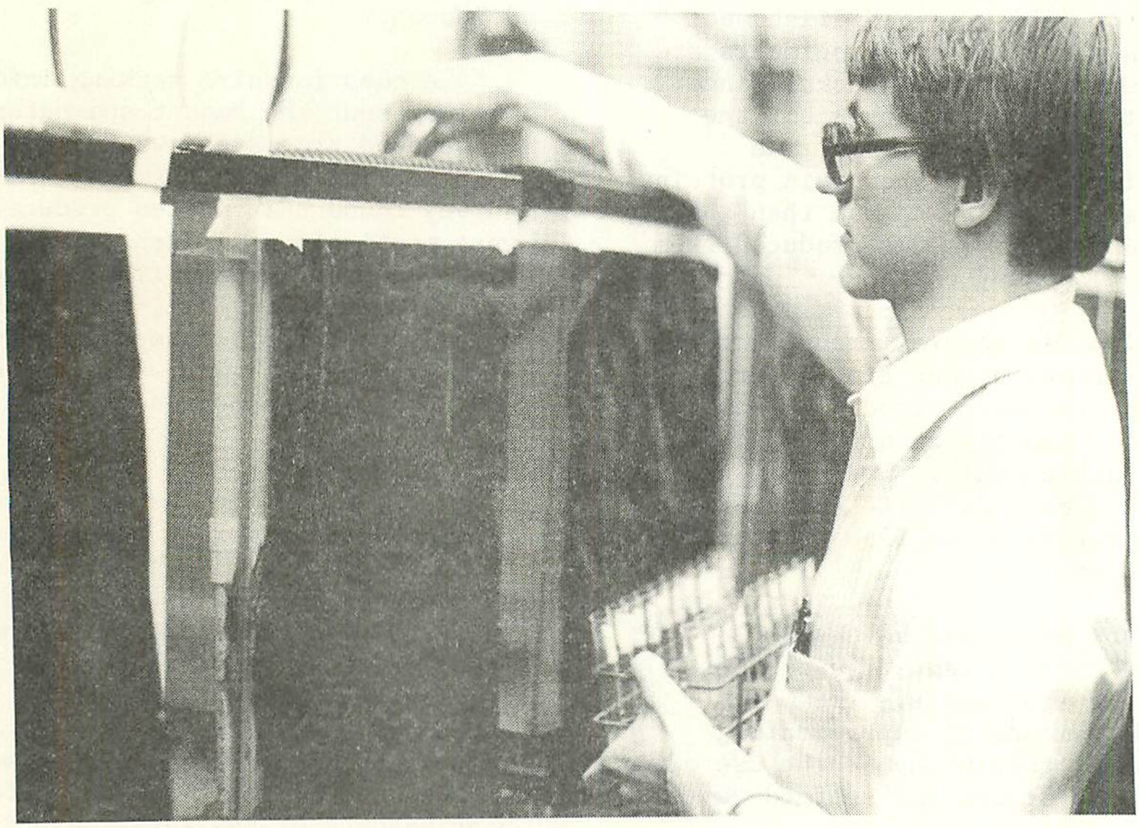
Many factors point to a feasible industry for additional waste processing:

- an uncertain future regarding waste disposal has produced willingness among seafood processors to consider expansion of waste processing;

- most waste production is concentrated in relatively few processors in the same general locality, therefore, a large supply of processed waste could be generated using a few operating plants; and

- the seasonality of supply varies, with crab wastes abundant in summer and fall when finfish catches are lower.

Nielsen also determined the composition of seafood processing wastes. The analysis of samples, collected January through May 1980, showed that blue crab samples fell into distinct groups, based on the processing method. One group included the carapace in the sample while the other group did not. The proximate composition of the two groups was influenced markedly. Crude protein content of blue crab samples without the carapace was 75.1 percent as compared to 41.8 percent for the group with the carapace. Protein estimates were determined by the micro-Kjeldahl method and thus are maximum estimates because they have not been corrected for the nonprotein nitrogen (chitin) in crab exoskeleton.



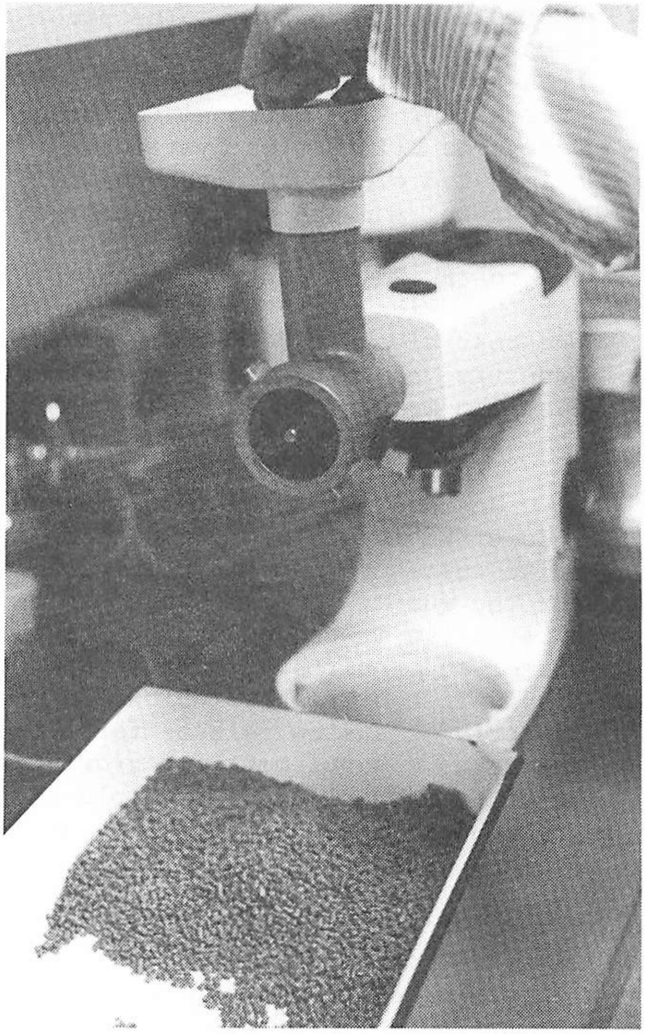
The finfish sample constituted a more heterogeneous assemblage of wastes and all other finfish, including mixed fish groups. The crude protein content of the flounder samples averaged 67.5 percent versus 61.0 percent for the mixed group. Standard errors of the two groups indicate that the crude protein content of flounder wastes was less variable than that of the mixed fish wastes.

Considering crude protein content, the flounder, mixed finfish, and blue crab (without carapace) groups all are comparable to menhaden meal as a source of crude protein in diets.

The lipid content of all sample groups is also comparable to menhaden meal, except in the mixed finfish group. The ash or mineral content of flounder, mixed finfish, and blue crab (without carapace) group are satisfactory, whereas it is exceedingly high in the blue crab (with carapace) group. The dry matter is somewhat important in that it affects the cost of processing the wastes into usable meal containing 10 percent moisture or less. Moisture content greater than about 15 percent leads to fungal growth and product degradation at room temperature. This increases the cost and problems with storage and transportation.

The mean dry matter content of the flounder, mixed fish, and blue crab (without carapace) groups ranged from 23 to 27 percent. The blue crab (with carapace) group averaged 30 percent dry matter due to the relatively dry carapace.

Considering the proximate composition of all groups, it appears that the flounder and the blue crab (without carapace) groups exhibit the most potential as fish meal substitutes in practical fish diet formulas.



Fertilizing Plants with Fish Soluables

The seafood industry has a great need for finding new and broad uses for its processing wastes and by-products. The problems associated with the disposal of these solid and liquid wastes are increasing. The National Pollutant Discharge Elimination System has eliminated overboard discharge of the waste; and the waste cannot go into most municipal sewage plants due to the Solid Waste Management Act. Physical treatment systems are the best alternative for the seafood industry; however, the cost of such a system is greater than the cost of constructing a processing plant.

Seafood companies must either reduce the levels of liquid and solid waste or find alternative uses for the waste. One such useful alternative is to convert the fish wastes and their by-products into liquid fish or fish solubles for use directly as a slow release fertilizer or as a supplement for growing major commercial decorative plants, green house garden vegetables, and field crops.

Fish has been used as a fertilizer for many centuries. In France, oil was made from a fish called merlan *(Gadus marlangus)*, with the scrap dried, ground, and packed in airtight casks for sale as manure.

Until the 1940's the American menhaden *(Brevoortia tyrannusaon* on the Atlantic and *Brevoortia patronus* on the Gulf of Mexico) industry depended heavily on the sale of scrap fish as fertilizer. A lack of interest in the menhaden industry, due to petroleum-derived chemical fertilizers, all but ended the production and use of fish fertilizers.

Fish-based fertilizers are becoming economically and environmentally desirable for crop growing today. The renewed interest is due, in part, to several factors. These factors include: (1) the cost of fish solubles is at $150 per ton; and (2) the fish materials, after evaporation, contain 50 percent solids. The waste marketed can bring in millions of dollars for the seafood industry. Also, an additional $450,000 per year can be saved for each industrial plant by not having to dispose of the waste through waste treatment.

Louis H. Aung, Associate Professor in the Department of Horticulture, along with Food Science and Technology Professor George J. Flick, began a study in 1979 to determine the potential use of stick water and unloading water as fertilizer on commercial plants. They also tested the growth responses of several house plants and vegetables fertilized with liquid fish and fish solubles and established the conditions and measures for optimizing the uses of liquid fish and fish solubles as fertilizer materials or as amendments in the nutrient media for plant growing.

Menhaden was found ideal for agricultural purposes in converting the wastes to fish soluble nutrients (FSN). In the production of FSN, stick and bilge waters were mixed and condensed. The stick or press water is the liquid left after steam extraction of oil from the fish and the bilge water is water rich with fish blood, residual oil, and small fragments of fish. Most of these two by-products were obtained from menhaden and tuna.

Plants of different species were grown under identical green house conditions to compare the effects of FSN, Hoagland nutrient solution (HNS) containing all necessary inorganic mineral nutrients, and commercial grade fertilizer commonly used by growers.

The plants were started from seeds, seedlings, or cuttings. Fertilization with FSN, HNS, and commercial fertilizers continued until the plants were ready for market or from three to twelve months. Root and stem growth, leaf production rate, flowering and fruiting were compared at set intervals.

Decorative house plants, such as philodendron, pothos, two peperomia and schefflera, and food plants, tomato, lettuce, radish, pea, sweet corn, field corn, and soybeans, were included in the experiments.

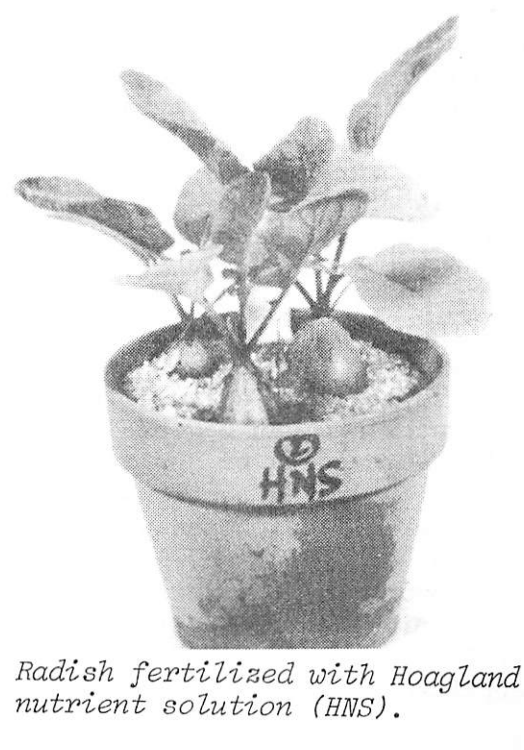
Each group was fed with various concentrations at different times. Some were fed following "market" directions for FSN or one tablespoon per gallon of water (15 ml per 3.8 liter) or two tablespoons per gallon of water (30 ml per 3.8 liter) with each feeding of one cup (240 ml) per pot once or twice a week and a fresh preparation of "food" for each feeding. HNS was used full-strength and a 25-10-10 (nitrogen-phosphorus-potassium) commercial fertilizer was used at one-fifth the rate.

The decorative house plants fertilized with FSN grew well and had a dark coloration and a glossy sheen on the foliage. They aged more slowly than plants fertilized with HNS. The growth of vegetable crops was also enhanced.

In both decorative plants and vegetable crops, senescence of foliage was delayed. The foliage of plants fertilized with FSN were greener than those fertilized with HSN. Tomato vegetative growth was delayed by several days. At higher rates of fish soluble fertilization, fruit size was reduced but not at medium concentrations. Fruits ripened in a similar manner to HSN-

Radish fertilized with fish soluble nutrients (FSN).

fertilized fruits. Tomatoes senescenced more slowly when fertilized with FSN than with HNS. Peas responded in the same manner. Peas fertilized with FSN produced pods with heavier seeds than peas fertilized with HNS. Both sweet corn and field corn responded with enhanced vegetative growth to FSN fertilization. Foliar sprays resulted in relatively poor growth. Corn responded to higher



Radish fertilized with Hoagland nutrient solution (HNS).

Radish fed with water.

concentrations of fish solubles than tomato plants. The higher fish soluble concentration (45 ml per 3.8 liter, 90 ml per 3.8 liter), which accelerated corn growth, was injurious to the tomato. Soybeans grown under both greenhouse and field conditions significantly increased seed yield. The nature of the cultivar also had an influence on the final yield.

Corn and tomatoes grown in a sand medium containing crabwastes showed that corn was more tolerant of higher rates of crab-wastes than the tomato. Crab-wastes added at 20 to 40 grams per 3.5 kilograms of sand medium did not appreciably inhibit corn growth compared to corn fertilized with FSN. These same rates of crab-wastes inhibited tomato growth. The inhibitory property of crab-waste may be useful where excessive vegetative growth of crop plant is undesirable.

The general advantages of using fish soluble fertilizers include: (1) fish solubles are easily mixed with water and can be readily injected at seeding or applied in the irrigation system to crops; (2) since fertilization and watering are done in one operation, it requires less labor; (3) the fertilizer can be distributed more uniformly; and (4) fish solubles are a complete fertilizer.

Based on the information obtained at Virginia Tech in cooperation with, and with partial funding from, Zapata Haynie Corporation of Reedville, Virginia, field evaluation of fish solubles on crop fertilization has begun in the states of Arkansas, Florida, Louisiana, Mississippi, Virginia, and West Virginia.

Aung and Flick presented a paper titled "Fish and Seafood Wastes as Nutrients for Agricultural Crop Fertilization" to the Conference on Seafood Waste Management in the 1980's, which was held in Orlando, Florida. Their paper outlined the accomplishments of this project.

Aung plans to investigate growth responses of soybean and corn which have been fertilized with fish solubles. He will place a special emphasis on the nutrient chemical composition of the harvested grains.

Aung will also assess and identify the active fractions of the fish solubles responsible for the beneficial or detrimental growth responses of crop plants. He will ascertain the normal microflora of fish solubles and establish thermal processing conditions on the storage life and biological potency of fish solubles.

Plans for 1982 include determining the flavor components of the edible products of FSN-fertilized crop plants; determining the intrinsic odorous compounds of fish solubles; and ascertaining the effects of fish soluble components on the nature and quality of soybean and corn proteins and oils.

Sound Waves as Prospecting Tools

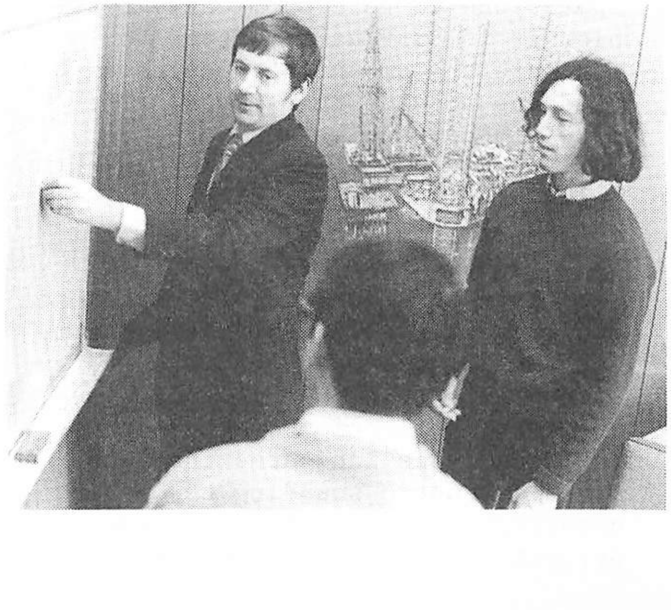
Manganese nodules have been found over vast areas of the world's deep ocean basin. Millions of years ago, a shark's tooth or a whale's earbone slowly collected bottom deposits around it, forming a nodule in much the same way that a pearl is formed. Consisting primarily of manganese oxide, with no organic compounds, many nodules contain such valuable materials as copper, nickel, and cobalt. Compared with ores mined on the land, these nodules have a high percentage of minerals in them.

The location of the nodules has prevented us from mining them. Nodules are at least three miles down in the ocean and are not easily accessible; however, the real problem lies with prospecting prior to mining. The current prospecting technique consists of lowering sensors, sampling apparatus, and other instruments several miles to the ocean floor by cables. When sensors find the nodules at the bottom, photographs and sometimes dredge samples are taken. The speed of this surveillance is low, making prospecting very expensive. Largely due to the inefficiency of the current prospecting method, mining manganese nodules has not been economical. A new preliminary surveillance system over large areas that is faster and more cost-efficient is needed.

Associate Professor of Aerospace and Ocean Engineering, Allen H. Magnuson is trying to meet this need. In March 1980, Magnuson began a project to study acoustic (sound) waves as a prospecting tool for mining manganese nodules. The project is sponsored by NOAA Sea Grant, with help from Deepsea Ventures, Inc. which offered technical consultation as well as the donation of bottom photographs and nodule samples from the Blake Plateau and the Pacific Ocean.

Magnuson and his colleague, Assistant Professor of Aerospace and Ocean Engineering, Karl Sundkvist, have developed a prospecting tool which works in this way; a transducer transmits acoustic pulses down to the bottom of the ocean where pulses are reflected back to the surface and then detected by a receiver. Unlike radio or light signals, acoustic signals are easily conducted through water.

Nodules and the ocean floor respond differently to acoustic pulses. This makes remote sensing of nodules possible. Manganese nodules scatter acoustic pulses in all directions, whereas the ocean floor covered with rock or silt reflects the pulses like a mirror. If nodules are present on the bottom,



Manganese nodules.

the sensor receives backscatter or characteristic "acoustic signature" from the nodules in addition to the reflection from the bottom. In order to distinguish these two responses, Magnuson's team is studying the acoustic properties of the nodule material as well as the acoustic response from a single nodule.

An equivalent reflection coefficient is also being used to estimate the amount of nodules. Because a certain minimum amount of nodules must exist per unit area for mining operations to be economically feasible, it is just as important to estimate the amount of nodules as to find the nodules themselves. The size of the nodules must also be estimated because small size and uniformity are essential to an efficient operation.

Magnuson and Sundkvist have had good results so far. Their preliminary analysis showed that the energy scattered by a nodule is four times the basic reflection of the bottom. Their analysis indicated that the use of acoustic sounding to obtain quantitative information on nodule deposits is probably feasible. The cost study showed that this remote sensing can survey the ocean bottom four times faster than the current technique, with a possible savings of $300,000 for each expedition.

Magnuson and Sundkvist have partially accomplished four of ten project tasks. The completed tasks are: (1) the analysis of a single nodule scattering; (2) wavespeed measurements for nodule material; (3) the analysis of photographs of nodule deposits; and (4) a multiple scattering analysis.

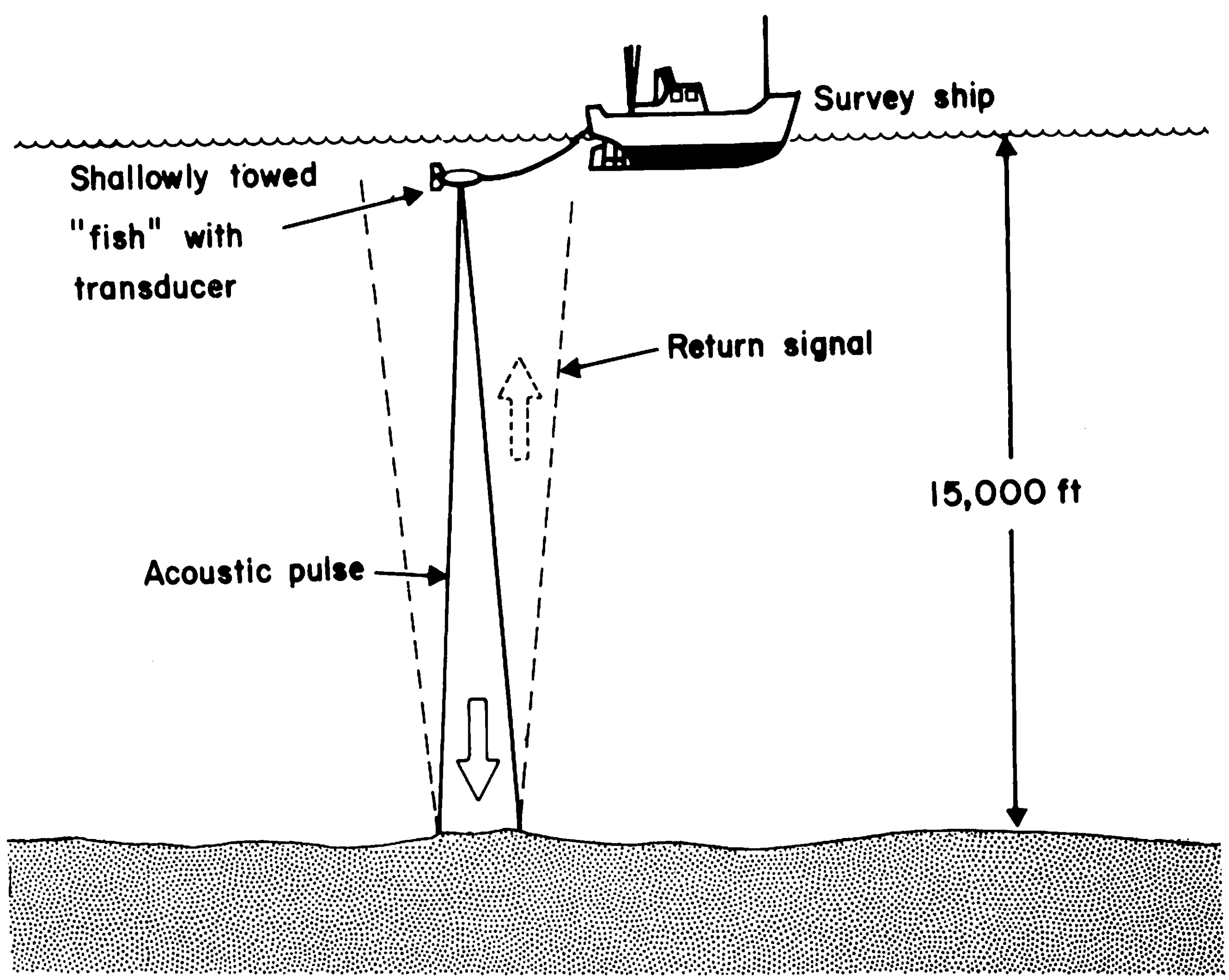
The analysis of single nodule scattering used plane wave excitation of an elastic sphere as the model for nodule acoustics. Plots of a scattering cross-section showed that the acoustic response or bottom acoustic signature is different from the response of a flat sedimentary or rock bottom.

Wavespeed measurements were made on nodule samples from the Blake Plateau and the Pacific Ocean donated by Deepsea Ventures, Inc. Water-saturated nodules were measured for sheer wavespeed, compressional wavespeed, and wet density. The results were used in the analysis for computing a cross-section of a Pacific nodule.

Bottom photographs (also donated by Deepsea Ventures, Inc.) were analyzed and information on the statistics of nodule sizes and spatial distribution was obtained. Histograms on nodule size, distribution, and separation distances were presented. This information is necessary for the multiple scattering analysis.

The multiple scattering analysis obtained information on the acoustic response of random nodule distributions. The information on a single nodule response is used and the responses are then added, taking into account the interactions between nodules. Results of a simplified analysis of normal incidence plane wave showed that the mean field response is also a plane wave. This means that the aggregate response from a planar distribution is similar to the response from a flat bottom. The reflection is frequency-dependent on nodule deposits, while it is independent of frequency on the flat bottom.

Laboratory tank tests of single nodule scattering and laboratory tank tests for nodule interation will begin in the summer of 1981. Magnuson and Sundkvist will then develop a data analysis technique for a sounding experiment and travel to Green Bay, Wisconsin, for sounding tests. They will also test transmission loss analysis and develop a data analysis technique for deep sea sounding along with a deep ocean sounding experiment.



Seafood Products Education

Food is essential for the growth and maintenance of the body. Medical doctors, nutritionists, and even psychologists frequently call to our attention the relationship between what we eat and how our bodies function. In 1977 the United States Senate Select Committee on Nutrition and Human Needs published *Dietary Goals for the United States*. This report details information about the possible links between diet and health in the U.S. and stresses that the eating patterns of this century represent a critical public health concern. The four recommended dietary goals listed in the report are:

- Increase carbohydrate consumption to account from 55 to 60 percent of the energy caloric intake;

- Reduce overall fat consumption from approximately 40 to 30 percent of energy intake;

- Reduce saturated fat consumption to account for about 10 percent of the total energy intake, and balance that with polyunsaturated and monosaturated fats, each of which should account for about 10 percent of energy intake;

- Reduce salt consumption by 50 to 85 percent to approximately 3 grams a day.

The background information which led to these dietary goals revealed that people generally lack knowledge regarding the food they consume. As a population, the U.S. is becoming increasingly overweight and obese; large sums of money are spent on low-calorie drinks that have minimal nutritional value. To counteract these poor eating habits, excessive sums of money are spent on athletic equipment, exercise equipment, and health spas.

One of the specific recommendations in the *Dietary Goals* is to decrease the consumption of meat and increase the consumption of poultry and fish.

Even many coastal residents do not readily accept seafood and seafood products, unless they were introduced to them at an early age. A survey of four coastal school districts in Tidewater, Virginia, indicated that little or no instruction concerning marine food resources was available in the home economics curriculum. Only tuna fish was purchased for class demonstration, though no Virginia seafood processing plants are engaged in the production of tuna or tuna products.

This situation is unfortunate in two respects: (1) the sea is becoming an increasingly important food source because land resources are limited; and (2) marine bioproducts may be consumed directly as food or be included in the diet as food and drug additives.

Anita H. Webb, Assistant Professor of Vocational and Technical Education, began a project in August 1977 to develop a comprehensive educational program on marine food products for intermediate, secondary, and college students. In order to insure success and immediate implementation of the project, a continuing education program for teachers was also proposed.

Marine food products were defined to include salt and freshwater species of finfish and shellfish and the food and food products derived from marine sources. The project covered a wide geographical area and included oceans, estuaries, rivers, lakes, and shores. Consequently, coastal and non-coastal states will benefit from the project.

Specific goals of the project were: (1) to develop comprehensive, sequential subject matter information; (2) to develop educational materials in the form of teacher guides; (3) to develop a graduate course for in-service training of teachers; (4) to pilot-test the materials and the entire educational program with target school systems; (5) to develop a model for coordination of educational activities within a school system to supplement classroom instruction; and (6) to conduct a national conference or workshop with educators to disseminate materials and information on a national basis.

The project was completed in July 1980, under the direction of Sandra Howlett, Research Associate in Vocational and Technical Education.

The Seafood Products Education project was completed in three phases. The prior two phases dealt with the collection and synthesis of seafood products education materials. This led to the development and field testing of educational materials appropriate to the specific needs of home economics and food service instructors at the intermediate, secondary, and collegiate levels.

Project emphasis for 1980 centered around the dissemination of the newly developed instructional materials to inform educators of the availabiltiy and the potential use of these materials. This objective was achieved through workshops and exhibits at state and national meetings for home economics educators. A total of twelve statewide meetings were attended by project staff who conducted group sessions and exhibits

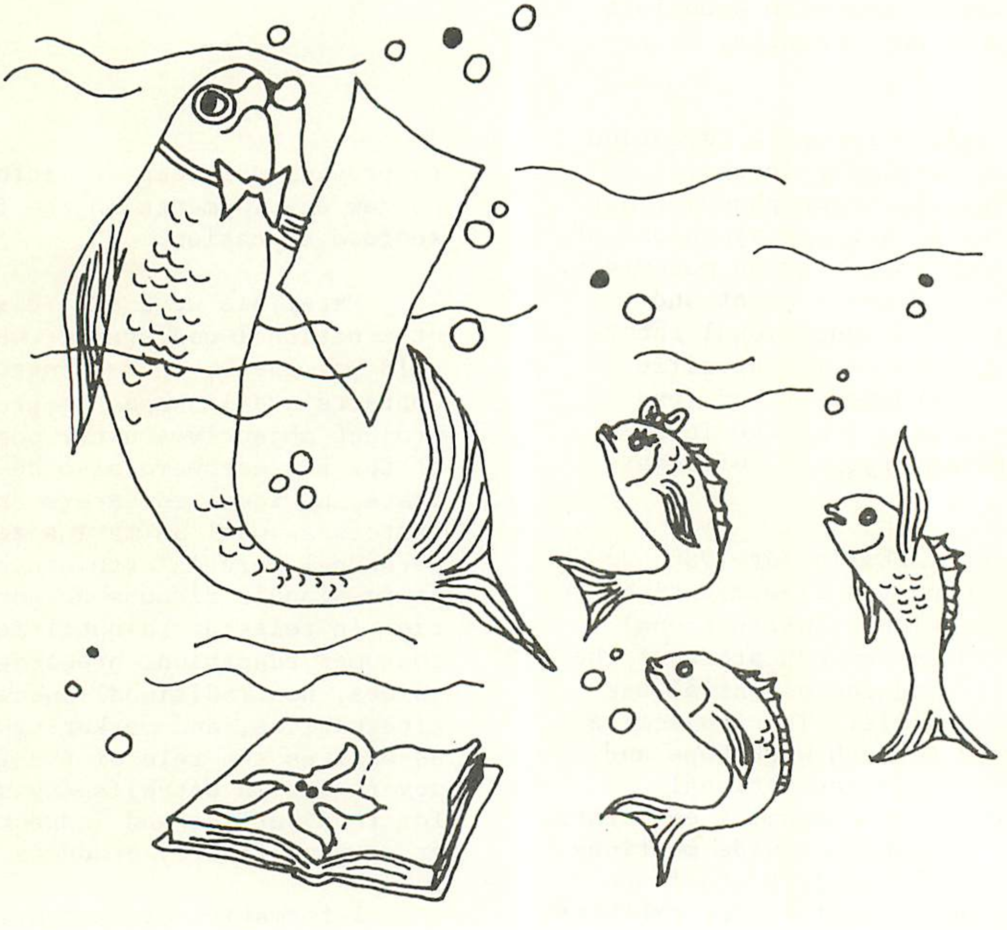
to provide participants information on new developments in the field of seafood education.

Materials were also disseminated at a national conference, which was held May 15-16, in Washington, D.C. Contacts and linkages to promote project objectives after completion of the project were also developed. State and local educators and administrators as well as marine resource personnel were in attendance to hear professionals discuss seafood education in relation to nutrition and consumer education, preparation guides, nontraditional species alternatives, and marketing strategies, as well as the role of the federal government in establishing standards for food service and inspection and grading of fishery products.

Information disseminated at the

conference included a course syllabus for a Food Science and Technology Marine Food Products class (college level), *Seafood Products: An Instructional Guide for Home Economics* (college, secondary, and intermediate levels), *Seafood Products: Food Service Program Guide* (secondary and intermediate levels), *Seafood Manual for School Food Service Personnel, Seafood Transparency Masters with Text,* and mimeograph masters for Home Economics teachers (secondary and intermediate levels). A conference proceedings document, *Seafood Products Education Conference Proceedings May 15-16, 1980,* was later compiled and forwarded to conference participants and other interested persons.

The Seafood Products Education Program for Intermediate, Secondary and College Students and Faculty provided a unique opportunity to fill a definite void in the curriculum resources of home economics and food service instructors. The project provided the foundation for others to build on in the hope of achieving the gola of maximum utilization of marine resources.



ADVISORY SERVICES

Marine Advisory Services

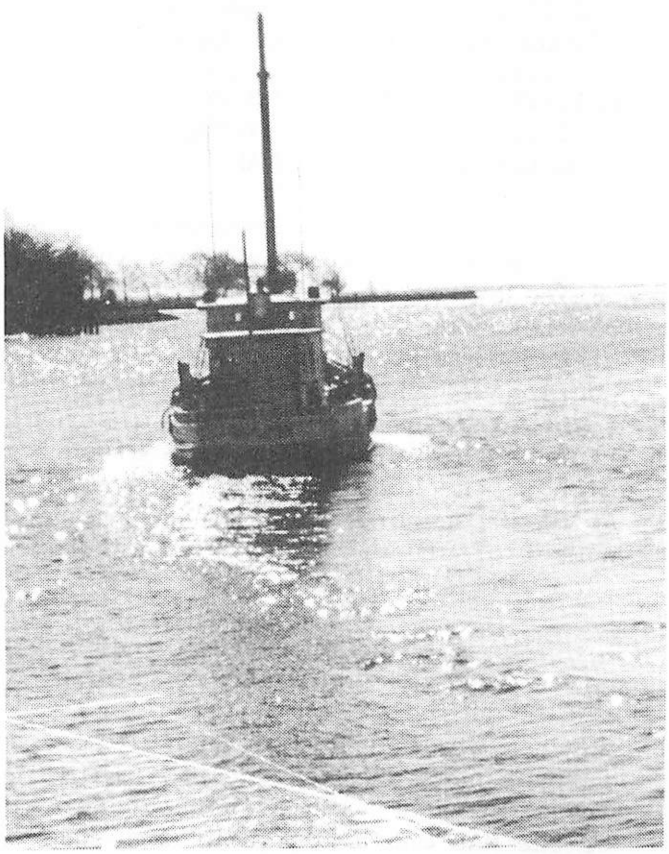
Virginia's marine resources are well known, not only to the citizens of Virginia but also on a national and international basis. The state has the largest shipyard in the world, the second largest export (marine terminal) port in the United States and one of the largest U.S. commercial marine fisheries. During 1979, the state ranked fourth within the U.S. in total seafood production and supplied approximately ten percent of the nation's seafood. While these resources contributed significantly to the social and economic welfare of the state, the development of the several marine resources is sometimes competitive. Many of the problems the state is now addressing result from the incompatibility of various kinds of resource development.

The Virginia Polytechnic Institute and State University Marine Advisory Service (MAS) was created to serve as a mediator between users and decision makers of marine resources. The MAS has developed and maintained an efficient and effective educational program for those seeking livelihood and recreation from marine resources. A major responsibility of the MAS is to identify the existing community needs so that the financial or human resources necessary to satisfy those needs can be found.

Sea Grant at Virginia Tech has focused on advisory services since its inception in 1971. In 1980, the MAS focused its activities on six areas:

- Firm management assistance
- Seafood utilization industry
- Consumer education
- Seafood retail marketing
- 4-H and youth
- Public participation in marine resource allocation

These areas will continue to be emphasized because of historical research capabilities, the ability to use the thirty Cooperative Extension Offices in the coastal plains counties, the importance to the



state of these segments, and the interest in avoiding overlap with other Sea Grant Consortium (College of William and Mary, Old Dominion University, and the University of Virginia) member strengths.

Advisory services at Virginia Tech are coordinated through the Cooperative Extension Service. Coordination of programs is provided by E. Neal Boyd, who is Associate Dean of the College of Agriculture and Life Sciences. Six Sea Grant specialists are assigned to academic departments in Blacksburg (Agricultural Economics, Food Science and Technology, and Mechanical Engineering). Two other specialists and three unit agents are located in the coastal communities of Lancaster, Northampton, and Accomac Counties and the City of Hampton. The three unit agents' support is derived from eight counties. Sea Grant support provides 50 percent of their salaries.

The progress and accomplishments of the MAS may be measured by several criteria. For example, campus-based and field staff have made over 22,000 individual contacts and conducted over 40 meetings. Often primary contacts become secondary leaders, thereby increasing the effectiveness of the MAS.

A two-year pilot project to train home economics teachers in the cities of Hampton and Newport News has resulted in the establishment of a seafood unit within the foods sections of their programs. Over 6,750 students have received instruction on the utilization of seafood without the help from MAS personnel. As more teachers are trained, the number of students receiving instruction will increase.

The seafood processing industry has recognized the value of the MAS and is actively working with local governments to provide funds for further personnel expansion. This industry is serving as both a user of the MAS and a contributor to the education process.

The professional accomplishments of individual staff members are indicative of the program quality. MAS personnel serve many professional and trade organizations. Participation ranges from serving on the Board of Directors to serving as committee members or as officers. This participation is an important aspect of Virginia Tech's Advisory Program. The primary organizations served by the MAS are: the Interstate Seafood Seminar, the American Chemical Society, the National Fisheries Institute, the National Fisheries Education and Research Foundation, Inc., the Commercial Fishermen's Exposition, the Atlantic Fisheries Technology Conference and the Food Research Society. MAS personnel also serve on the Board of Editors of *The Journal of Food Science*.

These professionals have sponsored a seafood utilization

symposium for the American Chemical Society, edit and publish *Sea Grant Today*, the journal of the National Sea Grant Program, and have established reputations based on their competence with the result of their being requested to participate in educational programs sponsored by other institutions and industry organizations. In addition, a MAS member won the 1978 Southern Association of Agricultural Scientists Professional Scientist Award, a MAS member is the only University Board of Director member on the National Fisheries Education and Research Foundation and is on its Executive Committee, and several members of the Communicator's staff have received awards from the Virginia Press Women, Inc. for excellence in journalism.

COOPERATION

Cooperative projects are a new activity for the Virginia Tech MAS. Since approximately 90 percent of the MAS budget is allocated to total salary and wage costs, it is possible to combine the human resources of the MAS with the financial resources of state, federal, and private agencies. Several projects are now in the planning or implementing stage. The more important projects are:

(1) Cross Country Transportation of Fish and Shellfish--a major retail store chain, a seafood processor, selected food-related firms, and various state and federal agencies have begun a study to ship fish and other seafood to Midwest food stores; and

(2) Time-Temperature Relationship in the Preparation of Fish Portions in Fast Food Chains--a major fast food chain has requested assistance in determining the optimum time-temperature for preparing and holding portions; the cooperative project was initiated with the food chain, the fish supplier, and the seafood battering manufacturer sharing the financial support.

1980 ACCOMPLISHMENTS

The MAS had many accomplishments during 1980. These accomplishments were made through the hard work of many MAS staff members.

1. MAS successfully co-sponsored the first National Symposium on Chemistry and Biochemistry of Marine Food Products with the American Chemical Society.

2. Presented a national conference on the use of steam tunnels in oyster shucking which could result in a 15 to 20 percent savings on labor costs.

3. Published a Sanitation Manual which was purchased and used by every processing plant inspector of the National Marine Fisheries Service (NMFS).

4. Assisted seafood dealers to qualify for $300,000 in low interest disaster-area loans.

5. Helped a fast food chain reduce a fish loss of 40 percent to zero percent with $30,000 in benefits.

6. Conducted a statewide program to train family resource extension personnel, which will result in over 5,000 secondary contacts after the first year of implementation.

7. Published the first book on endangered plants and animals of Virginia.

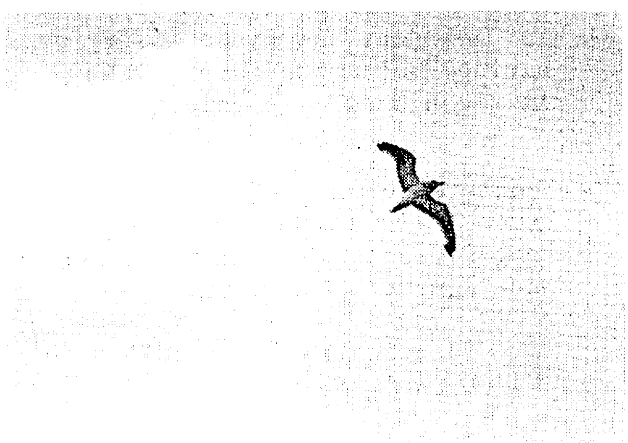
8. Assisted a Hampton processor in setting up a new seafood packaging system and monitored the performance of his quick chill method.

9. Assisted with a Capital Construction Fund agreement for

fishermen to protect the sale of a fishing boat, resulting in an approximate $4000 savings.

10. Worked closely with United States Public Health Service (USPHS) officials and saved ten commercial fishermen from $600 to $700.

11. Worked on the pasteurization and sterilization of crab meat packed in flexible retort pouches to study the shelf life and economic feasibility of the application for the crab meat packer.



12. A New Jersey clam dealer was assisted in having imported canned clams released for sale by the Food and Drug Administration (FDA).

13. Investigated and prepared a report for the Virginia Beach City Manager concerning the potential effects of dredging in the Lynnhaven River on the oyster industry there.

The Virginia Tech MAS will continue to maintain a strong effort in serving as a mediator between the users and decision makers of Virginia's marine resources. In trying to meet the needs of the users and decision makers, the MAS will focus on the Eastern Shore area, the Tidewater, and the Northern Neck. The problems facing these three areas are representative of other regions of Virginia.

PROGRAM STAFF

Director

E. Neal Boyd, Director University Sea Grant Program; Associate Dean College of Agriculture and Life Sciences

Program Coordinator

George J. Flick, Professor of Food Science and Technology; Extension Specialist Food Chemistry

Project Investigators

Louis H. Aung, Fish Solubles as Nutrients for the Fertilization of Commercial Decorative Plants and Major Vegetable Crops (R/UW-2)

George J. Flick, Marine Advisory Sea Grant Project (A/AS-1)

Sandra E. Howlett, Seafood Products Education Program for Intermediate, Secondary, and College Students and Faculty (E/VE-1)

Allen H. Magnuson, Acoustic Sounding for Manganese Nodules (R/OE-1)

Larry A. Nielsen, Seafood Wastes in Pelleted Fish Rations as Fish Meal Substitutes (R/UW-1)

Sanford J. Ritchey, Content of Mineral Elements and Bioavailability of Calcium, Iron, and Zinc from Fish (R/FD-1)

Jose M.A. Tanchoco, Analysis and Design of Production Systems for Seafood Processing (R/FD-5)

MAP Personnel

Charles W. Coale, Professor of Agricultural Economics and Extension Specialist

James A. Daniels, Marine Extension Agent

Laurie M. Dean, Marine Extension Agent, Home Economics

George J. Flick, Jr., Professor of Food Science and Technology and Extension Specialist

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MAP Consultants

Sandra Batie, Associate Professor of Agricultural Economics

Wayne Burkhart, Associate Professor of Agricultural Economics and Extension Specialist

Joseph Havlicek, Professor of Agricultural Economics

Werner Kohler, Associate Professor of Mathematics

Frederick Lamb, Assistant Professor of Occupational Health and Safety and Extension Specialist

William R. Robinson, Associate Professor of Entomology and Extension Specialist

BUDGET SUMMARY FOR 1980 BY ACTIVITY

	Federal Sea Grant Funds	University Matching Funds
Human Food Resources		
Mineral Elements in Seafood	$ 20,000	$ 7,300
Seafood Processing Production Systems	24,400	14,400
Utilization of Wastes		
Pelleted Seafood Wastes as Fish Meal	4,600	2,300
Fertilizing Plants with Fish Soluables	21,700	27,300
Ocean Engineering		
Sound Waves as Prospecting Tools	38,300	21,300
Education		
Seafood Products Education	26,726	12,299
Advisory Services		
Marine Advisory Service	105,000	71,200
*TOTAL	$240,726	$156,099

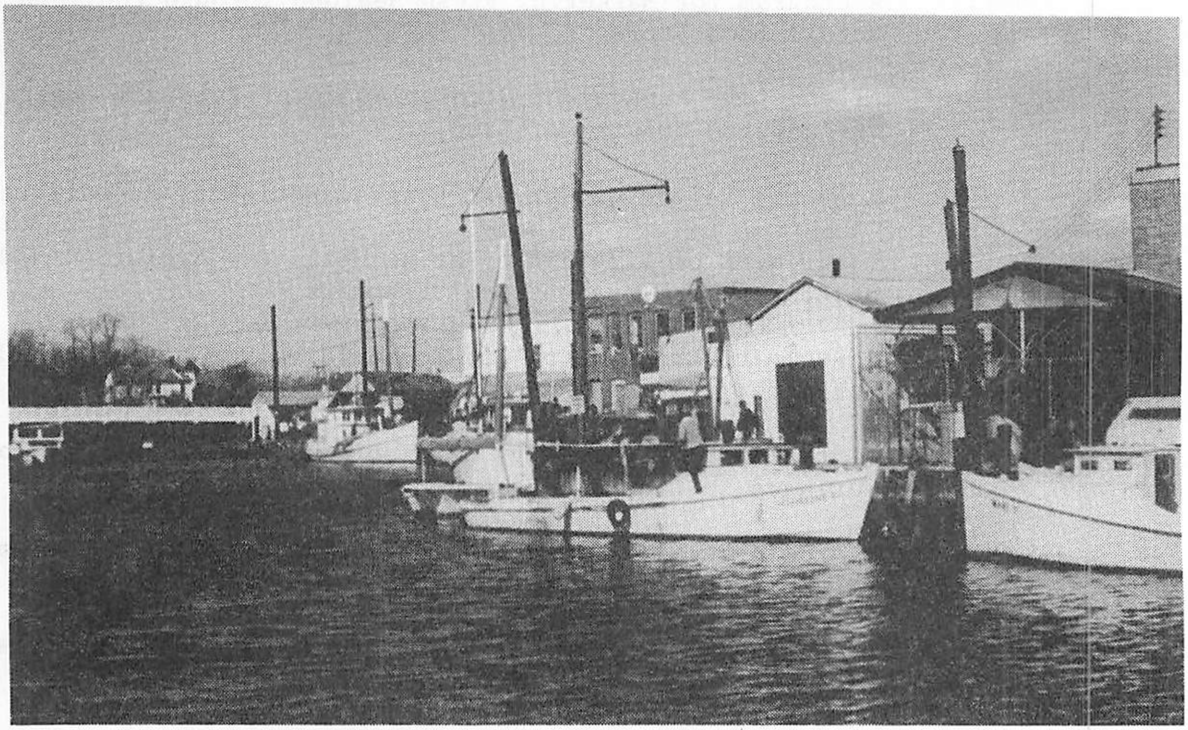
*The National Marine Fisheries Service provided an additional $10,000 as pass through funds to Sea Grant

MARINE ADVISORY SERVICE 1980 PUBLICATIONS

VPI-SG-76-04	Analysis of Exploited Fish Populations, revised
-78-07	The Virginia Tech Sea Grant Tip-Line Project
-79-13	Endangered and Threatened Plants and Animals of Virginia
-79-14	A Fresh Seafood Marketing Program: Management, Quality Maintenance, Merchandising and Profitability
-79-16	Comparison of Composition and Selected Enzyme Activities in *Crassostrea virginica* and *Crassostrea gigas*, Eastern and Korean Oysters
-79-17	A Program for Marketing Fresh Seafood Through the Independent Retail Food Store
-79-18	Alternative Management Strategies for Virginia's Coastal Wetlands: A Program of Study
-79-19	Economic Values of Natural Coastal Wetlands: A Critique
-80-01	Management of Virginia's Marine Wetlands: Evolution and Current Status of the Institutional Framwork
-80-02	A Reply to the Rebuttal of Economic Values of Natural Coastal Wetlands: A Critique
-80-03	A Stochastic Methodology for Estimating the Value of Coastal Wetlands in Controlling Non-point Pollution
-80-04	Economic Perspectives on Virginia's Coastal Wetlands Management Program
-80-05	The Management of Coastal Wetlands in Virginia land: Issues and Problems
-80-06	Seafood Transparency Masters with Text
-80-07	Engineering and Economics of Oyster Steam Shucking Process
-80-10	Analysis and Control of Less Desirable Flavors in Fish and Shellfish
-80-11	Seafood Products Education: Conference Proceedings May 15-16, 1980
-80-12	How to Enjoy Seafood in the Old Dominion Tradition

Videotapes

VPI-SG-78-02	Picking the Blue Crab
-78-04	Dressing the Finfish
-79-10	Blue Crab Industry of the Chesapeake Bay
-79-15	Hard Shell Clam Industry



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