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THE ECONOMIST AND THE SEAFOOD PRODUCER

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Seafood production economics is a relatively new research and extension area for agricultural and resource economists. There are, currently, 13 Sea Grant supported seafood production economics research projects at the University of Maine, University of Rhode Island, University of Maryland, Virginia Polytechnic Institute, North Carolina State University, Clemson University, University of Florida, Texas A & M University, University of California, and Oregon State University. The National Marine Fisheries Service also supports several seafood production economics research projects at their own Economic Research Division, their regional offices, and at several universities.

Seafood production economics extension work is currently being supported by Sea Grant funds in Rhode Island, Delaware, Virginia, North Carolina, South Carolina, Florida, Alabama, Mississippi, Texas, Oregon, and Washington. Several states are also reallocating some Land Grant funds for extension work in seafood production economics.

Costs and returns in commercial fishing and seafood processing were dealt with in the 1950 through 1969 fisheries management policy debates. However, during this period seafood production economics was only an appurtenance to policy concerns. Leaders in this early work were Crutchfield, Zellner, Scott, Pontecorvo, and Comitini. It is interesting to note that none of these people have an agricultural economics background, whereas nearly all the seafood production economics work currently under way (for its own sake and not subsidiary to policy) is being conducted in agricultural or resource economics departments and/or by agricultural economics trained people.

Therefore, seafood production economics research has a new focus, and has very nearly become the exclusive domain of agricultural and resource economists. This is not new information to those who belong to the small marine economics "fraternity." However, for those outside the fraternity, it may be beneficial to become acquainted with U.S. seafood producers, and become familiar with the current seafood production economics research and extension work in the United States. The purpose of this paper, then, is to (1) describe and characterize U.S. seafood producers; (2) briefly review current seafood production economics research; and (3) identify some needs and opportunities for the future.

Characteristics of United States Fishermen

There are over 25 major fisheries in the United States, differentiated by species, production technology, and geography. Fishermen may participate in one, two, three, or four different fisheries in one year, using a wide variety of production technology in locations 2,000 miles apart. The National Marine Fisheries Service [7] reported 140,538 U.S. fishermen in 1970, using 87,161 boats. Some of these fishermen depend entirely upon seafood production for survival, while many obtain the majority of their gross earnings from other sources.

A complete description of such a heterogenous group would be time- and space-consuming beyond the scope of this paper. However, such a description is simplified if U.S. commercial fishermen can be grouped or categorized according to fishery, investment, or objective functions. Research at Oregon State University suggests that categorization by objective function helps explain profitability and behavior. It is also possible to categorize, by objective function, into as few as three groups.

Fishermen's objective functions are comprised of monetary and non-monetary rewards. Monetary rewards are measured in terms of profit, gross earnings, fish landed, and investment. Non-monetary rewards predominant in the fishing industry include: the challenge of fishing, freedom and independence, the joy and pleasure of the sea, and fellowship.

The first of three relatively homogenous groups includes fishermen who have objective functions in which non-monetary rewards are of primary importance and monetary rewards are of secondary importance. These fishermen produce seafood with a relatively high market value. They use relatively unsophisticated production technology and usually own and operate their own boat. There are few, if any, employees, and participation in the fishery is frequently seasonal and will vary from year to year.

Most notable in this group are the inshore lobster fishermen of New England, who seldom have more than $50,000 invested in their business, and the Pacific salmon and tuna fishermen who may have up to $80,000 invested. Salmon gillnetting in the Pacific Northwest and Alaska is another highly seasonal, low investment fishery. There are still many cannery-owned gillnet boats in Alaska fished by part-time hired skippers. The Atlantic Coast and the Gulf of Mexico support a sizeable hook and line, and net fishery. These fishermen also sustain themselves as much from the non-monetary rewards as from the mullet, mackerel, rockfish, and other finfish harvested. Many watermen of Chesapeake Bay also belong to this group.

Fishermen in this group represent the majority of the approximately 140,000 U.S. fishermen. However, they are not well organized politically, nor do they have a significant collective economic impact.

Fewer in number, but more important in terms of political power, are fishermen who have objective functions in which monetary rewards are primary, and non-monetary rewards are secondary. The fishermen in this second group produce high-volume, low-value seafood as well as low-volume, high-value seafood. Production technology tends to be more complex, although less skill may be required than with simple harvest technology. Investments may range from \$50,000 to \$500,000, and owner/operators predominate. There may be from one to six employees with varying skill requirements. If the boat cannot be utilized in one fishery throughout the year, fishermen in this group tend to be flexible and participate in two, three, or four different fisheries.

Although many of the boats are company owned, the Gulf of Mexico shrimp fishermen exemplify this group. The offshore lobster fishermen of New England, with \$250,000 invested and the ability to fish flounder and cod, also exemplify this group. Others include the North Atlantic scallop fisherman; the North Atlantic drag boat skipper; the West Coast shrimp, sole, rockfish, and cod fisherman; the North Pacific halibut long-line fisherman; the Washington and Alaska salmon purse seine fisherman; and the Pacific Northwest combination (salmon, albacore tuna, and dungeness crab) boat skipper.

Fishermen with objective functions in which monetary rewards clearly dominate are the least in number, but the greatest in economic importance. The seafood product usually has a high market value and is produced in large volume. Production technology is very complex, and frequently requires the employment of technical specialists. Investments of $1 million are common, with some fishing companies operating several $1 million boats. Skippers may work for the fishing company, and as many as 15 employees may be on board.

While not of the same scale as the factory ships of the Soviet Union, Poland, and East Germany, the U.S. tropical tuna seiner is very impressive. It is also very efficient and characteristic of this group. The king crab fishermen of Western Alaska also exemplify this group. Some of the Western Alaska shrimp fishermen, Gulf of Mexico shrimp fishermen, and North Atlantic drag boat skippers also belong to this group.

Characteristics of Seafood Dealers and Processors

The seafood dealer usually markets fish in the same form as they are landed. Dealers handle a majority of the South Atlantic finfishes, northern lobster, troll-caught salmon, some blue and dungeness crab, and clams. The dealer, as opposed to the processor, may hold fish on ice or in cold storage for only a day or two, then ship to the wholesale or retail market.

In addition to shipping, the seafood processor also cleans, shells, cooks, fillets, cans, freezes, boxes, and frequently inventories the seafood. As little as 10 percent, or as much as 95 percent, of the raw product may be marketable as food. This increases the price differential between the fisherman and consumer, and results in large volumes of troublesome waste.

Since there are only approximately 3,735 seafood dealers and processors [7] compared to 140,538 fishermen, description without categorization becomes feasible. However, processors can be differentiated in terms of scale and vertical integration. Sales volumes range from $50,000 to $100 million. Only 36 percent of the 220 West Coast processors and dealers had sales in excess of $500,000.

Except for several specialized tuna canneries, those at the top are highly integrated manufacturing and marketing organizations dealing in nearly every seafood product. They have subsidiary plants in many major U.S. ports, and operate buying stations in others.

Most other seafood processors and dealers tend to specialize in two, three, or four seafoods, and obtain supplies on a regional rather than on a national or international basis. Among this majority in number, but minority in volume, there has been a long-standing management concept. Most attempt to maximize profit through price spreads, inventory manipulation, and market speculation, rather than through maximum processing and marketing efficiency. Conditions that make this possible, and the consequences of this concept, are subjects for another paper.

New management in many of the smaller seafood processing firms has been drawn from younger family members or management-inexperienced plant employees. This, plus the lack of emphasis on production efficiency, has resulted in antiquated seafood processing technology and high operating costs. Many processing operations are housed in old buildings perched on rotting pilings. They are great photographic subjects for the tourist, and a challenge to sanitation inspectors and plant engineers.

There are many notable exceptions to the above characterization of seafood processors and dealers, some of which are organized as cooperatives. Most of the approximately 80 fishery cooperatives in the United States simply act as agents for their members. However, the cooperatives at Provincetown, Mass., Point

Judith, R.I., and the Halibut Producers Cooperative in Seattle are examples of efficient and successful seafood processors.

The Economic Environment

Risk, in the form of biological and regulatory variability, externalities inherent in common property resource-based industries, and an oligopsonistic market, characterize the economic environment within which the seafood producer operates.

With the exception of aquaculturists, all fishermen harvest from a common pool of living marine resources. Many eloquent words have been produced on the common property problem in the fishery. A quote from Gates and Norton [9] will summarize sufficiently for our purposes:

> ". . . the high rate of foreign fishing, the old age of vessels and crewmen, and the low earnings to labor and capital in certain fisheries are . . . characteristic of a common property resource in which there is no ownership of the resource [and] entry into the fishery takes place as long as there is economic rent or profit to be earned. This means that in any fishery, unless there are restrictions on entry, fishing effort tends to increase to a level where average profits - or economic rent attributable to the resource - is dissipated. Therefore, while some vessels in each fishery earn a profit, the tendency is toward zero profits, with the result being old crewmen and vessels, and low earnings to labor and capital."

Fishery regulations are instituted on a regional or state-by-state basis, and by differing agencies. The agency decision-making process is based upon political expediency as well as biological needs. This adds a somewhat unique risk dimension to the fishing and seafood processing business.

Natural biological variability adds another risk dimension to the fishing business. Our ability to predict major fluctuations in fishery stocks is still inadequate, in spite of sizeable money and time expenditures.

The Economist's Contribution to Knowledge

As indicated earlier, the National Sea Grant Office currently supports 13 research projects in seafood production economics. Approximately $225,000 is allocated to these 13 projects. This represents only 17 percent of Sea Grant's total allocation to marine socio-economics and legal research. The National Marine Fisheries Service is the other major funding source for research in seafood production economics. However, most of its funding is internal, and integrated with other functions of this agency.

Much of the currently available literature dealing with the economics of seafood production has resulted from a variety of non-Sea Grant funded sources including Agricultural Experiment Stations, state fishery agencies, banks, the National Marine Fisheries Service, Bonneville Power Administration, and the National Science Foundation. Because seafood production economics research has been a subordinate to policy research, supported by so many different sources, published by different organizations, and conducted at many non-academic as well as academic institutions, identifying this work and giving proper recognition is difficult, at best. The seafood production economics research that has been identified can be conveniently classified as:

(1) Development of economic data and economic description of seafood producers, or

(2) Economic analysis of the seafood producing firm.

To date, the economist's greatest contribution has been in developing basic economic data and describing the seafood producer. This type of work has been extremely important, valuable, and is likely to continue. However, economists have not been latent in analyzing the economics of seafood production, in spite of a severe lack of data.

Economic Data and Description

The most comprehensive (although not the first) research in this area was conducted by the Economic Research Division of the National Marine Fisheries Service. This research was based upon data obtained from fishermen's records and National Marine Fisheries Market News sources. There are currently 10 reports available, each of which includes "Industry performance indicators", "Demand indicators", "Demand projections", "Domestic production", "Domestic employment, vessels, and effort", "Biological stock assessment", "International trade", "Foreign production", "Foreign consumption", "U.S. trade barriers", and "Government programs" [22]. Perhaps the greatest contribution of the National Marine Fisheries Service work is in its comprehensive nature. Data for as many as 24 years for each of 10 fisheries are available under some of the above headings. In-depth knowledge of any one of the 10 fisheries is obtainable from these reports.

The "Industry performance indicators" section of these reports includes costs and returns data on boats in the particular fishery. The greatest difficulty with these costs and returns data is the inconsistency in sources. Not only are the sources different for different reports, but there are no estimates of how well the data represents the population. In many cases such estimates would be difficult, at best, because there is little knowledge of the population. As we shall see, this is a major problem for all current costs and returns studies of seafood producers.

The first seafood producer costs and returns study published by an agricultural economics department came from Georgia in 1968 [5]. In addition to the usual descriptive material and catch statistics, this study was one of the first to report cost breakdowns by boat size and type of ownership. The major contribution, however, was an attempt to estimate functional relationships for the fishing firm.

By 1970 the first costs and returns data resulting from Sea Grant funding began appearing. The work at Oregon State University has resulted in available data for 50 different boats and fisheries [19, 20]. The University of Florida has published data on mullet fishermen [2]; the University of Hawaii has produced a publication on the costs and returns of local tuna boats [3]; and Texas A & M University has utilized National Marine Fisheries Service data to produce a shrimp boat costs and returns study [15]. Costs and returns work underway or completed but not published includes a study of small shallow-water boats in Guam by the University of Guam, and a more current (1973) shrimp boat costs and returns study by Texas A & M University.

The National Marine Fisheries Service is conducting a costs and returns study of the spiny lobster fishery of Florida, using data from the 1972-73 season. A new study is underway at the National Marine Fisheries Service Gloucester Laboratory on the earnings of multi-specie New England fishing boats.

Perhaps the most ambitious descriptive study currently underway is at the University of Florida. Prochaska and Cato have obtained Sea Grant funding to determine the social, cultural, and economic characteristics of Florida fishermen, and to analyze costs and returns. Their proposal is projected to continue until 1978, and is written quite broadly. As their data base develops, the descriptive character of their work is likely to become less important than the economic analysis.

Two early studies that involved some analytical work as well as costs and returns data appeared in Fishery Industrial Research [10, 16]. In some respects these were predecessors to the series of National Marine Fisheries Service reports referenced earlier. They include costs and returns data taken from cooperating fishermen in the San Pedro-based wetfish boat fleet (purse seiners for mackerel, sardines, bonita, etc.), and the San Diego-based tropical tuna fleet, and an analysis of vessel sizes and fleet expansion.

The tropical tuna study has some historical significance. Green and Broadhead [10] were able to demonstrate potential economies of size for tuna purse seine boats. They projected profit gains for increased boat sizes up to 400 tons. At about the time of this study, a minor revolution took place in the size of tuna boats being constructed; sizes were doubled and tripled. Out of 132 boats now operating in the U.S. tropical tuna fleet, only 51 have capacities less than 400 tons, and 7 have capacities in excess of 1,000 tons. If the study can be faulted, it must be because Green and Broadhead were not visionary enough to see economies of size beyond 400-ton capacities.

Crutchfield [6] completed a descriptive study for the Bonneville Power Administration in 1967. This was the first comprehensive look at fisheries in the Pacific Northwest. It includes a discussion (no data) of demand for Pacific Northwest fish, landings data, some supply projections, and some description of the fisherman population.

Costs and returns research on seafood processors and dealers is much less impressive in both quantity and quality. The Seattle and Juneau office of the National Marine Fisheries Service has a major study underway to determine the economic feasibility of expanding the sole and rockfish industry of Alaska. Costs and returns analysis of three sizes of seafood processing plants are included in this study.

Additional work has been conducted by the Juneau NMFS office in estimating the costs and returns in Alaska shrimp processing. Oregon State University has developed detailed costs and returns estimates on "typical" salmon, sole, and shrimp processing operations. This data has been utilized extensively in seafood marketing extension work.

A comprehensive study has been completed for the U.S. Environmental Protection Agency where costs and returns of every major size and type of seafood processing plant in the United States has been estimated. Unfortunately, the results of this study are not available in published form.

Agricultural economists at Virginia Polytechnic Institute have developed case study plants which represent costs and returns for Virginia seafood dealers. This data has also been used in seafood marketing extension work.

Although outside the scope of this paper, seafood production economics research in Canada deserves recognition. This work has not been insignificant. In fact, much of the work by Campbell, in British Columbia, and Proskie, in the Maritime Provinces, predates any major U.S. research. There has also been a substantial number of costs and returns studies undertaken by private firms in the United States. Ocean Science Capital Inc., Living Marine Resources Inc., and Research Development Planning and Research Associates Inc., are a few of the major U.S. consulting firms meeting the needs of private investors in the seafood industry.

A not-unjustified philosophy for seafood producer costs and returns research seems to be: "Something is better than nothing." Most of this work has an uncertain statistical base but, in nearly every case, this has been recognized and sources of data have been made explicit. Even if it were possible to identify a population and obtain a representative sample, obtaining unbiased and valid data from seafood producers is extremely difficult.

Each fishery and each fisherman has unique accounting procedures, accounting terminology, and pay systems. Accounting procedures range from a paper sack full of "fish tickets" to complete double-entry accounting systems. Not only is it difficult for the economist to understand and interpret the data acquired from seafood producers, it is nearly impossible to make the data compatible among fisheries and even among individual seafood producers. Several of the earlier costs and returns studies avoided the compatibility problem by simply reporting their work in the same terminology and using the same accounting procedures common to that fishery. This leaves the interpretation of "gross stock", "boat share", "condemned gear", and so forth to the user.

More recently, such standard terminology and procedures as "variable costs", "fixed costs", and "opportunity costs" have been used. This has made it possible for the Florida mullet fisherman to understand costs and returns data on salmon fishermen, and for California tuna fishermen to understand New England lobster fishermen's costs and returns. It has also improved communication among marine economists.

Available costs and returns and descriptive data is strictly "point in time" information. With the varying economic environment predominant in the industry, data from the same firms in successive years would be useful in further economic analysis.

Costs and returns research has provided data where data was non-existent. The increasing availability of fisheries costs and returns data has spawned some new analytical work, and has provided a better index of the economic welfare of the industry. Finally, the new costs and returns data has become an important input to marine economics extension programs.

Economic Analysis of the Seafood Producing Firm

The pioneering work in economic analysis of seafood producers was concentrated in New England. Frederick Bell's work for the Federal Reserve Bank of Boston [4] was concerned with the economic feasibility of new technology (stern trawling) and the economic impact of government aid on this technological change. Among the most notable achievements were attempts to construct empirical production functions for a fishing firm (various forms of the Cobb-Douglas were used), and a theoretical production surface for analyzing a discrete change in technology.

Bell's empirical base was not sufficient for complete success. However, the study's major contribution is not in the conclusions of empirical work, but in the attempted application of agricultural economics methodology to the seafood firm.

Holmsen, in his Sea Grant supported work titled "Remuneration, Ownership, and Investment Decisions in the Fishing Industry" [14], examines the effect of different crew payment systems on profitability and productivity in a fishery.

He explains several crew payment systems, and illustrates graphically the effects of each system on resource allocation and organization within the fishing firm.

There is an increasing amount of research which attempts to explain profitability or lack of profitability in seafood production. Holmsen [13] grouped 24 New England trawlers into low return on capital and high return on capital categories. He then compared such observable characteristics as boat size, engine size, market value, gross returns, crewshare, and costs among the groups.

Carley [5] estimated functional relationships among costs, boat size, and landings for Georgia shrimp fishermen. The analysis was based upon 50 of 258 shrimp boats operating in Georgia at the time.

A major study to explain profitability in a fishing business is underway at Oregon State University. This study is based on a random sample of 200 fishermen from the Oregon fishermen population, and 750 fishermen from the Alaska fishermen population. Its objective is to estimate various profit functions. An analysis of variance will be used to identify the more significant profit-determining variables.

One major problem has appeared in this study. Validity of data is extremely difficult to measure. Little is known about the population, and data obtained from interviews are of widely varying quality. It is also hypothesized that natural biological variability and externalities would explain a significant variation in profit. Accounting for these in any profit function will cause considerable difficulty.

A common weakness of all seafood production economic analysis has been the inadequate data base. It is well recognized that the fisherman's skill is an important input in any cost, production, or profit function. Further, the significance of this and other inputs becomes disproportionately greater or lesser as the economic environment changes from year to year. Two studies (at Oregon State University and Texas A & M University) have gone beyond cross-sectional data and have attempted to obtain and use time series data. One study (at Oregon State University) has obtained and is using fishermen skill data in economic analysis.

There is a considerable amount of new research in the economic feasibility of aquaculture. Three projects are currently funded by Sea Grant: "Economics of Aquaculture" at the University of California, "Economics of Salmonid Aquaculture in New England" at the University of Rhode Island, and "Economics of Oyster Production Under Controlled Environmental Conditions" at Oregon State University.

The University of Rhode Island project has already resulted in a report titled "Aquaculture in New England" [8]. In this study, Gates and others have analyzed the biological, technical, economic, and legal criteria for further examination of the American oyster, hard clam, bay scallop, silver salmon, or American lobster as an aquacultural specie. It is a good example of competent interdisciplinary work being encouraged by Sea Grant.

The Northwest Fisheries Center of the National Marine Fisheries Service has completed an economic study of salmon aquaculture on Puget Sound. Although not published, this study offers some excellent data for the potential aquacultural entrepreneur, and is another example of interdisciplinary work.

Research by Thompson and others at several Texas Universities deserves special mention. Their work is reported in three consecutive publications by

Texas A & M University [18, 21, 23], and represents the use of linear programming models to develop optimal shrimp fishing investment strategies. The authors summarize their 3 years of work:

> "That first bulletin contained a deterministic optimal control model of a shrimp fishing firm, in addition to much background information on the industry and justification for the model specification. The second publication extended the first model by incorporating unknown, but random, future shrimp prices and catches, and a constraint that required solvency to be maintained with a high probability, based on the probability distributions of the random prices and catches.
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> "In the third report, the original deterministic model was extended to require the purchase of integer numbers of vessels. Fractions could be purchased in the original application, but industry representatives suggested that a more realistic specification would require the purchase of integer numbers of vessels.
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> "This paper considers essentially the same model as described in the third report . . . but extends the numerical examples to include alternative sizes of boats. In addition, some relatively minor mistakes in the computer routine used to generate the numerical example . . . have been corrected, and the example is presented here in corrected form."

The objective of the research was to develop a decision-making tool for shrimp producers. All parameters except shrimp prices and catches can be specified by the firm. Prices and catches are "learned" in each period of the dynamic model. This is a desirable feature; however, many of the other parameters are at least as difficult to specify and, in actual practice, are "learned" in each period. The model probably outruns the firms' capacity to predict costs, boat purchase prices, interest rates, and borrowing capacity - all important parameters. A sensitivity analysis of these parameters would be useful.

Sharing the Knowledge

Seafood production economics researchers have not been delinquent in sharing research results with others. In fact, this may be the only area of economics where the number of publications exceeds the number of research projects. However, publications are not the only means of sharing the knowledge. As indicated earlier, several states have active extension programs in seafood production economics. Several of these extension programs have developed in conjunction with the institution's research in seafood production economics, while other extension programs have evolved and continued with no research back-up.

The relationship between seafood production economics research and extension is close. With little or no data base, and no prior economic analysis of the seafood producer, extension economists have made excellent use of their disciplines in assisting seafood producers, and have been instrumental in guiding recent research. As the body of seafood production economics research and the sophistication of the audience grows, extension economists will rely more heavily upon accumulated research for effective extension programs. Until then, we will continue to see extension specialists educating seafood producers in the delights of decision-making, financial management, business organization, and so forth.

Where Do We Go From Here?

Our situation in seafood production economics is analogous to a prematurely launched fishing boat with too little ballast in its tanks. If the sea becomes a little rough, the boat is likely to be swamped for lack of ballast. If the launching of seafood production economics is prematurely "discovered" by the industry, we are likely to be swamped by short-term research and extension demands. Indeed, the needs of the industry and the possibilities for economic research and extension are so great one has to be a great adventurer to "go to sea with so little ballast."

If one had complete authority over funds and effort allocation to seafood production economics research, it would be logical to apply the equi-marginal principle. Assuming for the moment that this is possible, let's list the alternatives:

(1) Continue descriptive work - i.e., costs and returns studies and economic characteristics of seafood producers.

(2) Continue estimates of functional relationships - i.e., production functions, cost functions, profit functions.

(3) Behaviour predictive research - i.e., measure the firm's response to, and the impact of, varying exogenous factors.

(4) Development of management tools - i.e., coping with risk and uncertainty, tools of financial analysis, forms of business organization.

Using net short-term benefits to the seafood producer as an index of marginal returns, funds and effort for the immediate future should be allocated first to Item 4, then Item 2, and finally, Items 1 or 3. If we use a longer planning horizon with the expectation of increased funding and effort, continued descriptive work and better estimates of the functional relationships within the seafood production firm should receive more attention. Finally, if our criteria is enlightened policy, behaviour predictive research deserves most of the funds and effort.

In reality, the allocation of funds and effort in seafood production economics research (and extension) is a function of the individual researcher's interests and motivation. The direction of future work will be determined by what the few marine economists actually do.

However, there are some problems that are easier solved if recognized by more than one seafood production economist. These include the problem of sampling, the source and extent of risk and uncertainty, and the persistence of policy concerns in microeconomic research.

We have long suspected the difficulties in sampling such an ill-defined, heterogenous, and mobile population as seafood producers. Recent experiences at Oregon State University have confirmed these suspicions. However, recent experiences have also taught us much regarding stratification, interview costs, and timing in random sampling. As common terminology evolves among the industry, and the sincere efforts of researchers are understood, sampling problems should be reduced, if not resolved. Much work still needs to be done in identifying the population. This can be expedited by close cooperation with the responsible state fishery agency.

There is some uniqueness to risk and uncertainty in the seafood production industry. This economic risk and uncertainty has given rise to peculiar management devices and decision criteria within the industry. These characteristics have been recognized by anthropologists and sociologists who have recently "discovered" the fisherman and are studying him intensively [1, 11, 12, 17]. There is an equal challenge for economists to develop management devices and decision procedures for financial success in the uncertain economic environment of fisheries.

Seafood producers are beginning to "organize" in an attempt to cope with risk and uncertainty. The reallocation of the individual seafood producer's labor, management, and capital to collective action will have both a positive and an adverse effect upon his business. How might this be measured? How can we predict the results?

Most of the recent and current research in estimating seafood production functions and profit functions borrows heavily from traditional agricultural models. With the greater number and importance of non-controllable variables in seafood production, can we be satisfied with these models? In fact, is it even valid to specify production or profit as a function of labor and capital? The coefficient for labor and capital may be insignificant, relative to the coefficients for biological stock, fishing time available, number of other participants in the fishery, and other non-controllable variables. Does the concept of a production or profit function make any sense under these circumstances?

Finally, seafood production economics research can be justified of its own accord, and does not have to be supportive of fisheries policy research. It is possible to take policy as given, and conduct research of great benefit to the individual seafood producer.

Coordination and Communication

The experience of preparing this paper has been beneficial in several respects. First, there was a naive notion that most of the work in seafood production economics was known to the author. Such was not the case, as additional work continues to be discovered beyond the due date of the paper. The lesson in this is that the work is widely scattered - geographically, academically, and professionally. Without many personal contacts, much seafood production economics research and extension would be undiscovered by the profession. Perhaps some form of organized communication or coordination among those participating would reduce the cost to each researcher and to the funding sources.

Second, in spite of the considerable seafood economics production research and extension work underway, it is of much less magnitude and scope than first envisioned. It is well publicized and well published; however, it has not yet reached the stature of marketing economics, water resources economics, and other corollaries to agricultural economics.

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