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OUTLOOK FOR U.S. AQUACULTURE

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Where will U.S. aquaculture be headed in the near future? The rapid pace of technological change injects too many unknowns to make good long-term forecasts, so this outlook is limited to the short-term.

- In the next several years the commercial availability of major fresh water fish such as striped bass, walleye, and yellow perch and shellfish species will have shifted almost entirely to aquaculture production.
- With relatively large amounts of suitable land and water supplies, plus a large domestic market, the United States will likely remain a major supplier of cold and temperate fresh water species.
- Development of new production technologies will be augmented by a growing body of knowledge in the areas of reproduction, growout strategies, disease prevention, and nutrition.
- The United States' position as a major grains producer, a major component in aquacultural feeds, will be a stimulus to aquaculture research.
- Over time, gains in aquaculture production efficiency will lower real production costs. Declining real production costs have already been a large factor in the growth of today's major aquaculture industries.

The future for marine aquaculture in the United States is less certain. The most serious problem is that most marine aquaculture is done in shallow coastal waters, the waters most affected by industrial and residential pollution and development. Because the ocean has traditionally been viewed as a common property resource there are also conflicts with other commercial and recreational users which may slow or prevent the development of marine aquaculture. However, the growing pressure on many marine stocks will continue to lead to research efforts into the practicality of their aquacultural production.

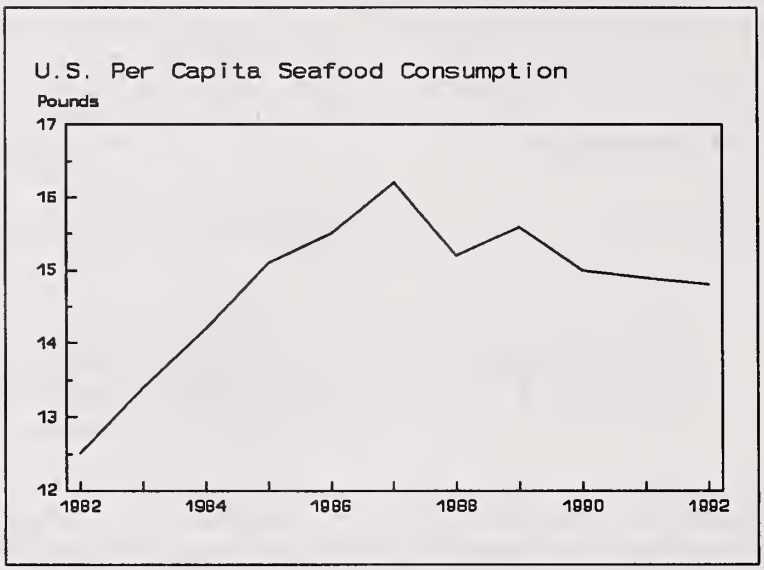
Future growth for U.S. marine aquaculture may come from expanding its role as a supplier of scientific expertise, advanced production systems, or specially bred or genetically improved juveniles for physical growout elsewhere. This role might be especially viable for warm water species that would be impractical to farm domestically.

Declining Consumption

Contrary to the impression you might have gotten from seafood or aquaculture trade publications, per capita seafood consumption in the United States is not rising, but rather it has been declining. While per capita consumption has fallen in the last several years, total consumption has been relatively steady as per capita declines have largely been offset by increases in population. For aquaculture, growing sales have been achieved mostly by capturing a larger percentage of the basically flat total domestic seafood consumption. This implies that aquaculture products have been able to displace wild-catch seafood products, but their growing sales have not had much of an impact on livestock and poultry consumption. Over the last several years, beef consumption has declined, pork consumption has been steady, and poultry consumption has risen steadily.

The primary reason that seafood consumption has declined over the last several years is its higher prices relative to beef, pork, and poultry. However, there are a number of secondary factors such as advertising impact,

product familiarity, safety concerns, and eating patterns. For the most part, on a pound for pound basis seafood products are generally more expensive than beef, pork, or poultry products. A prime example of these price differences is that major grocery chains in the Washington area can retail broilers for under 70 cents a pound. This is less than the current farm level price for catfish. It will take a great deal of work developing new production and processing techniques before the aquaculture industry can compete on a direct price basis with the poultry industry.



While relative price differences have probably had the largest impact on seafood consumption, advertising has also had an effect. The beef and pork industries both have aggressive generic advertising programs to promote consumption. The poultry industry does not have a generic advertising campaign, but it has plenty of brand name advertising. Also, the size differences between the aquaculture industry and the livestock and poultry industries mean that the advertising budget for aquaculture products is only a fraction of those for the other industries.

While much of the U.S. population lives within relatively close proximity to the ocean, most consumers are much less familiar with how to prepare the wider variety of seafood products then they are with beef, pork, or poultry. This tends to hold down purchases for home consumption.

The growth of fast food outlets has also helped beef and poultry consumption. With only a few exceptions, seafood products are not the primary items on fast food menus. A larger percentage of seafood consumption takes place in higher-priced restaurants, where people are more likely to try unfamiliar species. Meals at these types of restaurants are viewed as more of a luxury item, so their growth over the last several years has been much slower.

Aquaculture's Future Impact

Due to the price differences between seafood and beef, pork, and poultry products most of the growth in aquaculture will continue to come at the expense of wild-caught seafood. If there is the same type of growth in aquaculture production over the next seven years (1994 to 2000) as there has been in the last seven years, then by the end of the 20th century aquaculture could be supplying upwards of 25 percent of all the seafood consumed in the United States.

Farm-raised salmon and shrimp already account for up to 25 percent of worldwide production of those species. In 1992, U.S. farm-raised salmon imports were estimated at 71 million pounds, accounting for at least 60 percent of all salmon imports and around 16 percent of total domestic use. The estimated 390 million pounds and $1.3 billion of farm-raised shrimp that were imported in 1992 represented over 60 percent of all shrimp imports and 40 percent of domestic consumption. For these two species, U.S. farm-raised production adds only a small percentage to total consumption.

In addition to salmon and shrimp, basically 100 percent of the catfish, trout, and hybrid striped bass consumed domestically are farm-raised here in the United States. Aquaculture also accounts for approximately half of all the crawfish produced. Tilapia, which is rapidly growing in popularity, is chiefly a farm-raised product. In addition, a good percentage of the major mollusk species, such as oysters, clams, and mussels are also farm-raised. Over the next seven years a number of species including, turbot, sea bass, sea bream, and red drum

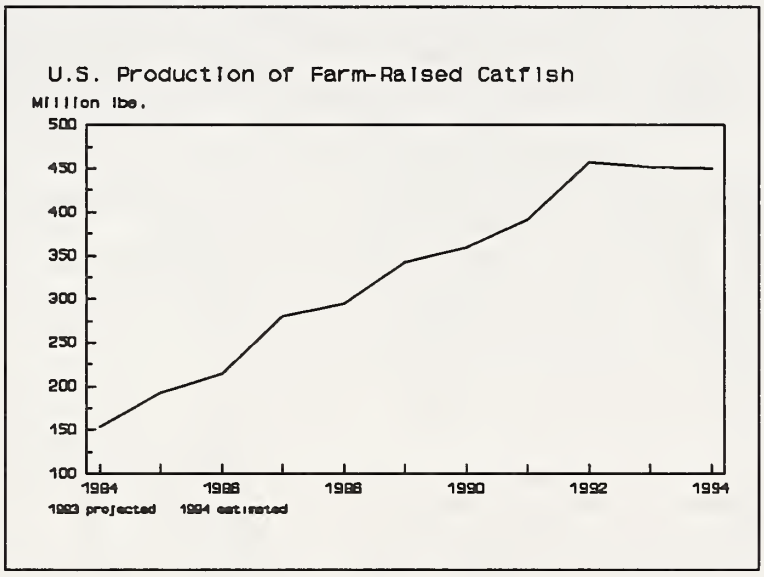
could be added to the list of species where aquaculture producers are major suppliers.

In the long-term, aquaculture will likely become a major supplier of seafood products in the mid-to-higher priced end of the market. Aquaculture will also have a large impact on the major freshwater and the coastal saltwater species that have been most affected by changes in water quality and habitat. The reasoning for this is relatively straightforward. If a particular species currently commands a high price in the market place or if there are indications that reduced availability in the future will cause price increases, these are the species that will be prime candidates for aquaculture.

There are three major areas to consider when trying to forecast future growth in aquaculture production in the United States. The first is physical attributes. The considerations for each species include temperature requirements, whether it uses fresh or salt water, reproductive success in a farmed situation, type of feed required, growth rates to market size, and susceptibility to diseases at acceptable stocking densities. If the species is nonnative, are there concerns about its possible introduction into the local environment?

A second set of considerations involves the present supply of the targeted species. These considerations include such areas as: the current stock estimates and harvesting yields if the species is a native, whether the population and harvest have been decreasing over time, whether the species is chiefly targeted by recreational or commercial fishermen, and whether the species is being impacted by environmental changes.

The third set of considerations deal with the available market for the target species. Some of the market factors are: current price level, overall demand, the availability of close substitutes, variety in preparation, whether the species is a regional or ethnic specialty, and whether sales are to restaurants or retail markets.



Challenges Facing the Industry

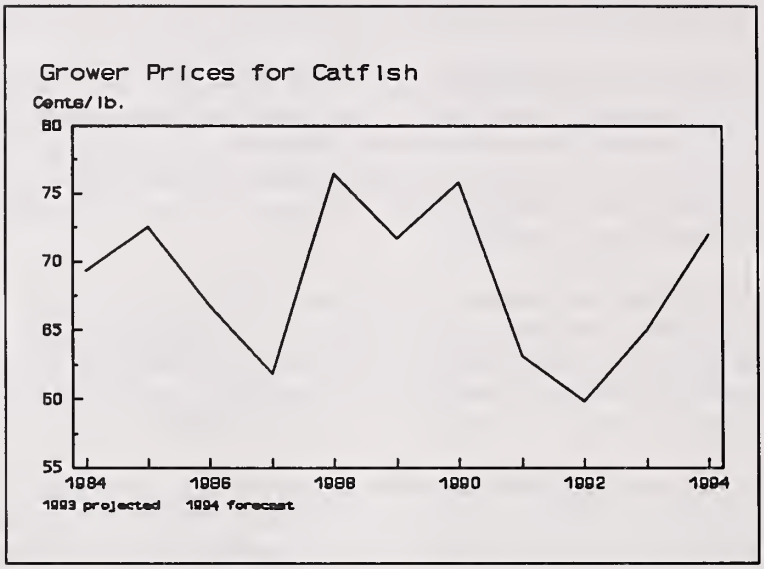
To achieve continued growth, the domestic aquaculture industry will be faced with a number of challenges. One major challenge will be to develop ways to increase consumption of aquaculture products in the face of a slowly recovering economy at home and declines in economic conditions in two of the major export markets, the EC and Japan. While growth in the domestic aquaculture industry up to this point has chiefly been by substituting aquaculturally produced products for wild-harvest product, in the long run the aquaculture industry will need to increase the demand for its products and not simply substitute sales from the wild-catch industry. As it attempts to increase the demand for its products, U.S. aquaculturalists will also be faced with increasing competition from foreign competitors and continued downward pressure on prices.

Outlook for Finfish

Catfish - At the present time, 1994 catfish production is forecast at approximately 450 million pounds, about even with the projected output for 1993. Processor sales should move in tandem with their purchases and are forecast to be in the 230 million pound range in 1994. This would mark the second year of little or no growth for the catfish industry.

However, there are some signs that growers are beginning to respond to the higher farm prices seen in 1993. Inventory estimates as of the first of October show that the number of fish held by growers is down in most categories compared to a year earlier, but the declines are less than they had been in earlier year-over-year

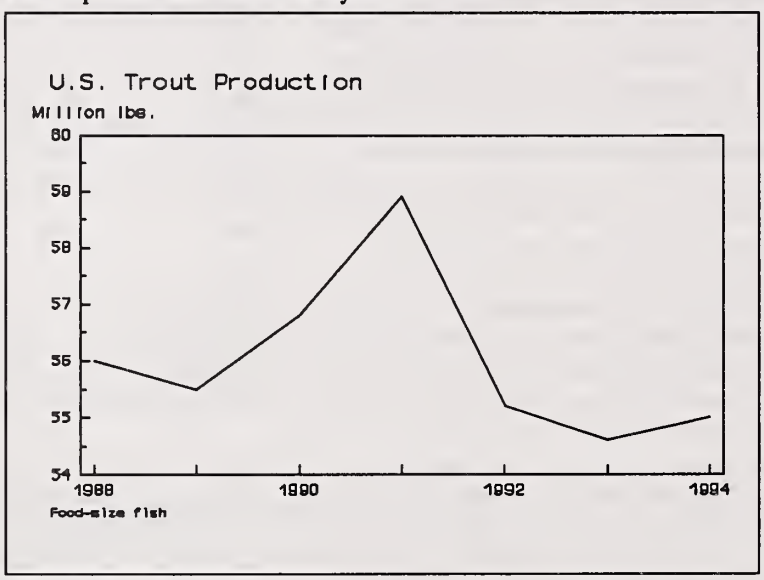
comparisons. Moreover, the inventory estimate for small stockers was actually 14 percent higher than the previous year. This increase in small stockers will likely not have any affect on the supply of food-size fish until at least the second quarter of 1994. Another positive factor is that growers' reports of the number of fish they stocked in the third quarter was substantially higher in all three categories (large and small stockers, and fingerlings), when compared to a year earlier.



In total, supplies of food-size fish should remain relatively tight through at least the first quarter of 1994. Any large scale increase in supply would likely not occur until the end of 1994 and then only if growers significantly increase their stocking rates in the spring of 1994.

Farm level catfish sales are projected to be down slightly in 1993. However growers have benefited from higher farm prices which should average 16 to 19 percent higher than the previous year. In 1994, with growers' supplies of food-size fish remaining tight, the farm price for catfish is forecast to average close to its present 72 to 73 cents per pound. These prices should be profitable for most growers and provide some incentive to expand production, but due to the time lag between hatchery production and growout to market size, any large rise in the availability of food-size fish will likely not show up until late 1994 or early 1995.

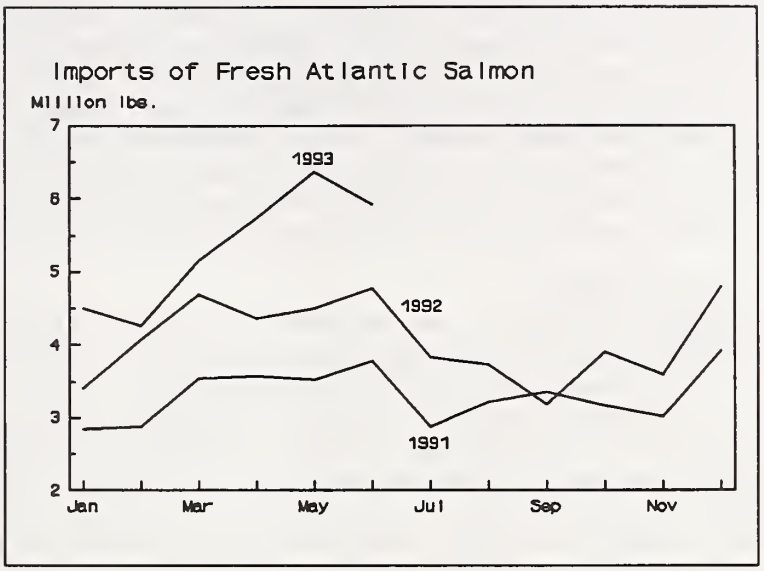
Trout - Overall production of food-size trout has remained basically flat since 1988, varying only between 54.6 and 58.9 million pounds. During much of this period, prices for food-size trout have fallen. Although average farm prices for food-size fish increased to 99 cents a pound in 1993, this is still 4 cents a pound lower than in 1988.



The outlook for domestic trout production in 1994 is for production to remain close to 55 million pounds. However, since no inventory estimates are collected from the trout growers it is difficult to accurately forecast future production. A second factor clouding the forecast is that many of the major trout producers are vertically integrated, so that sales of trout eggs in one year are not an accurate indicator of what production will be the following year. Prices for trout products may be under some downward pressure in 1994, due to the larger supplies of salmon products that will be available. Trout and salmon products are not interchangeable, but the forecast large supplies and falling prices for salmon products will impact the trout market.

The trout industry could be aided if the economy strengthens further. A stronger expansion in the economy would likely increase business at restaurants, which are a prime outlet for trout products. Over the longer run

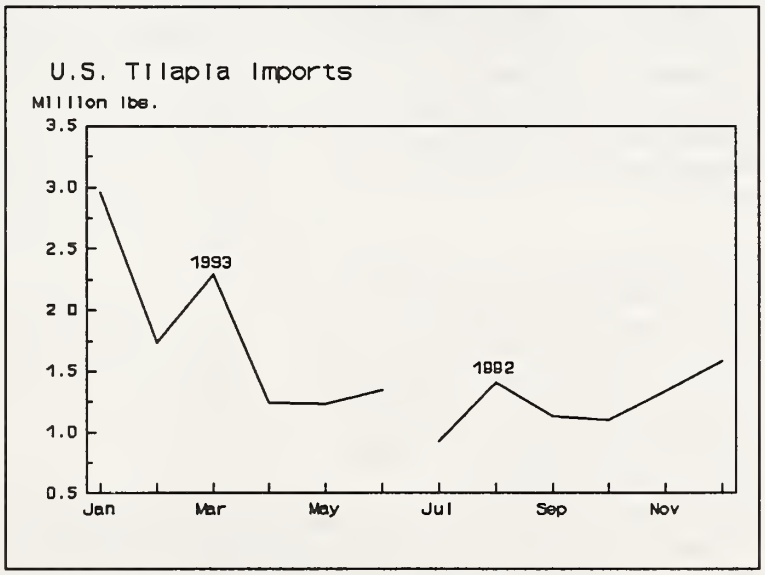
the trout industry needs to actively develop new markets for their products and to keep exploring different ways to increase their productivity, to stay competitive with various products from both the domestic and foreign salmon growers as well as products from foreign trout growers.



Salmon - During 1994, world and U.S. salmon markets will be heavily influenced by the large U.S. wild salmon harvest in 1993 and the continued rise in farmed salmon production, especially in Norway and Chile. Preliminary estimates are that the 1993 sockeye landings in Alaska set a record, topping last year's 347 million pounds. Farmed salmon production in Norway and Chile has been projected to be upwards of 500 million pounds in 1993. The combination of these factors will likely keep downward pressure on most salmon prices until at least mid-summer 1994.

A significant change in the salmon market in the long-term may come from the farmed sector, where Norwegian salmon producers reportedly are working on new production techniques that could yield large increases in efficiency. American salmon farmers will need to match any new production advances to stay competitive. If these reductions in production costs are realized it may start to move farmed salmon products out of the luxury market and into the reach of a much larger group of people. If this is the case, salmon producer and marketing groups will have to develop new ways to promote salmon consumption outside its traditional markets.

Tilapia - During the third quarter of 1993 the United States imported over 5 million pounds of tilapia products, an increase of 56 percent over the same period the previous year. For 1993 tilapia imports are projected at 21 to 22 million pounds, larger, on a quantity basis, than the amount of frozen salmon that the United States will import.



The outlook for 1994 and beyond is for rising imports of tilapia products, in addition to increasing domestic production and falling real prices. As more foreign operations begin producing tilapia and marketing them in the United States, domestic producers will be pressured to maintain sales. Domestic growers will have to develop marketing niches for themselves. They will need either a quality difference or some marketing advantage that will offset the lower production costs that foreign producers will likely enjoy. How far tilapia production can expand in the United States will hinge on the answers to a number of questions. Can low cost feeds be developed? Can economically efficient densities be maintained in production systems without incurring higher disease rates? Can the current ethnic markets for tilapia be enlarged to accommodate higher domestic production? Can new products be developed that will provide domestic growers with a wider market?

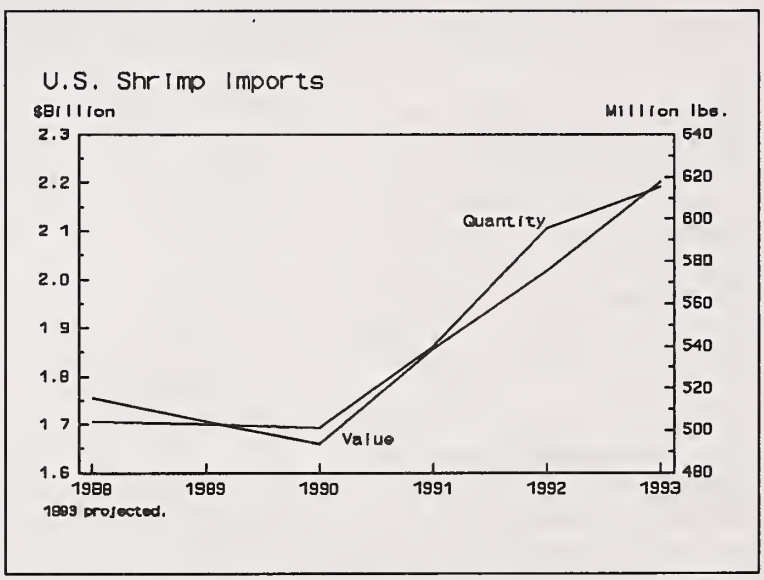
Other Species - Over the next several years, with increasing pressure on fresh and marine resources, there will be expanding incentives to examine the possibility of farming different species. As aquaculture expands, a number of newer species will become successful segments of the industry. A number of these species are already being produced in relatively small quantities, some commercially, some for research purposes. The hybrid striped bass industry is a successful example of an industry that was established because of harvesting pressure on wild stocks. Although not a large industry, it is now fairly well established as a consistent year-round producer. A number of other species are still in the formative stages, with growers experimenting with different growout and marketing strategies to determine which configuration might yield a profitable business.

Outlook for Shellfish

Crawfish - The outlook for crawfish over the next several years hinges on a number of factors. First, can the Louisiana industry continue to expand their export market? Exports of crawfish have risen over the last several years, but the market still has a short season and shipments go almost entirely to Sweden. Second, how high a price differential will large crawfish receive? A large price differential would favor crawfish farmers as the size of crawfish is chiefly a function of stocking density. While large crawfish could still be taken in the wild, farming operations would be better suited as consistent suppliers of large crawfish due to their control over the density of crawfish in the ponds. Third, will there be any changes in rice acreage in Louisiana? Many rice growers double crop crawfish. Fourth, will imports of crawfish from China continue to grow and will it put downward price pressure on Louisiana production or expand the market by developing new customers? Currently, imports are only a very small portion of total consumption. Fifth, there is the continuing question of whether crawfish consumption can be expanded beyond the traditional markets in the Southern States?

Shrimp - For the foreseeable future, domestic farm-raised shrimp production will continue to be only a small portion of the U.S. shrimp market. Some shrimp will continue to be grown in South Carolina, Texas, and Hawaii, but it will be either for local consumption or specialty markets.

The development of the domestic shrimp farming industry may depend on the success of projects to commercially produce disease-free shrimp post-larvae for shipment to other growing areas. At the present level of technical development, domestic producers probably will not be able to compete with foreign producers strictly on a price basis.



Shrimp prices in 1994 will likely be higher as several major shrimp farming countries have been experiencing production problems. Production for the current year is estimated to be down in Ecuador and Indonesia. The shrimp crop in China by various accounts has been terrible, impacted by a yet unknown disease. Since the Chinese crop is harvested in the fall the impact will not be fully seen until the beginning of 1994. Besides raising prices, the production shortfalls should increase imports from other Asian countries, mainly those that rely on wild-harvesting.

Mollusks - The outlook for domestic mollusk production in 1994 and beyond is somewhat uncertain. On one hand the wild harvest for a number of mollusk species has been falling, especially oysters. This would normally mean a growing demand for farm-raised production. On the other hand there is continuing concern over the safety of raw mollusk consumption and the need to utilize coastal waters to produce them. Production of the Eastern oyster is especially a concern. This species has been especially hard hit over the last decade by the

widespread occurrence of two diseases. While researchers have developed a number of new systems that would increase the productivity of oyster growing operations, there is still no way to prevent the two diseases. Moreover, no one has developed an effective disease resistant strain of oysters. Clam and mussel growers have not seen the same type of problems that are facing the oyster industry, but they also will have to contend with the many problems of trying to run an aquaculture business in a coastal zone with a number of conflicts over the use of the property. Mollusk farmers will also have to pay attention to competition from foreign producers.