Fish marketing

FOOD FROM THE SEA: AN ECONOMIC PERSPECTIVE OF THE SEAFOOD MARKET

By

Richard Marasco

INTRODUCTION

Food from the sea has been sought by man since primitive times. In ancient Egypt, fish even served as a medium of exchange. It is recorded that the Union Grave Diggers in Egypt, in the 29th year of Ramses III, filed a petition with royal authorities requesting as part of their wages larger quantities of fish, the indispenable food [18, p.41]. While fish are still an important source of protein, the potential is considered to exist for further expansion in use. Estimates indicate that fish could provide about 70 percent of the animal protein requirement of the present world population [9, p.7].

The importance of fish in diets varies considerably throughout the world. The average American uses only about one-seventh the fish consumed by the average Japanese. To facilitate meeting the dietary needs of American consumers, fish are made available in fresh, frozen, canned and cured forms. Seafood, irrespective of product form, moves through several market levels before it reaches consumers, the ultimate prime-movers in the process.

Associate Professor of Agricultural and Resource Economics, University of Maryland. College Park, Maryland.

Contributed paper, AAEA annual meetings, Aug. 1974, College Station, Texas.

The objective of this paper is to provide an economic perspective of the U. S. seafood market. Examined are relative and absolute consumption and prices, demand, supply, the marketing system, and the future position of seafood in the U. S. food basket.

RELATIVE AND ABSOLUTE CONSUMPTION AND PRICES

Historically, meat, poultry and fish have occupied important positions in the diet of U. S. consumers. Data published by the U.S.D.A. [19, p.16] indicate that civilian per-capita consumption of all three of these sources of protein increased between 1960 and 1971. Meat consumption increased from 160.9 to 191.8 pounds per capita, while poultry, chicken and turkey, and fish consumption increased from 34.1 to 49.9 and 10.3 to 11.4 pounds per capita respectively.[1] Therefore, these data indicate that between 1960 and 1971 per capita consumption of fish decreased relative to meat and poultry. Data for more recent years indicate a trend reversal in relative fish consumption. Between 1971 and 1972 the consumption of meat decreased to 188.9 pounds per capita. Meat consumption plunged down further in 1973 to 175.0 pounds per capita. Poultry consumption increased to 52 pounds per capita in 1972, but decreased by 1.6 pounds in 1973. Consumption of fish reached 12.2 pounds per capita in 1972, and decreased only one tenth of a pound in 1973.

Retail food price indexes contructed by the U.S.D.A. [19, p.31] indicate that the prices of meat, poultry, and fish have all risen since 1960, with sharp increases occuring in the last several years. Relative movements between the price of meat and fish do not exhibit a clear trend for the years 1967 through 1973. Since 1971, however, the price of meat has increased relative to the price of fish. Between 1967 and 1972, the price of fish increased relative to the price of poultry. This trend ended in 1973 with the price of poultry increasing relative to the price of fish.

CONSUMER DEMAND

A number of studies have examined factors that influence consumer demand for fish. For example, individual fish commodities such as shrimp, oysters, clams, halibut, and cod have been subject to investigation.[2] A characteristic of these efforts is the treatment of demand from a single commodity or sector perspective. That is, these studies do not consider the complete interdependent nature of demand. The studies of Brandow [3] and George and King [7] investigated aggregate demand for fish recognizing the interrelationships among all food commodities.

In addition to analyzing the effects of prices and income on the quantity consumed, it is also necessary to determine the effects of psychological, sociological, cultural, and regional factors.

Own Price

The landings, processor, and retail markets constitute the most important market levels in the fishing industry. Each one of these three market levels serve as a link in a chain of institutions affecting the marketing process. Prices at each of these levels are linked by marketing charges. In the whole process, consumers serve as the prime-movers. Since it is the retailer that faces consumer demand, it is the relationship that exists between price and quantity at this level that will be evaluated.

Price elasticities of demand for fish reported by Waugh and Norton [21], Brandow [3], and George and King [7] provide examples of empirical elasticities which have been estimated. Waugh and Norton, using the single commodity or sector approach obtained an elasticity of -0.37. Price elasticities of -0.65 and -0.23 were reported by Brandow and George and King. Thus, these estimates serve to indicate that the demand for fish at the retail level is quite inelastic. Both George and King, and Brandow found the demand for fish to be more inelastic than the demands for beef, veal, pork, lamb, chicken and turkey.

Comparison of the price elasticities of demand for finfish versus shellfish is not possible because of the lack of elasticity estimates at this level of aggregation. It is possible however, to make comparisons among species. The demand equations developed by Bell and et. al. [2] for use in their forecasting study indicate that the demand for shrimp and crab is more inelastic than the demand for lobster, scallops, oysters, clams, salmon and tuna. Demand elasticities for tuna and salmon were found to be less inelastic than the demand for oysters, the species reported to have the least inelastic demand of the shellfish studied.

Income

Both time-series data from market statistics and cross-section data from household surveys have been used to examine the effect of income on the demand for fish. Upon examining the results obtained from the National Marine Fisheries Service's panel survey, Nash [13, p.16] concluded that "Income does not appear to be as strong a factor in explaining purchases (fish) as is sometimes ascribed to it." He noted, as did Purcell and Raunikar [16], that consumption of fish does not increase continuously over all income categories. On the species level, low income households indicated frequent purchases of red snapper, catfish, and whiting. Households in higher income groups reported larger purchases of shrimp, clams, and scallops.

Estimates of the income elasticity of demand using both time-series and cross-section data appear to confirm Nash's conclusion. Waugh and Norton [21, p.35], using time series data, produced an income elasticity of -0.02. The "T" value reported, however, failed to reveal statistical significance. The time series analysis conducted by George and King [7, p.51] yielded an elasticity of 0.004, compared with respective elasticities of 0.29, 0.59, 0.13, 0.57, 0.17 and 0.77 for beef, veal, pork, lamb and mutton, chicken and turkey. An income elasticity of -0.06 has been produced for cross-section data [7, p.70]. Similar elasticities of 0.27, 0.55, 0.01, 0.591, -0.034 and 0.768 were obtained respective to beef, veal, pork, lamb and mutton, chicken and turkey [7, p.70].

Income elasticities of demand derived for individual species, using time-series data, illustrate that the importance of income on marginal consumption varies considerably among species. Respective income elasticities of 2.07, 1.87, 1.70 and 1.17 have been indicated for lobster, crab, shrimp and tuna. Negative elasticities have been reported for oysters, salmon, and halibut. Given these findings, it is not at all surprising that the importance of income on the marginal consumption of all seafood has been found to be of minor significance.

Substitute Relation with other Meat Products

In the United States, fish compete with meat and poultry for a place in the consumer meal. While each is usually served as a part of the main course, they are infrequently served together. To study the competitive relationship that exists between meat, poultry and fish, Waugh and Norton [21] analyzed annual indexes of per capita consumption, deflated retail prices, and deflated per capita incomes for the period 1935 through 1967. The result of the analysis was a cross price elasticity between fish and meat of 0.47. The cross effect found between fish and poultry was negative and lacking in statistical significance.

George and King, using data that spanned from the late 40's through the late 60's, estimated cross price elasticities between fish and beef, veal, pork, lamb and mutton, chicken and turkey. These elasticities range from a low of 0.002 to a high of 0.026. The quantity of fish consumed was found to be least responsive to the change in the price of turkey. The strongest cross price effects were those between fish and pork, and fish and beef.

Substitute Relation Among Species

In addition to considering the competitive relationship between fish and meat, it is also useful to analyze the extent of substitution among species. Salmon and tuna account for most of the canned fish consumed in the United States. The most popular canned fish product in the 1920's and 1930's was salmon. Since the 1960's however, tuna has been the major canned fish item. A one percent change in the price of salmon has been indicated to increase per capita consumption of canned tuna by 0.5 of a pound [21. p.42]. The existence of a substitute relationship between oysters and clams has also been suggested [12 and 20].

OTHER DEMAND PARAMETERS

Other socio-economic factors, in addition in income, have been found to influence purchases of fish for home use. Of these factors, ethnic background, household size and age have been found to be of importance.

To resolve whether or not ethnic background influenced fish consumption patterns, Nash [13] examined the purchases of various racial and religious groups. Data collected indicated that black families consumed twice as much shrimp as white families. Blacks were also found to consume larger quantities of oysters, crabs, ocean perch, red snapper, catfish and whiting. White families were found to have purchased larger quantities of lobster and halibut. Nash's survey results confirmed the findings of an earlier panel survey conducted in Atlanta, Georgia. Purcell and Raunikar [16] reported that the results of the Atlanta survey indicated the quantity of fish and shellfish purchases by non-white households exceeded similar purchases of white households by 82 percent. Among the religious sets delineated by Nash, Jewish households were found to consume the largest quantities of fish. Catholic households were the second largest consumers of fish with fish consumption lowest among Portestants.

Several studies have examined how household size effects fish consumption. Nash [13], in the only study that was national in scope found that per capita consumption of fish declined as family size increased. It was also reported that low-priced purchases increased with family size. Results of the Atlanta [16] and Massachusetts [6] surveys both indicated an increase in the total quantity of fish and shellfish purchases as family size increased. However, when Purcell and Raunikar [16] viewed consumption on the per capita level, consumption and family size were found to be inversely related, a result verified by Nash's study for the nation.

Survey results have indicated higher rates of fish consumption among older consumers, people 45 and over. It has been reported by Miller and Nash [12, p.13] that households headed by persons 45 years and older account for 72 percent of the oysters, 68 percent of the clams, 58 percent of the finfish and 58 percent of the canned fish consumed in the U. S. Viewed in light of the fact that these households account for approximately 50 percent of all the households in the U. S., it is apparent that they consume more than their proportionate share of fish. It was also revealed that households headed by persons 35 years of age, 28 percent of all U. S. households, consumed only 20 percent of the oysters, 14 percent of the clams and 23 percent of the finfish and 22 percent of the canned fish consumed nationally. These data indicate that age may be a very important determinant of fish consumption as the age structure of the nation changes through time.

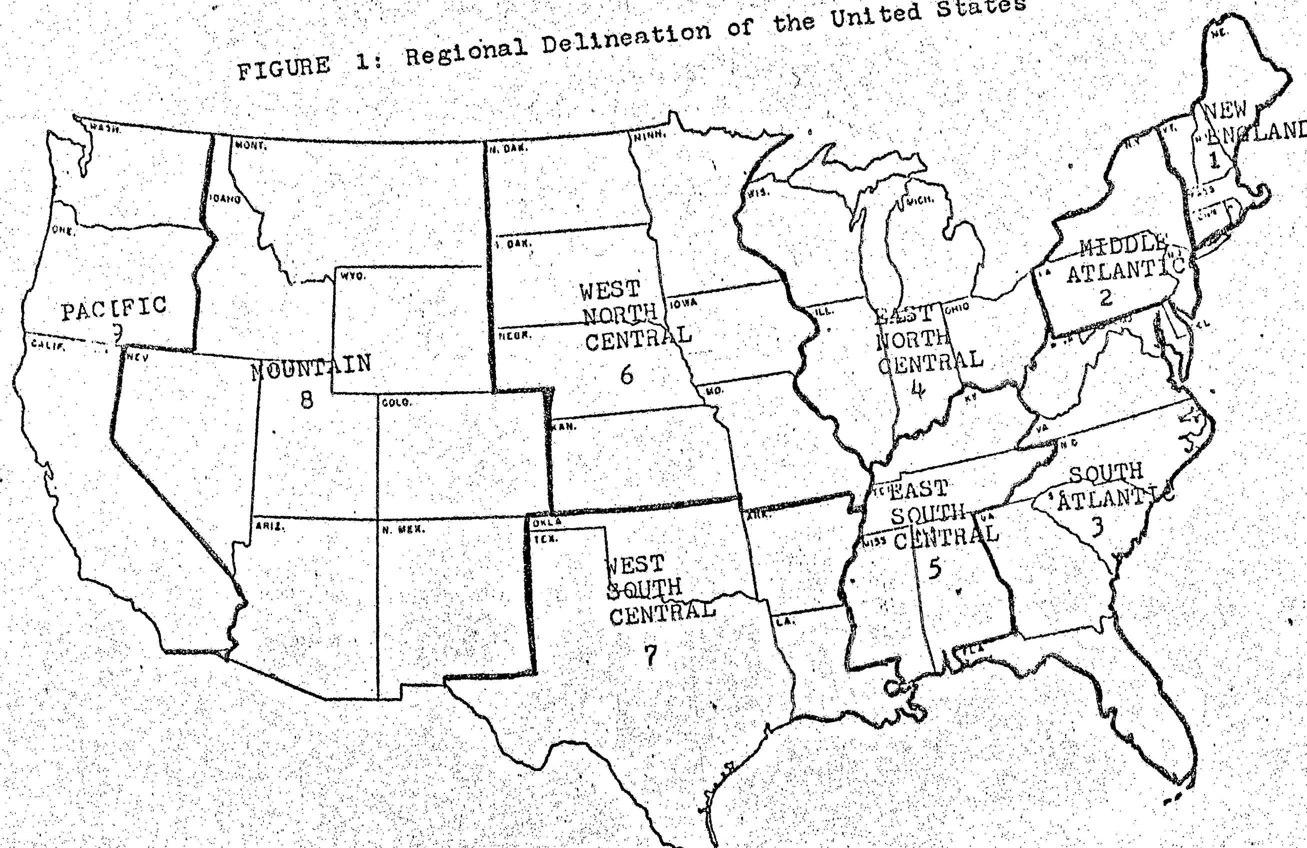
INTERREGIONAL DEMAND VARIATIONS

Consumption patterns evolve over long periods of time. In the case of fish, cultural and technological influences have played important roles in fixing regional patterns of consumption.

The New England region, Figure 1, leads the United States in per capita consumption of fish, with each person consuming 17.6 pounds over a 12 month period. The East South Central and West South Central follow with per capita consumption over the same time span of 17.2 and 16.5 pounds, respectively. Per capita consumption of fish is lowest in the West North Central region, 7.90 pounds. The popularity of different varieties of fish varies from region to region. In New England, for example, shellfish are very popular with the per capita consumption at-home of 4.1 pounds far exceeding the national average of 1.8 pounds. On the other hand, per capita finfish consumption in New England, 5.8 pounds, is only slightly above the national average of 4.9 pounds. The reverse is true for fish consumption patterns in the West South Central States. Finfish consumption per capita at-home in the West South Central region exceeds the national average by 3.7 pounds, while average per capita consumption of shellfish is 0.18 pounds below the average.

When per capita consumption is examined by species, the reasons for different regional consumption patterns becomes more apparent. For example, oyster consumption in the South Atlantic states, 0.47 pounds per capita, is more than double the national average, [12, p.16]. Per capita consumption in the East and West South Central regions, two regions located in close proximity to important oyster producing beds, ranks

FIGURE 1: Regional Delineation of the United States



second and fourth respectively in national oyster consumption. Thus, these data reveal that areas with the highest rates of per capita consumption are also the major oyster producing areas. In aggregate, these areas account for over 60 percent of the total oysters consumed at home, and further, they consume about 84 percent of their total production [12, p.3]. Cultural and technological influences have more than likely played important roles in shaping these patterns. In the case of oysters, technological factors have been very important. Historically, oysters have been preferred in a "fresh" form. The perishability of oysters in this product form has reduced incentives to develop extensive distant markets.

Heavy shrimp consumption in the South Atlantic and South Central States is also indicative of the tendency for seafood products to be consumed in the area of harvest [12, p.7]. Miller and Nash [12] found evidence that indicated concentrations of consumption in the area of production for clams, crabs, lobsters and scallops. Close proximity to production areas and consumption of finfish are also closely related. Per capita purchases of salmon by users residing in the Pacific region far exceeds purchases per capita in other regions [13]. Nash [13, p.15] reported that red snapper is most important in the East and West South Central areas and in the Pacific states.

Differences have also been reported to exist in consumption patterns within regions. Krebs and Storey [10] found that residents in Quincy, Massachusetts, a coastal community, purchased fresh fish more often than residents in Binghamton, New York. Purchases of frozen fish in the

New York community were found to exceed similar purchases in Quincy. Similar findings have been reported for two Virginia communities. While reporting only slight differences in consumer eating patterns for Norfolk and Roanoke, Virginia, Long and Coale [11] concluded that much of the difference documented was attributed, partially, to product availability.

SUPPLY

Potential Physical Supply

The productive potential of oceanic living resources is not accurately known. Depending upon the assessment method used, the estimated total yield ranges from 55 to 2,000 million tons [8, pp.248-249]. For the most part, the smaller estimates tend to be those extrapolated from catch trends or existing knowledge of world fish resources. The liberal estimates have been derived from the theoretical flow of energy through the trophic layers of the marine food chain.

Estimates of potential yield have been made for all those creatures that support major fisheries by the Food and Agricultural Organization of the United Nations [8]. The world's large pelagic, demersal, and shoaling pelagic marine creatures are estimated to have a yeild potential of approximately 100 million tons per year. Species covered by these three groupings include, for example, salmon, tuna, skipjack, bonito, flounders, cod, haddock, snappers, anchovies, herrings, sardines and mackerel. Lobsters, shrimps, prawns, crabs and other marine crustaceans are indicated to be capable of providing in the vicinity of 2 million tons annually. Large quantities of squid, cuttlefish, and octopus are harvested however, no estimated potential is available. The potential of squid is considered to be large. No estimate was made for clams, oysters, and other molluses because of the possibilities of increased harvest by cultivation. For smaller animals such as the krill of the Antarctic and the lantern fish, potential yield is estimated at several times the present world catch of all fishes. While it is not possible to harvest these economically at present, the establishment of operations on a commercial scale is considered to be in the not too distant future.

The term potential yield, as used in the FAO study, is the sum of sustainable yields of each individual stock of fish, in the group concerned, under average environmental conditions, with the pattern of fishing on each stock adjusted to make the yield a maximum [5, p.9]. Therefore, the estimates are maximum sustainable yields. Thus, the potential yields are upper limits of what can be taken on a sustained basis when harvesting is technologically and economically feasible.

With reference to the status of world fisheries, Gulland [8, p.252] has made two general remards, First, he has stated that significant catch increases of traditional stocks cannot be maintained. And second, large increases in the production of food from the sea can be achieved by turning to underutilized species.

Coastal waters adjacent to the United States support an abundance of marine life. These very productive waters have been fished by both domestic and foreign vessels. While some species located in U. S. adjacent waters can support considerable catch increases on a world-wide basis, they are fished very heavy near U. S. coasts. Bell and et. al. [2 p.36] have indicated that catch levels have reached critical limits for crabs, tuna, salmon, halibut and Atlantic groundfish. Tanner crab, northern shrimp, calico scallops, offshore lobsters and offshore clams were indicated to be capable of supporting catch increases. Therefore, it appears that underutilized species will also play an important role in the future expansion of U. S. fisheries.

World Competition for Fishery Resources

Of the many developments that have characterized world fisheries, it is the recent intensification of distant water efforts by numerous nations that looms as most important. The disposition of the catch taken in the Central Eastern Pacific is indicative of the expansion in distant-water effort that has taken place. Christy [4, p.13] indicated that the catch of African states bordering the Central Eastern Pacific dropped from 85 to 40 percent between 1958 and 1969. The balance of the 1969 harvest was accounted for by 15 foreign states, including Russia, Spain and Japan.

Since World War II, fishing fleets from numerous nations have extended their fishing activities into fisheries off the coast of the United States. After the War, both Japan and the Soviet Union began competing with the U. S. for marine resources off the coast of Alaska. More recently, Soviet vessels have also been recorded pursuing Pacific hake off the coasts of Washington, Oregon and Northern California.

Expansion of fishing activities has not been limited to developed countries. Aided by the development of long range self-contained freezing trailers, integrated fishing fleets, and the willingness of fishermen to work for long hours for low wages, some underdeveloped countries have been able to expand their fishing activities. For example, Korean longline tuna vessles fish all over the world. Ghana has vessels operating off Morocco.

The extent of interest in and perhaps an indication of future increases in the degree of competition between nations for marine creatures is given by the following statement made by Christy [4. p.21]:

> "The growing value of fisheries combined with the increased perception of the values, combined with the growing ocean interests of more independent states, all lead to increased demands for sharing in the sea's wealth. A decade ago, many states would have been satisfied by simply having the option to fish that was guaranteed to them under the principle of the freedom of the seas. But this option is now of little value. The opportunities that might be found in increases in world catch are now known to be quite limited. And the value of the option is further reduced by exclusionary tendencies in multilateral fishery arrangements. The declining value of the option is another stimulus to the demands for participating directly in distribution of the fisheries wealth."

Mariculture

Aquaculture, the growing of aquatic organisms under controlled conditions, has been practiced for hundreds of years. Recent intensification of interest in it can be attributed partially to the realization that the harvest limits of wild acquatic organisms is being reached.

Lack of data has made assessment of world production through aquaculture difficult. Information collected by the FAO indicates that world production during 1970 was about four million tons. More recent updated data from 42 countries reveals total world production to be over 5.0 million tons, 3.7 million tons of finfish, 1.0 million tons of molluscs and 0.4 million tons of seaweed [15, p.2205]. This total reflects tonnage derived from fresh, brackish and saline waters. Fish culturing activities in the United States account for approximately eight percent of the five million tons, with oyster and catfish production the most important forms.

The development of the culture of marine fish species has lagged behind that associated with fresh and brackish varieties. It has been stated that true mariculture is barely in its infancy [1, p.24]. The major mariculture industries are for shellfish principally oysters and mussels. Yellowtail culturing activities have expanded in recent years in Japan. Between 1958 and 1968 the Japanese expanded the production of yellowtail from 300 to 30,000 metric tons [1, p.563]. Other estuarine animals raised included lobsters, clams, abalone, scallops, pompano and plaice. For most of these species commercial production is insignificant, with the culture of most being still in the laboratory or early pilot stages.

Economic Supply

Assuming that the world is divided up into regions, the world maximum sustainable yield (MSY) is the sum of the MSY's for each individual region. To attain world MSY, each region would have to be maintained at its maximum sustainable yield. This is biologically possible but unfeasible under competitive conditions.

The world supply of fish at any given price is the sum of the amounts that would be supplied by each region at that price. The locus of all such points constitutes the world supply curve for fish, Figure 2. This curve has been referred to as the curve of world sustainable supply [2, p.99].[3] On the supply side, the corollary to maximum sustainable yield is maximum sustainable supply. Bell and et. al. [2] have estimated world MSS's for tuna (3,659 millions lbs.), salmon (1,069 million lbs.), groundfish (15,400 million lbs.), halibut (129 million lbs.), shrimp (3,278 million lbs.), crabs (1,253 million lbs.), lobsters (424 million lbs.), clams (1,762 million lbs.), scallops (844 million lbs.), other food fish (153,881 million lbs.), and species for reduction (66,400 million lbs.). With the exception of clams and scallops, it is estimated that all of the species will reach the point of maximum sustainable supply in the 1985-2000 period. Salmon, halibut and groundfish were indicated to be currently exploited at their MSS's. Estimates of MSS are not available for U. S. ocean fisheries. However, respective maximum sustainable yield for the species mentioned about of 792, 407, 5, 157, 59, 317, 343, 66, 381 and 1,034 thousand metric tons, can be used as upper limits on U. S. MSS's.[4]

MARKETING SYSTEM

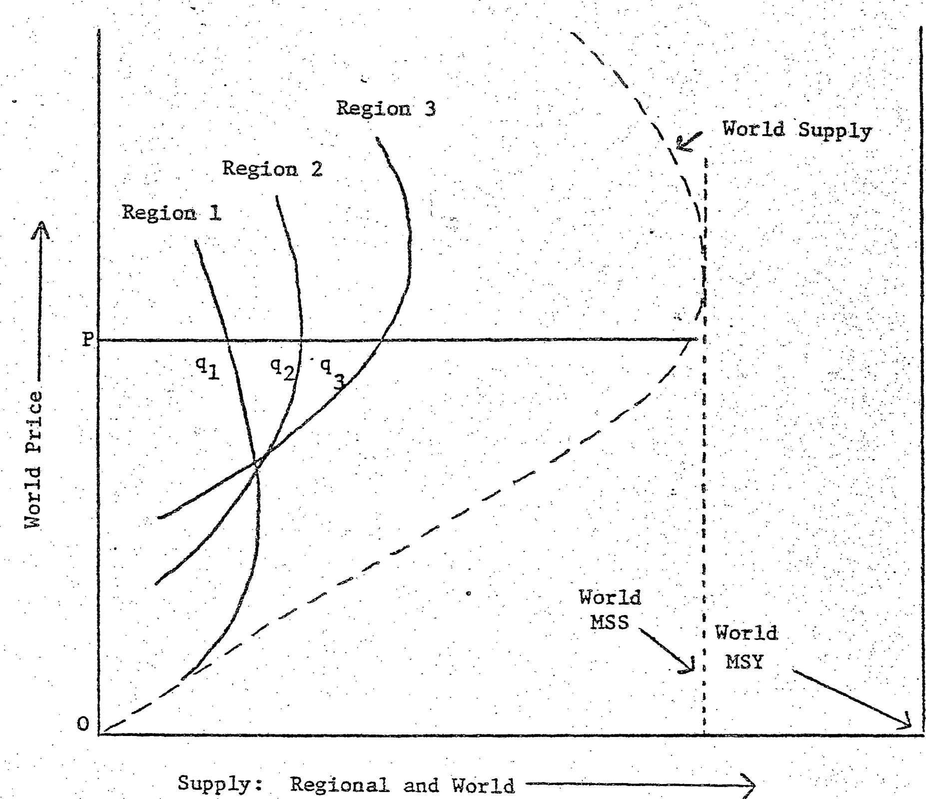
There are generally several stages which comprise the distribution channel for seafood. It is the primary wholesalers, processors, secondary wholesalers and retailers that are the critical links in the marketing system. The activities encompassed within the distribution process from the time the fish are caught until they are sold at the retail counter depends upon the species and product form. For example, in the case of frozen products cold storage would play an important role. Inventories may be held by processor plants, cold storage plants, wholesalers, and retail chain cold storage plants, While deviations exist, it is felt that the distribution stages mentioned above provide an adequate description of the marketing channel for seafood. It is necessary to note the role of brokers. In many markets, they serve as intermediaries between processor and wholesaler or even retailer. However, it is becoming increasingly common for large processors to bypass intermediaries and sell directly to large retail food chains.

The bypassing of stages between the processor and the retailer might be interpreted as movement of the seafood industry toward vertical intergration. There has been some acquisition of fish processors by food conglomerates however, the movement hasn't affected all segments of the seafood industry. A study of the Northwest fresh and frozen salmon industry indicated the absence of vertical intergration [17].

FUTURE POSITION OF SEAFOOD IN THE U.S. FOOD BASKET

In 1973, retail food prices averaged 14.5 percent above 1972

Figure 2: World supply and regional supply



prices. The extent of the 1974 increase will depend upon how much food output is stepped up, the strength of the demand for food commodities and the conditions in the U. S. economy. Under expected conditions retail food prices for all of 1974 are predicted to average 12 percent above their 1973 level [19, p3].

The recent increase in food prices has resulted in decreased per capita consumption of meat, poultry, and fish. Fish have experienced the smallest decline. While absolute fish consumption has declined slightly, relative consumption has increased. This leads to the following question, "Will relative fish consumption continue to increase?" Indications are that upward pressures will continue to be exerted on food prices by higher marketing and distribution costs. These factors will affect all food prices. Predicted crop supplies, smaller than those expected, could force meat and poultry prices to remain high. U. S. fisheries as a whole appear to be capable of withstanding increased market pressure. Barring the occurrence of any unforseen phenomenon fish supplies appear capable of supporting larger consumption levels. While this holds for fisheries as a whole, it must be noted that some fisheries are currently being exploited at their potential. Other fisheries will have to be relied upon. Therefore, in the short-run, it appears that seafood is capable of supporting a stronger position in the U. S. food basket.

While fisheries appear capable of supporting a larger role than current occupied in the U. S. food basket in the short-run, the picture is less favorable for the long-run. Bell and et. al. [2] indicate that by the year 2000 the reaching of world potential for species fished by U. S. fishermen will put increasing pressure on U. S. stocks which, in many cases, are almost fully utilized. Therefore, it would appear that the development of underutilized species will determine the future extent of the amount of seafood in the food basket

SUMMARY

Consumption of seafood in the U. S. is low relative to that of some foreign countries. Consumer demand for seafood is inelastic with respect to price and income. Various socio-economic factors such as household size, age and region affect consumption. While fish populations upon which major U. S. fisheries are based appear capable of withstanding short-run pressures, maximum sustainable supplies will be approached before the year 2000. Mariculture appears to possess the potential of adding to the supply of fish; however, the industry is in its infancy. The recent increase in relative consumption of seafood is capable of being supported and expanded by present stock levels. In the long-run, maximum sustainable supplies will be reached; thus the position of seafood in the food basket could be weakened especially if underutilized fisheries are not developed.

REFERENCES

[1] Bardach, John E., John H. Ryther and William O. McLarney, Aquaculture: The Farming and Husbandry of Freshwater and Marine Organisms. Wiley-Inter Science, New York, 1972.

[2] Bell, Frederick W. and et. al., "The Future of the World's Fishery Resources: Forecasts of Demand, Supply and Price to the Year 2000 with a Discussion of Implications for Public Policy," U. S. National Marine Fisheries Service, Economic Research, File Manuscript No. 65, December, 1970.

[3] Brandow, G. E., "Interrelationships Among Demands for Farm Products and Implications for Control of Market Supply," Pennsylvania University, Agricultural Experiment Station, Bulletin 680, August, 1961.

[4] Christy, Francis T., "Fisheries Management and the Law of the Sea," In Economic Aspects of Fish Production. International Symposium on Fisheries Economics, Paris, 1972, pp.4-39.

[5] Food and Agricultural Organization, United Nations "The Prospects for World Fishery Development in 1975 and 1985," Fisheries Circular No. 118. June, 1969.

[6] Gaede, Harold W. Jr. and David A. Story, "An Analysis of Consumer Purchases of Seafood in the Springfield, Massachusetts Metropolitan Area," University of Massachusetts, Agricultural Experiment Station, Bulletin No. 584. October, 1969.

[7] George, P. S. and G. A. King, "Consumer Demand for Food Commodities in the United States with Projections for 1980," University of California, Agricultural Experiment Station, Giannini Foundation, Monograph No. 26, March, 1971.

[8] Gulland, J. A., The Fish Resources of the Ocean. Fishing News (Books) Ltd. Surrey, England, 1971.

[9] Jackson, Roy I., "Fisheries and the Future World Food Supply," World Fisheries Policy: Multidisciplinary Views, Brian J. Rothschild, ed., University of Washington Press, Seattle 1972.

[10] Krebs, Edward H. and David Story, "An Analysis of Consumer Purchases of Fresh Haddock, Flounder and Cod in Quincy, Mass., and Binghamton, N.Y.," University of Massachusetts Agricultural Experiment Station, Bulletin No. 579, June, 1969.

[11] Long, D. L. and C. W. Coale, Jr., "Seafood Consumption Patterns Two Virginia Metropolitan Areas," Virginia Polytechnic Institute and State University, Agricultural Economics Research Report. March, 1972.

[12] Miller, Morton M and Darrel A. Nash, "Regional and Other Related Aspects of Shellfish Consumption: Some Preliminary Findings From the 1969 Consumer Panel Survey," U.S. National Marine Fisheries Service, Circular No. 361, June, 1971.

[13] Nash, Darrel A., "Preliminary Analysis of a Survey of Buying Patterns for Fresh and Frozen Fish and Shellfish by Household Characteristics," Unpublished report U.S. National Marine Fisheries Service.

[14] Nash, Darrel A. and Frederick W. Bell, "An Inventory of Demand Equations for Fisheries Products," U.S. Bureau of Commercial Fisheries, Division of Economic Research, Working Paper No. 10, July, 1969.

[15] Pillay, T. V. R., "The Role of Aquaculture Development and Management," Journal of the Fisheries Research Board of Canada, Vol. 30, No. 12, Part 2, December, 1973, pp. 2202-2217.

[16] Purcell, J. C. and Robert Raunikar, "Analysis of Demand for Fish and Shellfish," University of Georgia, College of Agriculture Experiment Station, Research Bulletin 51, December, 1968.

[17] Schary, Philip B., "Analysis of the Distribution System for Northwest-Originated Fresh and Frozen Salmon," U.S. National Marine Fisheries Service, Economic Research Laboratory, File Manuscript No. 95-1, September, 1971.

[18] Shapiro, Sidney, Our Changing Fisheries, U.S. Government Printing Office, 1971.

[19] United States Department of Agriculture, Economic Research Service, "National Food Situation," NFS-147, February, 1974.

[20] Visgilio, Gerald R., "An Economic Evaluation of Fishery Management Alternatives - An Analysis of the Surf Clam Industry," Unpublished Ph.D. Thesis, University of Rhode Island, 1973.

[21] Waugh, Frederick V. and Virgil J. Norton, "Some Analysis of Fish Prices," University of Rhode Island, Agricultural Experiment Station, Bulletin 401.

FOOTNOTES

[1]Per capita consumption is given in primary distribution weight.

[2]Demand relationships for a wide variety of fish have been inventoried by Nash and Bell [14].

[3]Behind the world sustainable supply curve is the assumption of no controls. It assumes only the normal competitive responses of the fishing industry to prices and cost.

[4]MSY's are not listed for other food fish and species for reduction.