

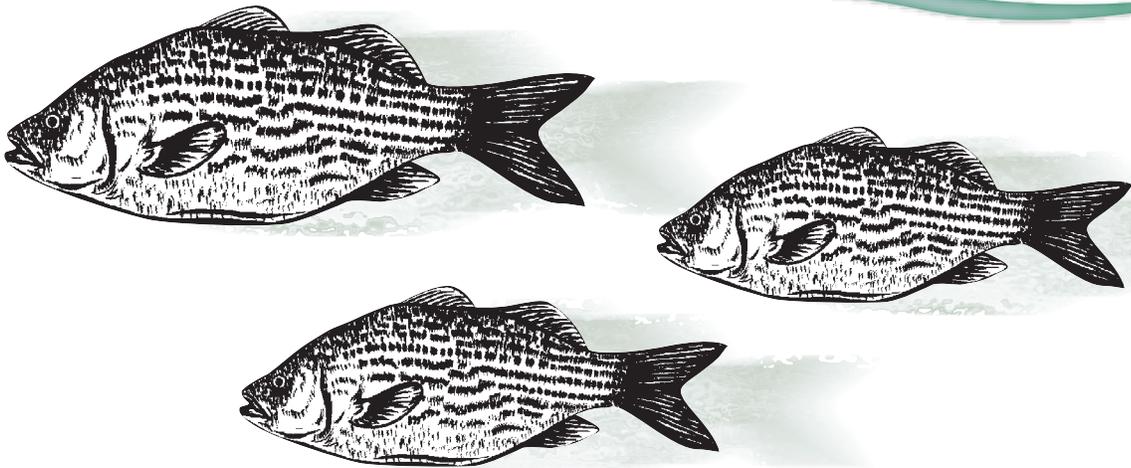
Aquaculture

in

North Carolina

Hybrid Striped Bass

Inputs, Outputs and Economics



*North Carolina Department
of Agriculture and Consumer Services*

Aquaculture and Natural Resources

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About this publication

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The North Carolina Department of Agriculture, Division of Aquaculture and Natural Resources, created this publication to assist individuals interested in the business of hybrid striped bass farming. The publication was also designed for bank lenders who may need more information on the industry to evaluate loan proposals. A description of the inputs and outputs of North Carolina hybrid striped bass farms, as well as an estimate of costs, returns, and resource requirements for an example farm are provided. For technical recommendations on building and operating a fish farm, individuals are encouraged to contact agents with the North Carolina Cooperative Extension Service. For information on state regulations governing aquaculture, or for help in preparing an aquaculture business plan, contact the North Carolina Department of Agriculture. See *Sources of Information* for individuals to contact.

North Carolina has more hybrid striped bass farmers than any other state. Twenty-two farmers harvested 2.2 million pounds of hybrids in 2000.

U.S. Aquaculture Production and Hybrid Striped Bass

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Aquaculture is the fastest growing segment of U.S. agriculture. The farm value of the U.S. aquaculture industry is estimated to be about nearly \$1 billion. Hybrid striped bass (HSB) production accounts for about 3% of the total.

estimated 2.2 million pounds on 640 acres (an estimated 450 acres are used for food fish production and the remainder for fry and fingerlings). Three hatcheries were operating in the state in 2000. In 1999 and 2000, existing producers expanded by about 70 acres.

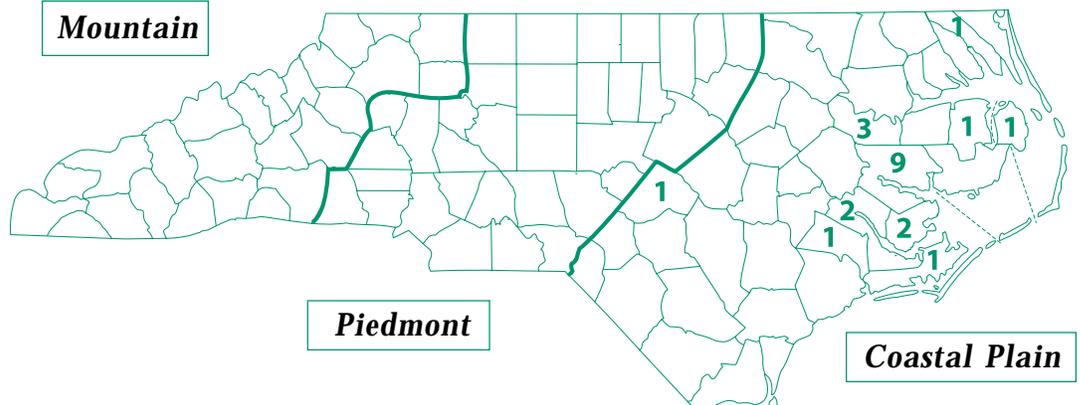
North Carolina Hybrid Striped Bass Production

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North Carolina (NC) supplied about 15% of the hybrid striped bass U.S. market in 2000, with 22 producers harvesting an

NC farms range in size from three to over 100 acres. The median size is 18 acres, with 12 of the 22 farms having less than 20 acres (eight of those have less than 10 acres). Of those greater than 20, four have 20-30 acres, four have 30-50 acres, and two have greater than 100 acres. The trend in recent years is for existing farms to enlarge, and new farms to be larger in size (25+ acres).

North Carolina Hybrid Striped Bass Farms, by County, 2000



Inputs

Following is a discussion of the production inputs used to raise HSB. These inputs—fingerlings, feed, water, etc.—determine yield and cost in both a direct and indirect way. When an input is used more intensively—for example, when more fish are stocked per acre—yield may rise enough to offset the increase in cost, resulting in a more profitable farm. As production intensity increases, however, the greater use of an input, such as feed, can have an indirect and negative effect on yield via changes in pond water quality. This can result in a lower yield and higher cost per pound harvested, *reducing* profits to the farm. The most successful farmers are those who efficiently use production inputs while maintaining a healthy water environment. Farmers are encouraged to work with agents and specialists of the NC Cooperative Extension service who can advise them on best management practices for HSB farming.

Water

Water is the growing environment for fish, so a reliable source of good quality water is vital to fish farming. Farmers choose between surface water (from streams, lakes, etc.) or well water. Nearly all HSB farms utilize well water because both the quality and quantity of surface water can be unpredictable. The major advantage of surface water is that it is usually much cheaper to obtain than water pumped from a well.

Water is used to fill the ponds each year, compensate for evaporation and seepage, and in an attempt to improve pond water quality. If ponds are constructed of high-clay soils, seepage will be minimal. HSB farming requires more water than other types of fish farming because ponds are drained and refilled each year. Farmers also use cool well water to try and improve water quality and reduce pond temperatures during warmer months. At water

temperatures above 32°C (90°F), fish may become “stressed,” agitated, refusing to feed, and more prone to disease. HSB also seem to thrive on the movement of water that results from pumping.

The quality of water at a potential farm site can be determined with simple water quality tests. If well water is to be used, existing wells near to the proposed site can indicate both the quality and quantity of water available. HSB grow best in water with high calcium hardness, and this is not available in all areas. In North Carolina, most of the HSB are grown on farms located atop the Castle-Hayne Aquifer. The hard, alkaline waters of the Castle-Hayne are ideal for HSB farming. This aquifer underlies much of the area along North Carolina’s east coast.

Farmers should also determine the quantity of water available. NC Cooperative Extension agents recommend that a farm well supply a flow rate (the flow of water is measured in gallons per minute, or “gpm”) capable of filling ponds to a depth of four feet within two weeks. Rapid filling of ponds prevents the establishment of pond-bottom weeds which negatively affect production.

In HSB ponds a rate of 35 gpm per water acre is typical. The cost to achieve this flow depends on the number of water acres in production and farm location. The cost of obtaining water is extremely site specific and varies tremendously across the state; it can make certain areas unprofitable for fish farming.

Well drillers that know the area around a potential site are a good source of information concerning water availability. They can also estimate the costs of obtaining suitable water. Farmers can determine the quality of water by sending a water sample to the NC Cooperative Extension service (see *Sources of Information*). When well water is to be used, existing wells near to the proposed site can be a source of water for testing.



HSB grow best in hard, alkaline waters. A flow rate of 35 gpm per water acre is typical.



Land for building fish ponds should have a clay content of at least 20%.



Hybrid Striped Bass Budgets (pages 14-17) estimate the cost for a well located on a farm in one of the eastern counties on NC's coastal plain. Pump size is estimated using the factor of 35 gpm per water acre, or two wells capable of pumping 1155 gpm for the example 33-acre farm.

Land

The best land for pond fish culture is cleared and flat or has a slight gradient, with a clay content of at least 20%. Agents with the Natural Resource Conservation Service (NRCS) can determine the suitability of a land area for fish farming, and test the soil for pesticide residues which may rule out the use of the land for any type of aquaculture. The North Carolina Department of Agriculture and Consumer Services (NCDA&CS), Agronomic Division, does a comprehensive soil analysis on request. The NCDA&CS or NRCS can also help the farmer contact someone with the U.S. Army Corps of Engineers to determine if any of the potential site is considered wetlands. In almost all cases, wetlands can not be converted into fish ponds.

The cost of land suitable for fish farming in rural NC typically ranges from \$1,000 to \$1,500 per acre. HSB Budgets assume a cost of \$1,200 per acre. The farm uses 33 acres of the total 41-acre site to build eleven 3-acre ponds. Fish farms typically use 80% of the land acreage for ponds and the remaining 20% for levees, roads, ditches, and support facilities.

In North Carolina, all commercial HSB farms use levee ponds averaging 3-4 feet in depth. In comparison to catfish ponds, which often range from 10 to 20 acres in size, the recommended size for HSB ponds is two to four acres. HSB appear to be more sensitive to changes in water quality than the tougher catfish, and smaller ponds are believed to give the farmer better control and reduce risk.

In eastern NC, several individuals have experience building aquaculture ponds, and can give estimates of construction for

potential sites. The cost of pond construction depends upon a number of factors including soil type, topography, number and size of ponds, and whether or not roads and ditches already exist on the site. Cost can range from less than \$1,200 per water acre to greater than \$2,200 per water acre for ponds built on cleared, flat farm-land. HSB Budgets assume ponds are built on cleared farm-land at a cost of \$2,200 per water acre.

While all NC HSB are grown in ponds, HSB are also grown successfully in tanks in other states. Advantages of tank culture are that the producer can more easily observe the fish and monitor water quality. The major disadvantage is the initial cost of the equipment and the operating cost of running and maintaining that equipment. Successful tank culture of food fish generally requires large amounts of low cost water and/or water of an optimum growing temperature. Optimum temperatures shorten the production cycle and reduce the cost per pound produced.

Fingerlings

The HSB production cycle begins in the hatchery with the spawning of broodfish captured from the wild. Male and female fish are stripped of sperm and eggs. Eggs are fertilized and then incubated in the hatchery until larvae emerge. The larvae are stocked into ponds which have been fertilized to promote the growth of algae and zooplankton. HSB "fry" (fish within a few days of hatching) feed on natural pond organisms until they are trained to eat feed pellets.

After 30 to 45 days, the fry weigh about one gram and are about one-half inch in length. At this stage they are called "fingerlings," or "Phase One fingerlings." Ponds are drained and fingerlings are collected for sale. It is at this point that most HSB farmers actually begin production, and purchase fingerlings from a hatchery. Because of the expertise and expense needed to spawn bass and maintain

HSB ponds typically range in size from two to four acres.

Three NC hatcheries produce fingerlings for sale. The average price over the last five years has been \$0.20 each for delivered fingerlings.

a hatchery and fry ponds, it is more economical for most producers to purchase fingerlings. Phase One fingerlings are available from May to August.

Three farms in North Carolina have hatcheries and produce fingerlings for themselves and for outside sales. NC HSB producers can also purchase fingerlings from farms in other states. There are more than a dozen commercial hatcheries in the southeast that sell HSB fingerlings.

The price of local, delivered, one-gram fingerlings over the past five years has averaged \$0.18 - \$0.20. The cost of fingerlings makes up about 10% of annual variable operating costs. Farmers typically contract the preceding year for the fingerlings that they will need.

The production parameter “stocking density” indicates the number of fish initially stocked per acre. Above a certain stocking density, the greater the density the less rapid

the rate of growth; higher densities create crowding and greater competition for food which stress fish and inhibit growth. The greater amount of feed required for higher stocking densities can also cause water quality to deteriorate.

In HSB farming, fish are stocked at three successively lower densities as their size increases. In April and May, hatcheries stock fry in ponds at densities of 150,000 to 200,000 per acre, with an expected survival rate of 20%.

In the second stage of production, these one-gram fingerlings are stocked at a rate of 10,000 to 15,000 fish per acre, with an expected survival rate of 85%. Fish are usually stocked in May-July. This stage is often referred to as “Phase One,” and the fingerlings as “Phase One fingerlings.”

After about six months, usually in the months January through March, these quarter-pound fish are transferred and restocked into third-stage ponds at a density of 3,500 to 4,000 fish per acre. The quarter-pound fish are referred to as “Phase Two fingerlings.” Before fish are restocked, farmers usually grade the fish by size to reduce size variability at final harvest. Fish are harvested from the third-stage pond after approximately one year when they reach a market size of 1.5 - 2.5 pounds. Average survival in third-stage ponds is estimated at 80%.

Feed

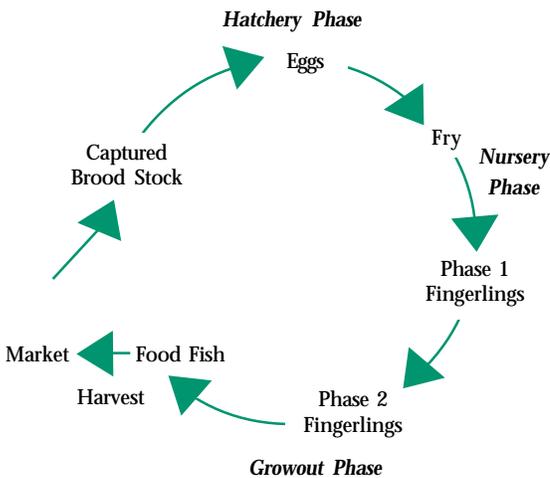
HSB fry feed upon the natural food found in ponds. Hatchery owners promote the growth of zooplankton (microscopic animals) for fry by fertilizing pond water. Because they are trained to commercial feeds in ponds and tanks before sale to farmers, Phase One fingerlings readily accept feed pellets.

Fish feed is often described in terms of its protein content. Protein content in HSB feed varies from 38% to 50%, with protein content greatest for feed used for smaller fish. HSB feed derives most of its protein

Fish are stocked at three successively lower densities. Growing time from fingerling to market size—1.50 to 2.50 pounds—is about 18 months.

Feed accounts for about 40% of total variable operating costs.

Hybrid Striped Bass Production Cycle



Activities:

- Spring - spawn broodfish and raise fry.
- Summer - stock phase-one fingerlings.
- Winter to Spring - transfer fingerlings, - harvest foodfish.

content from fish and soybean meal. Feed is available from a number of companies including Purdue and Southern States. Over the past five years the price of 38% protein HSB feed in NC has varied between \$340 and \$420 ton, with an additional \$10 to \$20 per ton delivery charge. HSB Budgets use a price of \$400 for 38% protein adult feed and \$520 for fingerling feed.

The “feed conversion ratio,” or FCR, is a critical parameter in fish production. FCR describes the number of pounds of feed fed per pound of fish harvested. HSB Budgets assumes an FCR of 2.2 to 2.4 in fingerling and food fish ponds. Feed cost accounts for approximately 40% of total variable cost.

Best management practices developed by fin fish researchers recommend feeding to “satiation,” but no greater. Satiation refers to the point when fish stop actively feeding. If more feed is applied to the pond, the result is an increase in FCR, greater cost per pound of fish produced, and deterioration of pond water quality. Farmers determine the point of satiation by watching the fish as they feed just under the water surface.

HSB grow faster and feed more during warmer months of the year. Feeding slows both in the winter and in mid-summer when water temperatures rise to the upper 80s. During months of heavy feeding, feed rates can reach 100 pounds of feed per acre per day. At this time, farmers are increasingly attentive to the effect of feed on the quality of the water environment.

Because fish are cold-blooded, their metabolic rate varies with the temperature of their surroundings. In cooler months, fish feed sparingly and larger fish can survive without feed for several months. In warmer months, HSB feed more heavily and may survive for only two to four weeks without feed, although this depends on the availability of natural food in the pond. Smaller fish are not able to survive without feed for as long a period as larger fish.

Oxygen

Like any other animal, fish require oxygen to live. Oxygen in natural waters comes from two sources: oxygen produced by algae, and oxygen transferred from the air into the water by wind action. In fish ponds, the churning action of diesel or electrically powered aerators speeds the transfer of oxygen into the water.

While a portion of the oxygen in the water is used by fish, phytoplankton both produce and use greater than 80% of the oxygen in the pond. Algae produce oxygen during the day and consume it at night. Algal growth is limited by the amount of nutrients in the pond. In commercial fish ponds, supplemental nutrients in the form of feed can result in an overabundance of phytoplankton. As algae use oxygen at night, oxygen can reach critically low levels. It is at this time that supplemental aeration is required.

An electrical aerator supplying two to three horsepower per acre of water is a standard feature in commercial HSB ponds. Timers, some costing less than \$100 each, can be installed to automatically turn aerators on and off at specified times. In addition to electrical aeration, one portable emergency aerator powered by a tractor is on hand for every two or three ponds.

In months of heavy feeding, farmers take oxygen readings at sunset, near midnight, and near sunrise. By tracking the change in oxygen, the farmer can make the determination if mechanical aeration is required. Dissolved oxygen is a manageable phenomena, and losses due to oxygen deficiency in a pond are generally the result of inexperienced management or lack of sufficient aeration equipment.

Medication & Chemicals

The Food and Drug Administration is in the process of approving several treatments for bacterial infections sometimes found in HSB ponds. Copper sulfate, potassium, and formalin have proven to be effective

Electrical and diesel powered aerators add oxygen to pond water. Aerators are often run nightly during the summer.

treatments for HSB as well as other fin fish. Farmers can also prevent the onset of bacterial infections through careful management of water quality.

Copper sulfate is a chemical approved for the control of algal growth in food fish ponds. It is used on a limited basis, and is applied directly to pond water.

Lime is used to alter the pH of pond water, and gypsum to increase calcium, just as they are used for soil. Gypsum is also used to settle suspended solids to increase water clarity.

The presence of aquatic weeds can be controlled with herbicides or by stocking a small number of grass carp into ponds. Grass carp feed on aquatic vegetation, and can be stocked at about 15 fish per acre.

The costs of all medication and chemicals typically makeup less than 1% of the total costs of growing HSB. HSB Budgets assume a cost of \$100 per acre annually.

Electricity & Fuel

The cost of installing electrical lines is very site specific, ranging from zero to tens of thousands of dollars depending on the distance to existing electrical lines. Farmers should contact their local electrical utility office for help in determining the cost.

Electricity and diesel fuel are used for aeration, water supply, feeding, and mowing of levees. Costs of electricity and fuel make-up about 8% of total variable costs. About 50% of the electrical and fuel costs for the year are expended during the three warmest months of the year, July - September, when aerators are often run nightly.

Loss of electrical power is rare in most areas. While a back-up generator could be used if power were lost, the tractor-driven emergency aerators which can be moved from pond to pond as needed are a cheaper option.

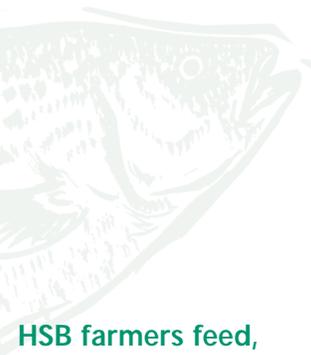
To reduce electrical costs, fish farmers in many areas can take advantage of off-peak demand programs offered by the electrical authority. The programs can reduce electrical costs by as much as 50%, and work well for fish farms since most power is used to run aerators between off-peak hours of 10 p.m. to dawn.

Labor

HSB farms use more labor than some other types of fin fish, such as catfish. HSB ponds are smaller and more numerous, and require more time for measurement of oxygen and water quality variables, which are taken per pond. More intensive use of aeration and other equipment requires more repair and maintenance. HSB also appear to be more sensitive to changes in water quality, and generally require more careful monitoring than catfish. HSB farmers harvest and transfer fish during several months of the year. In comparison, the catfish farmer usually sells fish pond-bank to a processor, who harvests and markets the fish.

During the summer farmers spend more time feeding and evaluating water quality. Farmers take “D-O’s,”—dissolved oxygen readings—at least three times per day, with one reading near midnight. The information determines if electrical aeration is required. During the winter months, farmers transfer fingerlings and harvest fish, and use any spare time for routine repair and maintenance of equipment.

Labor is used in the following daily activities and varies by season: feeding (during warmer months one to two times per day, but may be once or twice weekly or less during very cold or very hot weather); oxygen measurement (one to three times per day during warmer months and twice weekly in cooler months); water quality testing (two to three times per week and less frequently in cooler months); maintenance of equipment and levees as required; and transfer, harvest, and sale of fish.



HSB farmers feed, monitor water quality, repair and maintain equipment, and transfer, harvest, and sell fish.



HSB Budgets do not include any cost for the owner's full-time labor. The Budgets include a cost for half-time labor, and a charge of \$0.15 per pound harvested to account for both materials (boxes, ice) and labor at harvest.

Equipment Use

Greater than 80% of the equipment value used on the farm is specialized aquaculture equipment. A feed blower, aerators and harvest equipment are collectively the most costly specialized equipment needed. Some equipment, such as tractors needed periodically for harvest and to operate emergency aerators, is the same as that used for other farm enterprises. In HSB Budgets, the 33-acre enterprise is an addition to an existing farm, and land and some equipment—a tractor, pickup truck, mower, and repair equipment—is already owned.

Outputs

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Hybrid Striped Bass

HSB grow from one-gram fingerlings to average market size, 1.5 to 2.5 pounds, in about 18 months. Farmers begin harvesting fish in the fall and continue through spring, when pond space is again required for stocking of a new batch of fingerlings. Some producers stagger the transfer of fingerling fish and harvest so that market-size fish are available for more months of the year.

Food fish production can vary widely between ponds. Farmers who consistently harvest 6,000 or 7,000 or more pounds per acre may lose an entire pond, although this is rare. Fish are harvested and packed whole on ice in boxes that hold 50 pounds of fish. Some of the larger NC growers harvest and arrange sale for smaller farms, and some growers also share harvest equipment, which reduces the upfront equipment cost. Some fish are sold live, and buyers may send their own truck to the farm to transport the fish. The example budget

assumes a conservative estimate of 5,168 pounds of fish harvested per food fish acre per year. HSB Budgets assume that each farm harvests and sells its own fish whole on ice, and that the farm owns its own harvest equipment.

Effluent

Fish ponds release water in periods of heavy rainfall or when ponds are drained. Research on fish ponds has revealed that the natural biological activity in the pond acts to breakdown much of the organic matter in feed and fish wastes. The pond acts as a "digester" of organic matter.

Although ponds can act as their own treatment units for excess feed and fish waste, pond water normally contains more algae than natural water bodies such as nearby streams and estuaries. During months of heavy feeding, draining is best avoided; during these months pond water has the most potential to differ in quality from surface water. Discharge of excessive levels of ammonia (a by-product of the breakdown of organic matter in the pond) and phyto-plankton can normally be avoided by draining ponds during winter months.

In North Carolina, effluent from aquaculture operations is monitored if the farm discharges greater than 30 days per year and has annual production of greater than 100,000 pounds.

Economics

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The tables below estimate initial investment, operating costs, and annual returns for a 33-acre HSB enterprise. The enterprise consists of eleven, 3-acre ponds; three are dedicated to fingerling production and the others to growing food-size fish for sale. The farm purchases one-gram fingerlings and harvests and sells its own fish. HSB Budgets assume a stocking density of 12,000 fish per acre in the three fingerling ponds and 3,800 fish stocked per acre for the 24 acres of food fish ponds. Fingerlings are stocked in summer of Year

Farmers either arrange sale and transport of their fish, or market it through one of the larger NC farms.

1, and each summer thereafter, and transferred to food fish ponds each winter. Harvest of food fish ponds begins in September of Year 2. The average harvest weight is 1.70 pounds, with a survival of 85% for fingerlings and 80% for food fish. Average food fish production per acre is a conservative 5,168 pounds, or 124,032 pounds annually.

The HSB enterprise is an addition to an existing farm. The budgets assume that land and some equipment (a tractor, shed, mower, and repair equipment) are already owned. Summaries of the investment and operating costs and returns for years one and two are given below. A detailed investment budget and costs and returns for an average year appears on pages 14- 17.

Initial Investment

The 33-acre farm requires an initial investment of \$297,036 for pond construction, the well, and new equipment. In addition, the owner supplies the land (valued at \$49,560) and some equipment that is already owned (valued at \$24,500). The budget assumes that the farmer spends \$102,245 for new equipment, and other startup expenses, and borrows the \$195,391. Thus, the farmer invests 50% of the total initial investment by investing owned land, owned equipment, and cash. The borrowed amount is financed by a bank at 10% over 10 years for pond construction and five years for equipment.

Initial Investment

	Value(\$)	% of total
Land (owned)	49,560	14
Equipment (owned)	24,500	7
New equipment	116,400	31
Pond construction	108,350	29
Well and piping	56,500	15
Other	16,386	4
Total	371,696	100

Operating Costs and Returns

Sales are based on a price of \$2.40 per pound. Net returns are calculated before income tax and do not include the costs of owner labor or use of owner funds.

Because no harvest is made in Year One, the farm does not have a positive net return until Year Two. The simplified Summary Budget, on page 10, does not make an allowance for carrying over the costs of the first two years. If the owner is not able to pay operating costs and the debt payment from some other source of funds, additional interest costs will be incurred.

Costs are split into the categories of variable costs and fixed costs. Variable costs vary directly with the volume of output; if nothing is produced, variable costs are zero. Variable costs include the inputs described in *Inputs* (fingerlings, feed, electricity & fuel, etc.), repair and maintenance, and an interest cost on operating capital. HSB Budgets assume that the farm finances variable costs with credit lines from the feed mill and bank at an annual interest rate of 10%. A marketing cost of \$1,500 accounts for costs associated with selling of product such as telephone expenses or samples to potential buyers. A \$0.15 per pound charge accounts for the costs associated with harvest—ice, transport cartons, salt, labor, and electricity.

Fixed costs must be paid whether or not the farm produces, and tend to remain constant regardless of the volume of output. Fixed costs include property taxes, insurance, economic depreciation (replacement of worn-out equipment) and the costs of financing. Note that the cost of financing includes both principal and interest.

From Year two onward, the farm harvests 124,032 pounds of fish annually with sales of \$297,677. Variable Operating Costs are \$200,150, or \$1.61 per pound sold. The cost of feed and fingerlings makes up 50% of the variable operating cost. Annual debt payment is \$33,539. The farm has an annual net profit of \$61,926 or



HSB budgets assume a conservative harvest of 5,168 pounds per acre per year in food fish ponds.

The initial investment cost per pond acre (excluding land) is \$9,762.

For the example farm, the owner invests owned land and some equipment, and purchases most of the new equipment.



Hybrid Striped Bass Production Summary Budget

	Year 1	Year 2 & thereafter
Pounds harvested	lbs. -	lbs. 124,032
Income	\$ -	\$ 297,677
Expenses		
fingerlings	\$ 21,459	\$ 21,459
feed	\$ 13,042	\$ 76,517
electricity & fuel	\$ 10,800	\$ 40,345
repair & maintenance	\$ 4,365	\$ 8,730
hired labor	\$ -	\$ 18,000
harvest expenses	\$ -	\$ 18,605
interest on operating	\$ 2,162	\$ 9,595
debt payment	\$ 33,534	\$ 33,539
other	\$ 5,063	\$ 8,963
Total Expenses	\$ 90,430	\$ 235,753
Returns to Owner's Labor, Land, & Capital	\$ (90,430)	\$ 61,926

* Excludes annual depreciation estimated at \$22,256.33

By year 3, the 33-acre farm has a net profit of \$61,926 annually.

A slight change in the sale price can greatly affect profits, either positively or negatively.

More efficient use of inputs (with lower feed or fuel cost) can improve profits.

\$1,877 per water acre (or \$0.50 per pound produced). This is what the owner earns for his or her management skills, labor, and any capital invested in the farm.

The breakeven price for Year two and subsequent years is \$1.90. This means that the farmer must receive a price of \$1.90 or higher per pound to pay all of the costs associated with raising the fish.

A change in the sale price greatly affects returns. If the sale price falls by 10¢ per pound (to \$2.30), net income falls to \$58,443 annually. A 10¢ increase in price raises income to \$83,249.

Purchasing Phase Two Fish

As discussed earlier in this publication, most HSB farmers begin production with one-gram fingerlings purchased from a hatchery. Fish are stocked in summer; harvested, graded, and restocked into Phase Two ponds in the late fall and winter; and then harvested for sale about one year later. Thus, the production cycle is about 18 months long. Since most farmers are

involved in two stages of the production cycle, a certain portion of the water acreage, typically one-quarter of the total, is dedicated to Phase Two fingerling production.

Some farmers have begun to adopt an alternative production strategy: purchase of Phase Two fish from other farms or hatcheries. By not raising their own fingerlings, these farmers have two big advantages. One is that all of their water acreage is used for the production of income-generating foodfish. The second advantage is that a new farmer can generate income within the first year of production, since the first 6-month fingerling cycle is avoided. A quicker harvest helps not only with operating cash flow, but also increases the chance that a bank will be willing to fund the farm. This single-phase production option also helps farmers who do not have many ponds; a farmer with only one or two ponds can buy Phase Twos and then market fish through a larger farm, and not have to dedicate limited pond space to fingerling production.

A few years ago it was very difficult to purchase Phase Two fish. Farmers might sell a few if they had extra fish at transfer. As interest has grown in Phase Twos, fry and fingerling producers have responded by dedicating ponds to grow-out of Phase Two fish. As the industry continues to mature, more farmers may specialize in either food fish or Phase One and Two fingerling production, resulting in a more efficient, and profitable, use of pond space.

Other Topics

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Financing

HSB farming is capital intensive. Construction and equipment costs of \$6,000 - \$12,000 per acre plus operating costs of nearly the same amount are required before the first harvest is made. For this reason, most individuals with an interest in HSB farming hope to gain lender financing.

While the climate for aquaculture loans is improving in NC, lenders still consider fish farming to be riskier than other farm ventures. Unlike farm land which can be used for many different crops, fish farms are specialized (and capital-intensive) facilities which cannot readily be converted to other uses. The time delay between first stocking and first harvest (18 months) and the uncertainty as to the movement in price over that time period is also a source of concern. While aquaculture is considered a form of agriculture, it differs in that fish are sold through seafood marketing channels, with which agricultural lenders are usually unfamiliar. Lenders are unsure where hybrid striped bass will be sold, and wonder how the bank would be able to sell the fish (and manage the farm) if the fish farm were to fail. Another concern is that, in comparison to livestock and other crops, lenders can not see the fish to exactly determine the amount in the pond, or gauge the management success of the farmer. Also, unlike the production of some other types of livestock—hogs, turkeys, chickens—the

aquaculture industry does not have integrator companies which contract with growers for quantity and price.

North Carolina has a small aquaculture industry with a much shorter history (about 15 years) than some other states. Lenders are more familiar with aquaculture in states with larger industries, such as the catfish industry in Mississippi or tropical fish in Florida. Construction and equipment loans, as well as operating loans based on pond inventory, are commonplace. As NC lenders have more experience with successful fish farming operations, the opportunities for lender financing should increase.

Those who have been able to gain financing have had a combination of owned assets, either land, equipment, or cash, typically making up 50% or more of the total investment amount; a good credit history and good relations with a banker; and experience on a fish farm. Many individuals who have built HSB farms spent time working on other farms to gain valuable experience.

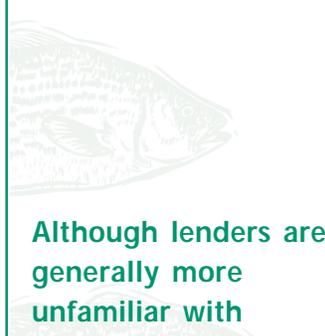
Farm Size

Like farming of traditional agricultural crops or livestock, aquaculture operations must be of a certain size to create returns to justify the large initial investment in facilities. Investment on a per acre basis varies greatly depending on the size of the farm. Larger farms allow savings in per acre pond construction and equipment costs, just as larger cotton or peanut farms are less costly to develop on a per acre basis the larger the total size of the farm.

Many HSB farms in NC have no more than two or three ponds. At this size, farmers can not easily achieve the economy of scale which lowers investment cost per acre and fixed cost per pound produced. Smaller farms continue to succeed financially, however, because of the large profit margin from raising HSB.



Some farmers choose to purchase phase II fish rather than use pond space to raise their own.



Although lenders are generally more unfamiliar with aquaculture than other agricultural enterprises, the number of loans made for fish farming is on the increase.



Insurance

Government programs provide weather-related disaster payments. Farmers should contact their local Farm Service Agency office for information.

General liability policies are available for HSB farms as are policies covering equipment damage due to weather. The difficulty of determining the number of fish in a pond at any one time has impeded the development of more inclusive policies to cover fish kills. Research is ongoing to develop techniques, such as ultrasound, to more accurately determine inventory.

Permits & Licenses

The North Carolina Department of Agriculture grants an aquaculture license for a period of five years. The license is free. A free capacity use permit is required for well-water withdrawals in some areas. If the proposed operation is not in a wetland and does not meet the criteria of both (1) discharging water more than 30 days per year and (2) producing more than 100,000 pounds per year, it is likely that no other permits will be needed. Potential producers are encouraged to contact the NC Department of Agriculture (see *Sources of More Information*) to learn about situations when other permits may be required.

Alternative Uses of Hybrid Striped Bass Ponds

Ponds constructed for raising HSB can also be used for other aquaculture species. Catfish and, to a lesser extent, ornamental fish, large-mouth bass, brim, yellow perch, and baitfish are also raised in eastern North Carolina. The small pond size typical of HSB farms also allows a farmer to experiment with other species without committing a large water area.

The land used for ponds can be reconverted into farm land. Levees must be carefully pushed down so that original topsoil is replaced. Fertilization and liming may be required.

Markets

Wild striped bass are caught in waters from Maine to North Carolina. In 1973, the U.S. commercial striped bass harvest topped 15 million pounds; by 1983, harvest had declined to 3.5 million pounds. This led to imposition of fishing quotas by states in the mid-1980s restricting the fishing season, poundage, and size. In the late 1990's, the fishery appeared to be recovering, and quotas were relaxed.

In the mid-1980s when quotas were imposed, prices for striped bass—wild or hybrid—reached upwards of \$5.00 per pound. New farmers of HSB were able to sell to markets that once relied solely on the wild harvest. As the amount of cultured product increased and the quotas imposed on wild caught fish were relaxed, prices fell. Surveys indicate that over the past three years (1998-2000) wholesale prices for HSB have averaged \$2.40 per pound. Live-hauled cultured fish are reported to sell at premiums of \$0.25 to \$1.00 per pound.

While the greater number of wild fish has put downward pressure on some markets, farmers report that periodic large supplies of wild striped bass do not necessarily affect the price of their product. Possible reasons are the following: (1) the larger required size for wild-caught, which does not compete with the file-size of 1.50 - 2.00 pound fish purchased from fish farms, (2) most fish are caught by recreational fishermen, and do not compete in the marketplace with cultured fish, (3) cultured fish is available year round (some operations harvest year-round) and there is less variance in size and quality, both desirable characteristics for buyers. Wild striped bass are also only available during a few weeks a year, and fish farmers can avoid harvesting during these periods.

Most NC HSB are sold to wholesale fish dealers from Maryland to New York, and in Canada. These wholesalers in turn sell to restaurants and retail markets. In contrast to the catfish industry, where almost all fish

The small pond size typical of HSB farms allows a farmer to experiment with other species without committing a large water area.

are sold in large volumes to a few processors, HSB have a number of potential buyers and farmers are more likely to be more actively engaged in the marketing process. NC producers either harvest and sell their own product, or they have informal agreements with one of the larger farms to sell their fish for them.

A survey of fish wholesalers conducted in 1996 discovered the following: 75% of wholesalers prefer a 1.5 to 2.0 pound fish, because it will yield two 6 to 8 ounce fillets suitable for sale in restaurants and retail markets; 19% of wholesalers contract with a HSB grower, and 43% said that they would be willing to contract; most wholesalers indicated that 80% to 100% of their HSB sales were destined for Asian markets; a strong market exists in both U.S. and Canadian Asian communities, and in China and Japan, for live-hauled HSB; mid-western states show perhaps the greatest potential for expanding sales of the current product form—whole HSB shipped on ice; and wholesalers (and retailers) say that expanding marketing opportunities for HSB depend most on lowering the price and achieving a more consistent year-round supply.

Because there is still a wide margin between sale price and production costs (\$2.40 vs. \$1.90, for the example farm in this publication), HSB farming continues to be profitable. As production increases, however, it is expected that the profit margin will narrow unless new markets in the U.S. or abroad are found, or different product forms (such as fillets from a processor or smoked product) are used to expand markets, or unless the price falls by enough to make hybrids competitive with less expensive species. A fall in the price of HSB may not necessarily mean farmers lose: improvements in production practices can serve to lower cost without impacting the farmer's profit margin.

Research

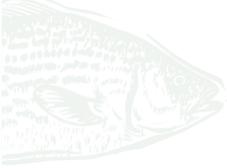
Pond culture of HSB began in North Carolina in 1987. Two factors have been largely responsible for the rapid growth of the industry: an established market for striped bass, and rapid transfer of technology from NC researchers to private farmers. As a result, NC now has more HSB farmers than any other state.

It can be expected that research of HSB culture will follow a similar course as that of other fin fish species. Early catfish farmers, for example, used costly feeds, exchanged large volumes of water in an attempt to control water quality, and had more fish kills due to low oxygen and stressed fish than they do today. Over the years, researchers defined the nutritional requirements of catfish and substituted grain by-products for costly fish meal. Catfish feed prices fell 40% in real terms over the past decade. Research also identified best management practices which reduced water exchange and fish kills. As a result, the cost of producing catfish fell, and variable operating costs is approximately \$0.50 per pound in comparison to around \$1.61 for HSB.

Today, researchers in NC and other states are investigating HSB nutrition, pond management, brood stock domestication, and other topics. NC researchers who were involved with the early stages of industry development continue to work with farmers on ways to increase production, reduce risk, and trim costs.



Pond culture of hybrid striped bass began in 1987 in Beaufort County, NC. North Carolina now has more HSB farms than any other state.



Hybrid Striped Bass Budgets

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These worksheets provide only general costs and returns estimates to fish farming.

Investment costs in particular can vary greatly and are extremely site specific. Prospective fish farmers should use these worksheets as a guide to obtaining costs specific to their site.

.....

acres water	33.0
acres land	41.3
number of ponds	11.0
acres fingerlings	9.0
ponds fingerlings	3.0
acres foodfish	24.0
ponds foodfish	8.0
fingerlings info:	
stocking density/acres	11,921.6
size @ harvest, lbs	0.25
FCR	2.2
survival	85%

foodfish info:	
stocking density/acres	3,800.0
size @ harvest, lbs	1.7
FCR	2.4
survival	80%
lbs harvested/acre/year	5,168.0

bank credit line interest rate for yearly op. expenses	10%
percent of construction financed by owner	0%
percent of new equipment financed by owner	77%
bank interest rate for construction (10 year loan)	10%
bank interest rate for equipment (5 year loan)	10%
sale price per lb	\$2.40

.....

For this set of worksheets:

(1) No cost is assumed for owner’s labor or for the interest cost of using the owner’s personal funds. Labor is estimated at 40-50 hours per week, with one part-time employee. Harvest labor is included with the harvesting charge.

(2) Budgets assume that all construction and equipment purchases take place at the beginning of year 1. Loan payments begin in year 1, but sales do not take place until year 2, and sales sufficient to cover the full operating cost in a year are not realized until year 3. If the owner does not have another source of income to make the payment until sales begin, then additional interest costs will be incurred.

(3) The owner funds 1/2 of the total initial investment in land, equipment & facilities. For this example, the owner contributes 41.6 acres of land, \$24,500 in existing equipment, and \$102,245 in cash for the purchase of new equipment. A total of \$195,391 is borrowed.

HSB BUDGETS
ELEVEN, 3-ACRE PONDS
INVESTMENT COSTS

Addition to existing farm
Land is owned and some
equipment shared

New Construction & Equipment

	UNIT	PRICE/UNIT(\$)	# OF UNITS	TOTAL(\$)
Pond Construction				
pond construction (varies widely by site).....	acre	2,200.00	33	72,600
vegetative cover and levee gravel	pond	750.00	11	8,250
drainage structure & piping	pond	500.00	11	5,500
electrical equipment and installation	pond	2,000.00	11	22,000
SUBTOTAL	-	-	-	108,350
Water Supply				
well & motor (varies widely by site).....	unit	20,000.00	2	4,000
water distribution system (installed)	pond	1,500.00	11	16,500
SUBTOTAL	-	-	-	56,500
Equipment(* indicates used equipment)				
feed blower	unit	5,000.00	1	5,000
feed storage	unit	4,200.00	1	4,200
electrical aerator	unit	3,900.00	11	42,900
emergency aerator	unit	4,300.00	3	12,900
tractors (50 HP).....	unit	17,500.00	2	35,000
boom truck*	unit	5,000.00	1	5,000
live car	unit	700.00	1	700
transport tank	unit	1,000.00	1	1,000
seine	unit	3,200.00	1	3,200
seine reel	unit	4,000.00	1	4,000
misc. (waders, scale, test equip).....	unit	2,500.00	1	2,500
SUBTOTAL	-	-	-	116,400
Other Startup expenses				
initial pond filling	dol.	-	-	11,246
lime treatment	acre	80.00	33	2,640
installation of utilities (varies widely by site).....	dol.	-	-	2,500
SUBTOTAL	-	-	-	16,386
TOTAL INITIAL INVESTMENT	-	-	-	297,036
Investment cost per water acre	-	-	-	9,019

Shared Farm Equipment, Owned				
shared with other farm activities				
tractor	unit	7,000.00	1	7,000
shop equipment	unit	5,000.00	1	5,000
mower	unit	500.00	1	500
pickup	unit	12,000.00	1	12,000
TOTAL				24,500

HSB BUDGETS
OPERATING COSTS, YEAR 1,
FINGERLING PRODUCTION

*Addition to existing farm
 Land is owned and some
 equipment shared*

	UNIT	PRICE/UNIT(\$)	# UNIT	TOTAL(\$)	% OF TOTAL
Gross Receipts	-	-	-	-	-
hybrid striped bass	-	-	-	-	-
TOTAL GROSS RECEIPTS	-	-	-	-	-
Variable Costs					
fingerlings	per	0.20	107,294	21,459	24%
1st year fingerling feed	lb	0.26	50,160	13,042	14%
chemicals	acre	100.00	9	900	1%
electrical usage					
aeration	hr	0.85	3,960	3,366	4%
water supply	hr	1.50	2,151	3,226	4%
fuel					
aeration	hr	1.50	1,980	2,970	3%
misc.	acre	15.00	83	1,238	1%
repair & maint. of equip.	mo	363.75	12	4,365	4%
office overhead	mo	50	12	600	1%
hired labor	mo	-	-	-	-
pescalator rental	day	500.00	3	1,500	2%
other equipment rental	total	-	-	-	-
interest on above operating funds	dol.	-	-	2,162	2%
marketing cost	dol.	-	-	-	-
harvest (box,ice,harvest labor)	lb	-	-	-	-
SUBTOTAL, VARIABLE COSTS	-	-	-	54,827	60%
Fixed Costs*					
payment on land and const. debt	dol.	-	-	25,687	28%
payment on equipment debt	dol.	-	-	7,852	9%
property taxes and insurance	acre	25.00	20	2,063	3%
SUBTOTAL, FIXED COSTS	-	-	-	35,601	39%
TOTAL COSTS	-	-	-	90,428	100

* Excludes annual depreciation, estimated at \$22,256



HSB BUDGETS
OPERATING COSTS, YEAR 2 AND THEREAFTER
FINGERLING & FOODFISH PRODUCTION

*Addition to existing farm
 Land is owned and some
 equipment shared*

	UNIT	PRICE/UNIT(\$)	#UNIT	TOTAL(\$)	% OF TOTAL	\$/LB HARV
Gross Receipts						
hybrid striped bass	lb	2.40	124,032	297,677	-	-
TOTAL GROSS RECEIPTS	lb	2.40	30,000	75,000	-	-
Variable Costs						
fingerlings	per	0.20	107,294	21,459	9%	0.17
1st year fingerling feed	lb	0.26	50,160	13,042	5%	0.11
2nd year feed	lb	0.20	317,376	63,475	27%	0.51
chemicals	acre	100.00	33	3,300	1%	0.03
electrical usage						
aeration	hr	0.85	24,060	20,451	9%	0.16
water supply	hr	1.50	6,422	9,633	4%	0.08
fuel						
aeration	hr	1.50	6,015	9,023	4%	0.07
misc.	acre	15.00	83	1,238	1%	0.01
repair & maint. of equip.	mo	727.50	12	8,730	4%	0.07
office overhead	month	50.00	12	600	0%	0.00
hired labor	mo	1500.00	12	18,000	8%	0.15
pescalator rental	day	500.00	3	1,500	1%	0.01
other equipment rental	total	-	-	-	0%	-
interest on operating funds	dol.	-	-	9,595	4%	0.08
marketing cost	dol.	-	-	1,500	1%	0.01
harvest (box,ice,harvest labor)	lb	0.15	124,032	18,605	8%	0.15
SUBTOTAL, VARIABLE COSTS -		-	-	200,150	85%	1.61
Fixed Costs						
payment on land and const. debt	dol.	-	-	25,687	11%	0.21
payment on equipment debt	dol.	-	-	7,852	3%	0.06
property taxes and insurance	acre	50.00	41	2,063	1%	0.02
SUBTOTAL, FIXED COSTS	-	-	-	35,601	15%	0.29
TOTAL COSTS	-	-	-	233,751	100.00%	1.90

* Excludes annual depreciation, estimated at \$22,256.33

RETURNS SUMMARY			
Returns to owner's management, labor, and capital			
	LB	FARM	WATER ACRE
Returns above variable costs	\$0.79	\$97,527	\$2,955
Returns above total costs	\$0.50	\$61,926	\$1,877
Breakeven price/lb above variable costs	\$1.61		
Breakeven price/lb above all costs	\$1.90		

SOURCES OF MORE INFORMATION

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The **North Carolina Department of Agriculture and Consumer Services** provides assistance with permitting and helps individuals analyze the economics of proposed or existing aquaculture operations:

Permitting

Tom Ellis, Director
North Carolina Department of Agriculture
Division of Aquaculture & Natural Resources
P.O. Box 27647
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(919) 733-7125
tom.ellis@ncmail.net

Business Planning

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Agricultural Economist
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Marketing

North Carolina Department of Agriculture
Division of Marketing
P.O. Box 27647
Raleigh, NC 27611
(919) 733-7125

Many technical publications are available on hybrid striped bass culture methods. Also, as part of the **North Carolina Cooperative Extension Service**, the following aquaculture extension agents can be contacted to work one-on-one with prospective hybrid striped bass farmers in eastern and central North Carolina:

In the Northeast

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Notes



Notes



A series of 20 horizontal lines provided for taking notes, spanning the width of the page.