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Hybrid striped bass culture a U.S. success story

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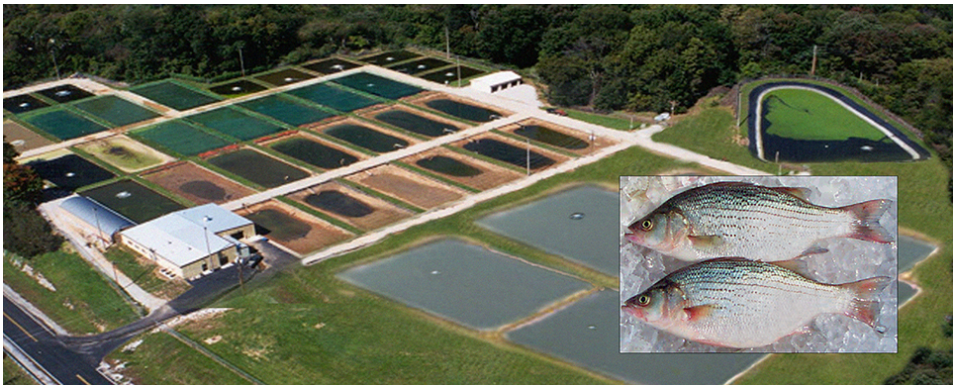
Production costs must go down, new markets must be established



Most of the hybrid striped bass produced in the United States come from outdoor culture ponds. Photo by Charles Weibel. Inset: The “sunshine bass” is a commonly used U.S. hybrid cross.

The culture of hybrid bass in the United States can be considered one of the country's aquaculture success stories. In 1989, production of this food fish was about 450 metric tons (MT), most of which was grown by a single producer in California. In 2002, production of 4,760 MT with a value of approximately U.S. $26 million was grown by over 60 producers. Hybrid striped bass are now fifth in volume and fourth in value of all food fish grown in the U.S.

Tank production

While striped bass have been produced in hatcheries since the 1970s for stock enhancement by federal and state hatcheries, only three commercial producers attempted to culture the fish during the '70s. It was not until the mid-1980s that the first successful commercial operation, Aquatic Systems, Inc., in California, consistently produced quantities of hybrid striped bass for sale at seafood markets.

Known today as Kent SeaTech Corp., the company operates a high-density tank culture system using geothermal groundwater and biofilter systems to produce market-size fish. With the success of tank culture, other ventures, some using indoor recirculating systems, have raised hybrid striped bass in Colorado, Massachusetts, and Mississippi.

Pond culture

Pond culture of hybrid striped bass was developed in North Carolina and South Carolina, where several operations were initially established. With their successes, further pond operations were established in Louisiana, Maryland, Virginia, Mississippi, Florida, and Texas. By the late 1990s, smaller operations had also developed in Georgia, Rhode Island, Alabama, Pennsylvania, and Delaware. The largest pond producer of hybrid striped bass in the U.S. is Nature's Catch of Clarksdale, Mississippi, which devotes about 360 ha of ponds to food-fish production.

Changes in production

As the hybrid striped bass industry grew during the past 10 to 15 years, changes in production methods and the amounts of regional production and sales occurred. In 1987, approximately 98 percent of the fish were produced in tanks. By 1996, tank production accounted for 49 percent, pond production accounted for 48 percent, and cage production accounted for 3 percent of the hybrid striped bass produced. In 2002, ponds accounted for 57 percent of production, with 43 percent produced in tanks.

Regional shift

Regional production also underwent changes in the past 10 years. In 1990, most production was from a single producer in California, but by 1999, other regions became established as major suppliers of hybrid striped bass. In 1999, 53 percent came from California and Texas, 20 percent came from the southeast (Mississippi, Louisiana and Florida), 18 percent was produced in North Carolina and South Carolina, and 9 percent was produced in Massachusetts and other New England states.

In 2002, the regional production had altered slightly, with the west and southwest states comprising 45 percent of production and mid-Atlantic states comprising 25 percent. Southeastern states had 20 percent of hybrid striped bass production, and the northeast had 10 percent.

Products

Of the total 2002 hybrid striped bass production, approximately 17 percent was sold live. The remaining 83 percent was sold as whole, “in the round” fresh product to wholesale seafood distributors. These wholesalers then sold whole and processed fish to restaurants and some food-service vendors.

Western producers dominate the fresh product market, but the mid-Atlantic producers sell most of the live product (Fig. 1). While the wholesale price (fresh FOB farm) paid for hybrid striped bass has declined – as production increased – from U.S. $6.28 per kilograms in 1990 to $5.67 per kilograms in 2002, prices paid to producers remained relatively stable. They fell only $0.62 per kilograms in 12 years, even as production increased 500 percent during that time period.

In 2002, the average price paid for fresh (FOB farm) hybrid striped bass was U.S. $5.67 per kilograms. Fresh delivered fish drew $6.02 per kilograms. The average live (FOB farm) price was $6.81 per kilograms, while live delivered bass got $7.54 per kilograms. The prices varied somewhat by region.

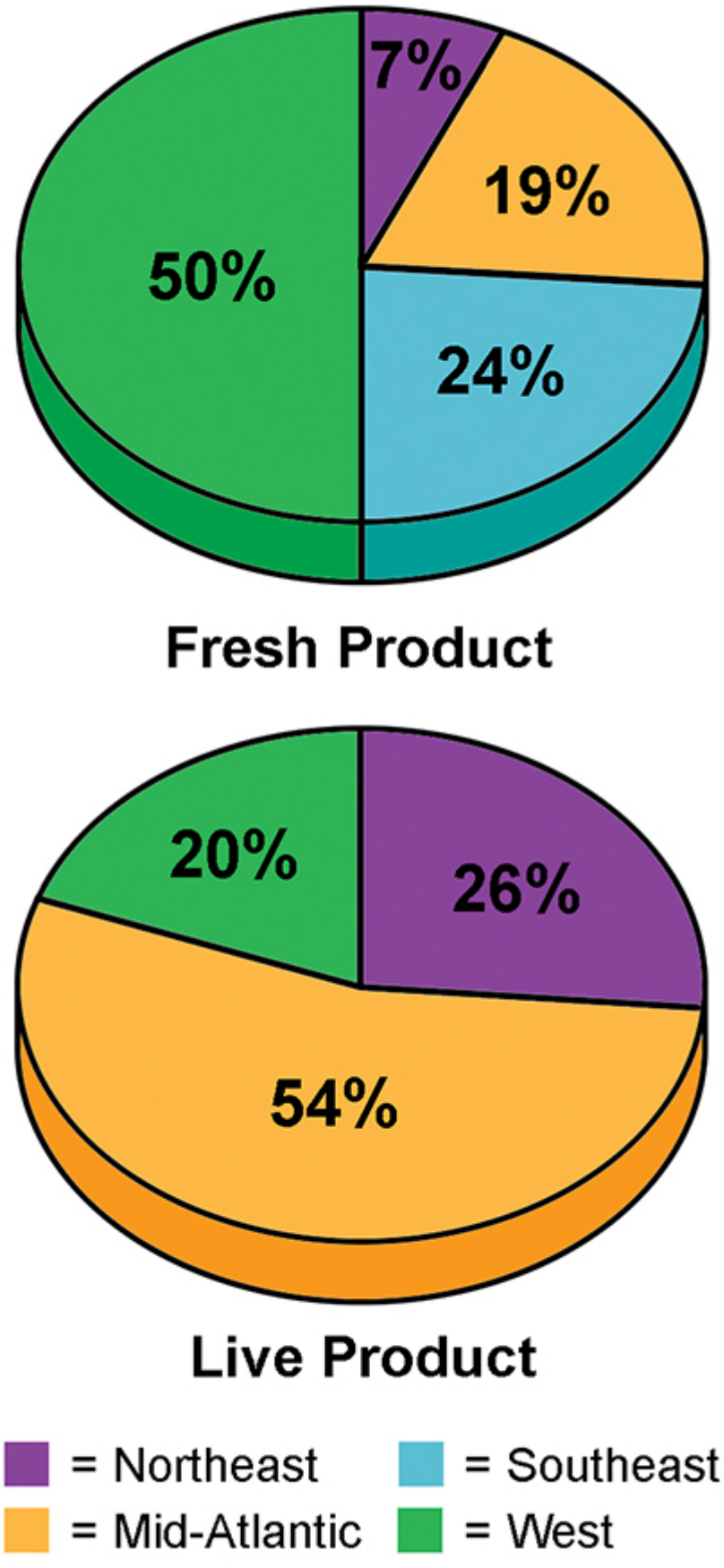


Fig. 1: U.S. production distribution of hybrid striped bass.

Seedstock

There are fewer than 15 major private producers of hybrid striped bass fry and fingerlings in the United States, with Keo Fish Farms in Arkansas supplying about 50 percent of the fingerlings. Eighty percent of the fry produced is sold domestically, and 20 percent is exported. However, the fingerling market is almost exclusively domestic, with only 4 to 5 percent exported.

As the industry expands, it is vital that the production of fingerlings increases to meet the demand. Further, the use of domesticated broodstock will be essential, so desirable traits such as fast growth, tolerance of stress, disease resistance, and efficient utilization of food can be selected and the resulting progeny used by producers.

Culture methods

Hybrid striped bass are produced by crossing striped bass (*Morone saxatilis*) with white bass (*M. chrysops)*. Two crosses can be produced. The “original cross,” or palmetto bass, is produced by crossing a female striped bass with a male white bass. The other cross is called the “reciprocal cross,” or sunshine bass, which is produced by crossing a female white bass with a male striped bass. Sunshine bass are more commonly cultured, due to the ease of obtaining suitable white bass females for spawning, compared to the legal and other difficulties in obtaining striped bass broodstock.

Production phases

Hybrid striped bass require water temperatures of 28 to 30 degrees-C to achieve optimal growth. They can be cultured in ponds, tanks, and cages. Hybrid striped bass culture is divided into four phases of production: the hatchery phase; phase I culture, in which the fish grow from fry larvae to 8-cm fingerlings; phase II culture, where the fish grow 15 to 100 grams in five to nine months; and phase III culture, in which the fish grow to a market-size of 700 to 1,200 grams.

Spawning

Spawning broodstock are typically placed in circular tanks with a constant water temperature of 17 to 20 degrees-C, similar to that at which the eggs will be incubated. Various types and combinations of hormones have been used to induce ovulation of suitable white or striped bass females, but human chorionic gonadotropin (HCG) is commonly used. Recommended dose levels of HCG for striped bass are 50 to 100 IU per kilograms of body weight, although it appears doses of up to 800 IU per kilograms have no negative effect on ovulation. White bass females doses run 200 to 400 IU per kilograms.

When the fish are ready to ovulate, the eggs are easy to expel with a slight pressure applied to the posterior of the abdomen. The eggs are placed in a container of water, where milt from several males is then added and gently stirred to ensure optimal fertilization. The time required for eggs to hatch varies depending on water temperature, but at 16 to 20 degrees-C, it takes 40 to 56 hours.

Larval and fry rearing

Newly hatched larvae have incomplete mouth parts and depend upon their yolk sac and lipid globule for nutrients. At 5 days of age, palmetto bass larvae have functional mouth parts and a simple digestive tract, and begin to seek food. Sunshine bass larvae, which are 60 percent smaller than palmetto bass larvae, have functional mouth parts and a digestive tract when 4 days old.

The larval fry are usually moved from the hatchery when they begin feeding to appropriately prepared ponds. The ponds should have an abundance of zooplankton, no predators, and suitable dissolved oxygen, temperature, and pH levels. Pond stocking rates vary from 125,000 to 1.5 million fry per hectare. An average of 250,000 to 625,000 per hectare are stocked for stock enhancement, with 125,000 to 300,000 per hectare stocked for commercial fingerling production. Commercial producers often stock fewer fish to grow larger fish at harvest.

Kent SeaTech Corp. operates a successful high-density tank culture system that uses geothermal groundwater and biofilter systems to produce market-size bass. Photo by Jim Carlberg.

Feeding

Supplemental feeding of a prepared diet can be used when fish are 21 to 26 days old or greater than 2.5 cm in length. Most often, a high-protein salmon diet is fed as small crumbles or a fine meal. Initial feeding rates are 1 to 5 kilograms per hectare per day, and can be increased after a few days to 5 to 15 kilograms per hectare per day. Feeding can be done by hand or blower 1 to 3 times per day. With supplemental feeding, the fish are easier to train for more-intensive grow-out situations and may reach a larger size than if fed only zooplankton.

Grow-out

Once phase I fish are harvested from the pond, they can be restocked for grow-out to phase II. Phase II fish should be fed at frequent intervals for at least two weeks before harvest, with at least two daily feedings. Stocking densities for phase II juveniles vary depending upon the size desired at the end of the phase.

Pond production of phase III hybrid striped bass involves growing fish to market size as food fish or adults suitable for use as broodstock. Proper aquaculture methods need to be followed, including monitoring dissolved oxygen levels, feeding a nutritious diet, and measuring various water quality

parameters.

Intensive culture systems

Hybrid striped bass can be grown using intensive recirculation systems, but extra care must be used when raising fish by these methods. Recirculating systems require biological and mechanical filtration so that waste solids and metabolites are removed from the culture water.

Mechanical filtration can be accomplished with sand filters, diatomaceous earth, coral, carbon, or various man-made fabrics or plastic beads. Biological filtration is a process where bacteria convert excreted nitrogenous compounds (ammonia and nitrate) to nontoxic forms (nitrate). If either filtration system has problems and ceases to remove wastes from the culture system, fish growth and health can be severely compromised, possibly leading to disease and mortality.

Nutrition and diets

Reported dietary protein content for hybrid striped bass ranges 36 to 55 percent. However, the optimal protein level appears to be 38 to 40 percent. While the species needs a diet with a modestly high protein level, it has an ability to effectively use and digest carbohydrates in numerous plant ingredients, unlike most carnivorous fish. Ingredient digestibility values for hybrid striped bass appear between omnivorous species like channel catfish and carnivorous species like rainbow trout. This allows nutritionists to formulate diets with higher levels of plant ingredients and lower levels of fishmeal for hybrid striped bass.

The optimal dietary energy-to-protein ratio for sunshine bass has been reported as 6 to 9 kilocalorie per gram protein for a diet that contained 35 to 45 percent crude protein. In an effort to reduce diet costs for hybrid striped bass, nutritionists have recently begun to determine the minimum practical level of fishmeal in grow-out diets.

During the past five years, encouraging nutrition research indicated that hybrid striped bass diets with little (less than 10 percent) or no fishmeal did not result in decreased growth or survival compared to those with more fishmeal. Most of the diets had both animal- and plant-source proteins, but at least one feed mill (Freedom Feeds in Ohio, USA) is selling diets for hybrid striped bass that contain only plant-protein sources. No research has yet been reported on the growth of bass fed diets containing only plant protein.

HUFA requirement, flavor issues

Highly unsaturated fatty acids (HUFA) of the omega-3 group are essential for the proper growth and development of marine fish larvae. Like marine fish larvae, hybrid striped bass appear to have a limited ability to make omega-3 HUFA and require dietary sources for them. This requirement in both larval and grow-out diets may limit the amount of fish oil that can be replaced in hybrid striped bass diets. Since marine fish oil is more expensive than plant-derived oils, research on the amounts and types of oils that can be used for hybrid striped bass, especially during the grow-out phase, needs to be conducted.

Commercial diets can affect the flavor of cultured fish. While many plant proteins and animal byproduct meals do not add to the flavor, some ingredients – such as oils, fats, and fishmeals –can affect the flavor, appearance, composition, and storage quality of fish. Fish oil contributes to the “fishy” flavorof fish, while fishmeal in a diet may notimpart a strong flavor. A stronger “fishy” taste may not be a problem, however, if target consumers prefer it.

Market issues for U.S. industry

Foreign and domestic competition

Hybrid striped bass producers in Israel, Mexico, Taiwan, China, Spain and Japan have expressed interested in exporting their products to the United States. An examination of other aquaculture sectors, such as the Atlantic sal-mon industry, shows that foreign countries can quickly and effectively gain dominate production of a species that is then exported to the U.S. Further, as production of hybrid striped bass increases in other countries, there will be fewer export opportunities for U.S. producers.

While foreign competition may be of concern in the future, competition from lower-priced, white-meat fish presents a current challenge that may increase dramatically. Hybrid striped bass are highly valued in the marketplace (especially in live markets), but other fish with firm, white, mild-tasting fillets can effectively compete with them, especially if the other fish can be grown or caught less expensively. Catfish, tilapia, yellow perch, largemouth bass, and commercially caught white and striped bass are several examples. While production of yellow perch and largemouth bass may be high, catfish, tilapia, and commercially caught fish are less expensive and could reduce prices paid to hybrid striped bass producers.

Increase production, open new markets

In order for producers to continue to be profitable, production costs need to be reduced and new markets established. With the current slump in the U.S. economy, demand for hybrid striped bass may have decreased as fewer people eat at “white tablecloth” restaurants, a large market for the fish.

Reductions in production costs could allow hybrid striped bass to be sold in midrange restaurants and seafood sections of grocery stores, and vastly increase market opportunities for producers.

Producers could also investigate the possibility of forming market cooperatives. In addition, a national marketing and promotion group similar to the one for cultured U.S. channel catfish could be established to promote and market cultured hybrid striped bass and educate consumers on its value.

Production issues for U.S. industry

Water effluent guidelines

The U.S. Environmental Protection Agency (EPA) has proposed a ruling that would limit effluents and set standards for wastewater discharges from new and existing aquaculture facilities. These guidelines have been a cause of great concern in the U.S. aquaculture industry, and it is not known how they will impact the hybrid striped bass industry. It is hoped there will be few adverse effects, while at the same time assuring the public that aquacul-ture is environmentally responsible.

Feeding strategies

Research needs to be conducted to determine the benefits of feeding multiple times during the day. Further, there is no information on which times of the day may be more advantageous to feed. Such schedule information is as important as the diet formulation, since feeding practices directly relate to feeding costs.

Feed-conversion ratios

Feed-conversion ratio (FCR) values for hybrid striped bass have ranged 1.5 to 5.7. It may be unrealistic to expect FCRs for hybrid striped bass to approach those of coldwater fish, which are often about 1.0, because coldwater fish utilize high levels of dietary fat very effectively.

Diets with 20 to 40 percent fat are fed to sal-monids, which tend to store the fat and consume less food per unit of weight gain. Hybrid striped bass are warmwater fish that cannot use levels of fat over 15 percent. Too much dietary fat can actually reduce fish growth and lead to mortality. However, with careful feeding and nutritious diets specifically formulated for hybrid striped bass, more economical FCRs should be obtainable.

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