HYBRID STRIPED BASS
"IS THERE AN ALTERNATIVE TO CATFISH?"

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Selection of alternative species for cage culture should be based on economic considerations. Will the rearing of a fish provide a positive return? this return could be in monetary terms, or have value as an alternative activity or hobby. In the United States, the warm water fish most often raised in cages is channel catfish. One alternative fish which has been raised successfully in cages in Virginia is the hybrid striped bass (Nerrie 1990). The USDA (1990) identified the hybrid striped bass as an ideal candidate for aquacultural production. This presentation will focus on the hybrid striped bass as an alternative species for cage culture.

Striped bass originally had a wide natural range from Canada to Florida on the east coast of the United States and into the gulf of Mexico. However, in 1879 and 1882 approximately 430 striped bass were transported by train in two shipments from the Atlantic coast to San Francisco Bay. Today, on the west coast, the range is from Canada down to Mexico. Striped bass are anadromous fish, living in salt water, but moving into fresh water to spawn. Several landlocked reproducing populations of stripers have been established due to extensive reservoir stocking programs.

Hybrid striped bass were first successfully produced by Stevens in 1965 (Bonn et al. 1976). Hybrid striped bass are being used in pond culture rather than striped bass because the hybrid can withstand the warmer temperatures in farm ponds and demonstrates a faster rate of growth than the parent stocks. Additional desirable characteristics of the hybrids are improved disease resistance and survival. A recent summary of culture development of hybrid striped bass can be found in Newton and Nerrie (1989).

Hybrid striped bass are being cultured in cages in many states in varying water quality, salinity and temperature regimes. Cage or net pen culture of hybrid striped bass can be found in Virginia, Maryland, Georgia, Florida, Pennsylvania, Colorado, and North Carolina. The first privately produced and marketed hybrid striped bass in Virginia were from a cage operation. These 18 oz. fish were produced during the 1988-1989 growing seasons and marketed by the farmer directly to restaurants.

It may be necessary to provide some term definitions for hybrid striped bass:

Phase I: Hatchlings to when artificial food accepted
Phase II: Remainder of first growing season
Phase III: Second growing season

Regulations

Individual states have regulations concerning the stocking of hybrid striped bass. In Virginia regulations are in place to assure against escapement of large numbers of hybrids which may impact on native fish populations. State agencies responsible for such regulations should be contacted for specifics.
Water Quality

Temperature

The length of growing season is a function of water temperature. Hybrid striped bass can survive in water temperatures ranging from near freezing to over 90°F. However, optimum temperature is reported to be 82°F (Hodson 1987). Vigorous feeding activity is observed when temperatures exceed 59°F (Hodson 1987). With a 180-210 day growing season in Virginia, fingerling (450 fish/pound) hybrid striped bass can reach a market size of greater than one-pound in 16 months.

Overwintering

Hybrid striped bass fingerlings are widely available only in Phase I or early Phase II. Fish must be overwintered to allow sufficient time for market size to be achieved. All cage culture operations in Virginia overwintered hybrids with minimal losses. Successful overwintering of hybrid striped bass was also reported by Harrell et al. (1988). Growth rate is reduced during the cooler temperatures.

Oxygen

The dissolved oxygen concentration in water is the most important parameter for the farmer to monitor. Oxygen should be maintained above 4 ppm for conditions. Many ponds stratify during late summer with an upper layer of warm oxygenated water and a lower layer of cold water which is low in oxygen. Stratification occurs due to absorption of heat by water near the surface of the pond. Algae in this layer will produce oxygen which under these conditions does not easily diffuse throughout the pond. Sunlight is blocked from reaching the lower, cooler waters, where accumulating organic matter uses up oxygen while decomposing. Use of supplemental aeration is advised.

pH

As is the case with many cultured warm water fish, the desired pH range is between 6.5 and 9.0. At higher pH levels (greater than 9), especially at higher water temperatures, ammonia toxicity can effect cultured hybrids.

Hardness and Alkalinity

Hardness and alkalinity are usually related in pond water. Desirable levels exceed 25 ppm as calcium carbonate equivalents. Much of the early research with hybrid bass reported optimal alkalinity and hardness levels greater than 150 ppm. It may be necessary to add agricultural lime or gypsum to ponds to raise the alkalinity and hardness levels. Hybrid striped bass are being caged raised in Virginia ponds with hardness levels less than 20 ppm. However, the fish are not handled until harvest.

Stocking

Two conservative stocking procedures are followed in Virginia for cage operations. To provide practical experience for first time fish farmers and to encourage the growth of hybrid striped bass culture, the Virginia State University Aquaculture Office holds early Phase II fingerlings in ponds for distribution to farmers. In cool early morning hours, fish are harvested and transported to cage operations by standard techniques.
Cage operations without supplemental aeration with 0.5 inch mesh cages are stocked with 5-8 hybrids per cubic foot of cage. These fish will remain in this cage until harvest. Other cage operations without supplemental aeration receive 1000 fish (approximately 2 inches/fish) per cubic yard of 0.25 inch mesh cage. These fish will later be size-rated and transferred to larger mesh cages. Total number of fish stocked should not exceed an expected harvest of 2500 pounds per acre. If supplemental aeration is available, the stocking density should be increased.

Individuals contacting hatcheries for private stockings should be aware that the fingerling supply is the major concern facing the hybrid industry. Stock the largest available uniform size hybrid bass fingerlings from a reputable source before water temperatures reach 70°F in the springtime. Cannibalism can result if fish vary in size and are underfed.

Feeding

A commercial feed developed specifically for hybrid striped bass is not readily available in the United States. Successful crops have been grown on both high protein catfish, trout and salmon diets. Feeds of this grade should be available to the farmer at the required size and at reasonable cost.

Competitive commercial diets available at particle sizes appropriate for the mouth size of the fingerlings are nutritionally complete (36-40% protein) and based on years of fish nutrition studies to assure high quality at the lowest cost. Although more expensive, added growth may make it beneficial to feed a diet with more protein. Feed conversions of approximately 2.5 pounds of feed to 1 pound of fish growth can be expected. Ongoing nutritional research leading to a hybrid striped bass diet will improve conversion rates as the specific nutritional requirements for hybrid striped bass are identified.

A shaded feeding area in the cage is recommended for the fish. This could be as simple as burlap bags covering half of the cage to limit direct sunlight. Automatic feeders can be used for Phase II fish because of continuous feeding activity. It is not possible for farmers to be present all the time. Farmers however should make observations concerning feeding activity each morning and evening.

Sampling

Not recommended.

Markets

The commercial catch of striped bass reached its peak in 1973 when 14.7 million pounds were landed on the Atlantic coast (Nortan et al. 1983). Only a fraction of this amount is being marketed during recent years due to fish population management plans to prevent over fishing. Opportunities exist for the further development of a market niche for cage grown hybrid striped bass of approximately one pound size. A renewal of the commercial catch of striped bass will have size limitations, harvest seasons, and perceived consumer concerns about freshness (ocean pollution, length of time from ocean catch to processor, etc.).
Literature Cited


Nerrie, B. L. 1990. Growout of phase II and III hybrid striped bass in Virginia’s farm ponds.


Estimated Production Costs  
Phase III Hybrid Striped Bass in Cages  
5 Cage budget  
210 Days  
500 Fish per Cage  
10% Death Loss

<table>
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<th>Unit</th>
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| Fixed Costs                         |      |       |          |         |
| Equipment Cap. Recover @ 11% Int.   |      |       |          | 546.00  |
| Property Taxes                      |      |       |          | 60.00   |
| Insurance                           |      |       |          | 74.00   |
| General Overhead                    |      |       |          | 200.00  |
| **TOTAL FIXED COSTS**               |      |       |          | 880.00  |
| **TOTAL COST**                      |      |       |          | 6846.00 |

| Breakeven Variable Cost per pound   | 2.12 |
| Breakeven Total Cost per pound      | 2.43 |
| Breakeven Total Cost per pound minus labor | 2.17 |

Fixed Asset Worksheet

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This budget is only a guide. It does not include maintenance, pond construction, or marketing costs. It assumes 2250 fish sold at 1.25 pounds each.
SITE SELECTION AND WATER QUALITY: SUCCESS OR FAILURE IN CAGE CULTURE

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Many bodies of water have the potential to serve in multiuse capacity. They may be used for livestock watering, irrigation, recreational fishing, swimming, and, in some cases, aquaculture. Fish can be raised for personal consumption or supplemental farm income. Usually the "open pond" method of aquaculture is practiced, but, due to certain circumstances or by preference, floating fish cages can be used. The success or failure of "cage culture" often depends on proper site selection and the maintenance of adequate water quality.

"Open pond" and "Cage" culture are the most practical methods of aquaculture at this time. Raceways require vast quantities of water and "tank" culture has not been very profitable.

A common problem with "open pond" culture in many existing bodies of water, is the inability to drain and/or seine the pond or lake. Ponds that are deep, irregular in shape, uneven on the bottom, or have trash and stumps do not lend themselves to seining very well. Floating fish cages thus allow some ponds to be used, however, there is no practical reason to use floating cages in ponds that are drainable and/or seinable, except to sort, grade, or separate different species of fish. Generally, fish experience less stress in an open pond than in a cage, therefore, some degree of risk is taken with "cage" culture.

When a pond is considered for floating fish cages, certain requirements need to be met. Most of these criteria focus upon maintaining adequate water quality inside the cage. The pond must:

1. contain sufficient water throughout the growing season - at least 1/2 to 1 acre in surface area and greater than 5 feet deep in 1/2 to 1/3 of the pond, when the water is at its lowest level. At least 1 to 2 feet of water must be kept below the bottom of the cage at all times in order to flush the wastes away from the cage. Small ponds cannot breakdown the fish wastes fast enough and almost inevitably have water quality problems (low dissolved oxygen, high total ammonia and nitrite, and excessive algal blooms). Larger ponds have a greater capacity to buffer the effects of fish wastes and feed residues. They also tend to be deep enough to eliminate aquatic plants as a problem.

2. not be located in areas where it can be contaminated by run-off containing high levels of pesticides (can be harmful to the fish and to the people who eat them) or large amounts of livestock wastes (lead to dissolved oxygen problems). Excessive watersheds can also cause rapid water temperature changes and pond turnovers after heavy rains. It is a good practice to inform your neighbors about your fish project, so they can use caution applying chemicals during rainy or windy weather.

3. be able to receive the prevailing winds for overall mixing and aeration. Locate the cages in the pond to maximize any available water movement. Ponds that are low in a valley or deep in the woods usually will not have good water circulation.
4. be convenient to get to for feeding and inspection. An all-weather access road is usually not necessary, but on occasion, one could be used.

5. not be heavily stocked with fish. The carrying capacity of a pond is 1,000 to 1,500 pounds of fish per surface acre, if no fresh water or supplemental aeration is provided. This rate applies to both loose fish and/or caged fish. Therefore, the poundage of loose fish already in the pond will affect the number of cages that can be stocked.

Maintaining good water quality in "cage culture" ponds is absolutely essential. Failure to do so will result, at best, in poor growth and high feed conversions or, at worst, a total loss of all the fish. Fish in a pond are living in their own wastes, therefore, the pounds of fish that can be produced is limited by the ability of the pond to provide adequate oxygen. Oxygen is needed to keep the fish alive (respiration), to metabolize the fish food and enable them to grow, and to breakdown the nitrogenous wastes throughout the pond. Decomposition is faster and more complete in an aerobic (oxygen present) environment than in an anaerobic (no oxygen present) one.

The major oxygen sources in a pond are the algae plants (tiny floating plant cells). All green plants manufacture food for themselves by a process called photosynthesis. Plants use nutrients such as nitrogen, phosphorus, and potassium and carbon dioxide plus some water and energy from the sun to make their food. A waste product of this process is oxygen which is given off and dissolved in the water.

The amount of dissolved oxygen (DO) in the pond water normally cycles up and down during a 24 hour period. The DO is lowest at sun-up and highest in mid-afternoon. You want to feed your fish when the DO is high, by the way, since they consume more oxygen during their feeding activity and directly afterwards, and you want to have some sunlight available for the algae to restore the DO level before darkness. During the night the algae are the major consumers of oxygen. Since there is no sunlight for photosynthesis, they must use respiration (take in oxygen and give off carbon dioxide) for energy production. Consequently, if your pond has an excessive amount of algae, the night-time consumption of oxygen by the plants may be enough to stress your fish and eventually suffocate them. The management of a "cage culture" pond involves observing the algae population as well as the fish. If you put your arm into the pond water and lose sight of your fingers before elbow depth (less than 12 inches), your pond probably has too much algae. A freshwater flush or small amounts of algicide may be needed. If you can still see your fingers past your elbow, the algae population in probably adequate.

Diffusion, the movement of air containing oxygen into the water at the pond surface, is of minor importance compared to algae. You can increase the rate of diffusion by agitation (paddlewheel or water fountain), but that is more costly.

The dissolved oxygen should be checked early in the morning as needed. DO should be maintained at 4 ppm and above. In the absence of an oxygen meter or kit, an aquaculturist can observe signs of possible low oxygen that appear several days before the fish are stressed. Indicators of low oxygen are:

1. A sudden change in the color of the algae bloom, from greenish to brown or gray, indicates that some of the algae has died. Dark streaks may also appear in the water.
2. Low DO should be suspected when DO-sensitive fish like golden shiner minnows or tadpoles or crayfish move to the margin of the pond and snails crawl up on emergent plants.

3. A noticeable reduction in feeding by the fish is often associated with low DO.

4. Musty odors or the rotten-egg odor of hydrogen sulfide can accompany oxygen depletion.

The best method to correct a low DO situation is to pump well aerated water from an adjacent pond into the poor one. A paddlewheel can be used to mechanically aerate and mix a pond in an emergency, but it is hard to operate one on a tractor continuously. Air diffusers (blowers) are good to prevent low DO situations, as are air-lift devices, especially around the cages. But, they are not very effective in an emergency.

A routine inspection of the sidewalls of the fish cage for algae or moss build-up is important. Any reduction in water exchange and flushing through the cage can lower the water quality inside the cage.

The alkalinity and chloride level should be checked about three weeks after filling a pond and again if a large volume of water has been added. Alkalinity is a measurement of the buffering capacity against pH swings in the pond. It is the total concentration of bases, carbonates, and bicarbonates available to neutralize any acids. Total alkalinity should be at least 40 ppm, and it is better if it is above 70 ppm. Chlorides should be at least 30 ppm, however 50 ppm and higher is desired. The chlorides appear to counter problems with nitrites and help the fish with osmoregulation.

pH is an expression of the acidity or alkalinity of the water. Less than pH 7 is acidic and greater than pH 7 is basic. The pH should be measured weekly or whenever a water quality problem is suspected. The best range is pH 6 to 9. pH affects the toxic levels of ammonia and carbon dioxide (check hand-out for details).

Ammonia levels correlate to crowding and heavy feeding at warm water temperatures (usually a late summer problem). There are two forms of ammonia; they are ionized (not toxic to fish) and un-ionized (toxic to fish). The pH level and water temperature determine which form of ammonia is prevalent (higher pH and temperature favors toxic, un-ionized form). Un-ionized ammonia at levels of 0.06 to 0.10 ppm can stress fish, so a level of 2 to 3 ppm total ammonia (ionized + un-ionized) is cause for concern. There are several sources of ammonia:

1. The major source is fish feed turning to waste product through the fish; every 100 pounds of feed can create 2.2 pounds of ammonia.
2. Decaying plants and animals in the pond produce ammonia.
3. Uneaten fish food decays to produce ammonia.

High ammonia levels can be corrected by reducing the feeding rate (even to stop), flushing the pond with fresh superphosphate (0-20-0) or 20 pounds of triplesuperphosphate (0-46-0) per surface acre to stimulate algae growth. The algae in turn uses the ammonia as a nutrient source.

Nitrites should also be checked when the pH is greater than 7.5. Fish can be stressed if the ratio of chlorides to nitrites is less than 7:1, and brown blood disease may occur.
The three hand-outs available to you are from Drew Mitchell, a diagnostician in the water quality workshop, Fish Farming Experimental Station, Stuttgart, Arkansas. They are an excellent summary of the water quality parameters used in aquaculture. Good water quality prevents stress, which prevents disease, which means successful "Cage Culture."