SRAC
Southern Regional Aquaculture Center

SRAC Publication No. 3000
December 2013
Revision

Comparison of Costs of Different Hybrid Striped Bass Production Systems in Ponds

Siddhartha Dasgupta[1] and Kenneth R. Thompson[1]

Hybrid striped bass are primarily grown in the United States as food fish. They are bred artificially by crossing striped bass *(Morone saxatilis)* and white bass *(M. chrysops).* There are two types of hybrid striped bass: sunshine bass, a cross between female white bass and a male striped bass, and palmetto bass, a cross between female striped bass and a male white bass. Sunshine bass are typically the ones raised commercially.

Hybrid striped bass forms a major part of the U. S. aquaculture industry, with a total production of nearly 4,000 tons of fish in 2012. When compared to the 150,000 tons of catfish sold to U. S. processors and 26,000 tons of food sized trout sold by growers in 2012, the hybrid striped bass industry is small. However, with a value of $29 to $30 million in 2012, this industry is an important segment of U.S. aquaculture (USDA ERS 2013).

This fact sheet provides costs of hybrid striped bass pond aquaculture in the southern U. S. The focus is on the cost of growing fish from stocking to harvest. Details of marketing costs are excluded from our results because they are highly variable. Pond culture of this fish involves both open pond systems and floating cages. Open pond culture is the most common production method in the southern U. S. However, cage culture fills a small niche in southern Appalachian states such as Kentucky, where there is a prevalence of deep, watershed ponds that are not amenable to seining. The results in this fact sheet use costs of land, pond construction, equipment, and variable inputs (e.g., fingerlings, feed, labor, etc.) that are developed from expected prices in several states of the southern U.S. These expected prices are not representative of prices faced by any particular hybrid striped bass farmer because such prices will depend on location (i.e., transportation costs), and time (i.e., prices change over time). Therefore, the results in this paper should be taken as a guide for farmers to compare profitability of different culture systems. Farmers are encouraged to project their own costs using the actual input prices that they have to pay.

Costs of Open Pond Aquaculture of Hybrid Striped Bass

SRAC Publication No. 301, *Hybrid Striped Bass: Hatchery Phase* presents details of hybrid striped bass hatching. Fry from hatched eggs (2 to 10 days to post-hatch or DPH) are nursed in fertilized ponds where they live on zooplankton. Fry that are 14 to 21 DPH are fed artificial diets that have 45 to 50 percent crude protein, such that by age 28 DPH the fish should mostly be feed trained. Fingerling hybrid striped bass are harvested from nursery ponds at age 30 to 45 DPH (expected weight = 1 gram). In the industry, these fish are called Phase I fingerlings.

Fixed costs Associated with Open Pond Culture

SRAC Publication No. 4402, *Determining the Profitability of an Aquaculture Business: Using Income Statements and Enterprise Budgets* is an excellent resource to readers unfamiliar with cost calculations in aquaculture businesses. Production costs for an aquaculture farm can be divided into fixed and variable costs. The former represents costs a farmer must pay regardless of the level

[1]Aquaculture Research Center, Kentucky State University

of production, such as the ownership costs of facilities and equipment, and property tax. The latter represents costs that depend upon the level of production, i.e., variable costs are zero if there is no production and increase with higher levels of output. Total fixed costs include the depreciation and interest accrued to investment in facilities and equipment and are calculated on a "per year" or "per production cycle" basis. Fixed costs vary with farm size for two reasons: 1) larger farms require more land and facilities, and 2) larger farms need more specialized equipment than smaller farms. For example, smaller farms do not always need feed bins or mechanized feed blowers because they use small volumes of bagged feed that can be easily stored and the fish are usually fed by hand. Feed bins and feed blowers are useful for larger farms because they can buy tons of bulk feed at a time and hand-feeding of fish will be prohibitively laborious. The marginal fixed cost is assumed to decline as the farm becomes larger.

Hybrid striped bass farm sizes vary significantly in the southern U. S. For example, in North Carolina, farm sizes range from 3 to 100 water-acres, with a median of 18 water-acres. Pond sizes vary from small (1 to 2 water-acres), to medium (4 to 5 water-acres), to large (10 water-acres). Since pond sizes and farm sizes vary significantly, the economic analyses in this fact sheet were standardized to represent both small and large farms using different pond sizes and number of ponds.

Fixed costs for a production cycle are calculated based on depreciation and forgone interest associated with land, facilities, and equipment over the growing season, which varies from 480 to 550 days. We give examples of fixed costs for two scenarios of open pond hybrid striped bass aquaculture: large 50 water-acre farm with ten 5 water-acre ponds (Table 1), and a small-scale farm with a single 2 water-acre pond (Table 2). All equipment prices are contemporary and obtained from commercial aquaculture suppliers. Tables 1 and 2 demonstrate how fixed costs diminish with increasing farm size: $35,933 per water-acre for the 2 water-acre farm and $9,722 per water-acre for the 50 water-acre farm.

Table 1. Fixed costs of a 50 water-acre hybrid striped bass farm, with ten 5 water-acre ponds. Depreciation was calculated using the straight line method. Interest foregone was charged at the rate of 8 percent per annum[a].

Item (units)	Amount	Original value	Depreciation	Interest
Land (Acres)	52	$78,000	$0	$8,548
Ponds[b] (Acres)	50	$150,000	$6,849	$13,699
Aerators	10	$50,000	$9,785	$2,740
PTO-powered aerator[c]	1	$7,400	$658	$395
50-hp tractor	1	$20,000	$1,827	$1,096
Water supply (well & plumbing)	1	$30,000	$1,712	$1,918
Water pump	1	$540	$148	$30
Dissolved oxygen meter	1	$1,400	$192	$77
Water quality kit	1	$185	$85	$10
Feed bin	1	$15,000	$1,370	$822
Generator	1	$5,000	$685	$274
Seine	1	$3,385	$927	$186
Seine reel	1	$4,000	$365	$219
Live car	1	$200	$55	$11
Mower and brush cutter	1	$4,000	$548	$219
Feed blower	1	$9,500	$868	$521
Use of a pickup truck	50%	$10,000	$776	$630
Miscellaneous	1	$500	$137	$27
Property tax		$246		
Total		$389,356	$26,987	$31,422

[a] Production season for Phase II-Phase III technology is approximately 500 days (June to September of the following year). Total fixed cost per growing season = Depreciation +Interest + Property Tax = $58,655.
[b] Pond construction cost is assumed to be $3,000 per water-acre, which is typical of building multiple, large ponds in the southern U. S.
[c] PTO-powered aerator is a tractor-powered emergency aerator

Table 2. Fixed costs of a 2 water-acre hybrid striped bass farm, with a single pond using the direct-stocking technology. Depreciation was calculated using the straight line method. Interest forgone was charged at the rate of 8 percent per annum[a].

Item (units)	Amount	Original value	Depreciation	Interest
Land (Acres)	2.08	$3,120	$0	$345
Ponds[b] (Acres)	2	$10,000	$829	$773
Aerators	1	$2,500	$493	$138
Water supply (well & plumbing)	1	$30,000	$1,726	$1,933
Water pump	1	$540	$149	$30
Dissolved oxygen meter	1	$1,400	$193	$77
Water quality kit	1	$185	$85	$10
Feed storage	1	$5,000	$345	$276
Generator	1	$5,000	$690	$276
Seine	1	$2,141	$591	$118
Seine reel	1	$4,000	$368	$221
Mower and brush cutter	1	$4,000	$552	$221
Use of a pickup truck	20%	$4,000	$313	$254
Miscellaneous	1	$500	$138	$28
Property tax		$10		
Total		$72,396	$6,472	$4,700

[a] Production season is approximately 504 days (June to October of the following year). Total fixed cost per growing season = Depreciation +Interest + Property Tax = $11,182.
[b] Pond construction cost is assumed to be $5,000 per water-acre, which is typical of building small ponds in non-delta areas of the southern U. S., such as in Kentucky

Phase II-Phase III Pond Culture System

In the Phase II-Phase III fish production system, farmers purchase Phase I fingerlings from a commercial hatchery and grow them to food size in two phases: Phase II and Phase III (Fig. 1). D'Abramo et al. (2002) provides a real world example of the Phase II-Phase III system. Here, the Phase I hybrid striped bass fingerlings are stocked in May to June at densities of 8,000 to 12,000 per water-acre, harvested after 150 days. The harvested fish are Phase II fingerlings of average size 0.3 pounds (145 g); they are size graded and restocked at 4,000 per water-acre. The Phase II fish are cultured for an additional 250 to 300 days, and reach food size (1.5 to 2 pounds) by the following Fall. Another variation in this system was described by Dunning (2001) in which Phase I fingerlings were stocked in August at the rate of 16,000 per water-acre and grown to Phase II size by the following February (Fig. 1). In February, these fish were harvested from Phase II ponds and restocked at 4,000 per water-acre in ponds called Phase III ponds and grown to food size by October of the same year. The Phase II ponds' water acreage was typically a fourth of the corresponding Phase III water acreage. Dunning and Daniels (2001) reported obtaining 0.22 pounds (100 g) Phase II fish from 1 gram (454 fish per pound) Phase I fingerlings over a 6 to 8 month growing season; the Phase II fish were harvested, size graded, and stocked in Phase III ponds for an additional 9 to 12 months at 3,000 to 5,000 per water-acre. The expected final product was 1.25 to 2.50 pound fish, with a per season yield of 4,000 pounds per water-acre.

The D'Abramo et al. (2002) model was used in this economic analysis. It was assumed that Phase II survival rate was on average, 75 percent, while Phase III survival rate was expected to be 80 percent. Fingerling prices were obtained from Keo Fish Farms (2013) and feed prices for a 40 percent crude protein diet were obtained from various commercial sources. Hybrid striped bass feed costs, without transportation expenses to a farm, varies from $930 per ton (bulk feed price) to $960 to $1,100 per ton (bagged feed price); however, feed price increases significantly with transportation costs. Farms distant from hybrid striped bass feed mills could expect to pay an additional $100 to $300 per ton in transportation cost. Table 3 lists expected variable costs associated with the Phase II-Phase III system for a 50 water-acre hybrid striped bass farm containing ten, 5 water-acre ponds. The table has variable costs partially isolated for Phase II and Phase II fish production. Labor for each phase of production included effort needed for daily feeding and water quality monitoring per pond. Other labor for farm maintenance operations, such as mowing, cleaning, purchasing feed, etc., were included in the 'Other Labor'

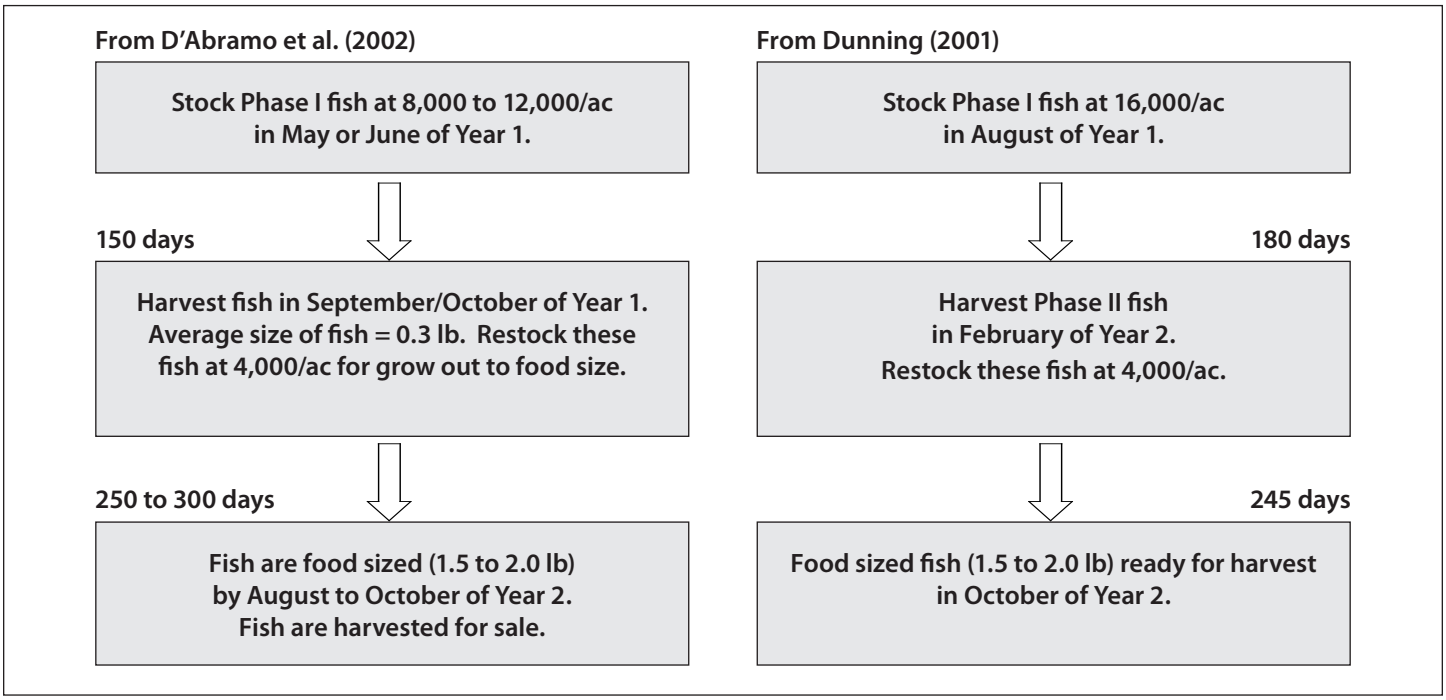

Figure 1. Illustration of the Phase II-Phase III culture methods, as described by D'Abramo et al. (2012) and by Dunning (2001).

Table 3. Variable costs associated with a Phase II-Phase III hybrid striped bass production system using a 50 water-acre farm, with 10, 5 water-acre ponds.

Item	Unit	Amount	Price	Value
Costs associated with Phase II fingerling production:				
Phase I fish	Fingerlings	180,000	$0.25	$45,000
Feed	Tons	54	$1,200.00	$64,229
Electricity use	KWH	10,921	$0.06	$655
Labor	Man hours	689	$7.25	$4,992
Costs associated with Phase III fish or food sized fish production:				
Feed	Tons	197	$1,200.00	$236,845
Electricity use	KWH	58,904	$0.06	$3,534
Labor	Man hours	2,961	$7.25	$21,467
Other variable costs:				
Electricity meter fee	Months	16[b]	$10	$164
Other labor	Man hours	286	$7.25	$2,071
Harvest labor	Pounds	162,000	$0.24	$38,880
Chemicals	Acres	50	$79.23	$3,962
Fuel	Gallons	429	$3.50	$1,503
Telephone	Months	16[a]	$30.00	$492
Management	Months	16[a]	$1,000	$16,393
Legal permit				$50
Maintenance				$2,225
Insurance				$500
Interest forgone				$60,686
Total				$503,648

[a] Number of Phase II fish produced = 135,000. Total amount of food sized fish produced = 162,000 pounds.
[b] The actual number of months of growing season is approximately 16.44.

category. Harvest labor cost and chemical application cost were adopted from Dunning (2001), with appropriate changes made to account inflation of currency since 2001. The yield of food sized hybrid striped bass was 3,240 pounds per water-acre per season.

Total cost of operating the 50 water-acre hybrid striped bass farm for a given production season is the sum of fixed costs and variable costs. If total cost is divided by total output (162,000 pounds), the result is the total cost of production per pound of output, i.e., the breakeven price, which is the least price that the food sized fish could be sold without an economic loss. Since total cost was $562,303, the corresponding breakeven price in this scenario was $3.47 per pound. The average wholesale price of farmed hybrid striped bass has been $3.75 per pound at the farm gate, during 2010, or $4.14 per pound in 2013 U. S. dollars. This indicates that the 50 water-acre hybrid striped bass farm has the potential for profit (estimated at $108,540) in wholesale markets in the United States.

Breakeven price is strongly affected by feed price because feed cost comprises 60 percent of variable cost. Feed price increases substantially with transportation from the feed mill to the farm. For farms located near a feed mill, feed price could be as low as $930 per ton (bulk feed), resulting in a $3.00 per pound breakeven price. A 1 percent increase in feed price translates to a 0.58 percent increase in breakeven price. When compared to feed price, stocking and labor costs have much less impact on total cost and breakeven price in the Phase II-Phase III production system because they account for 9 percent and 13 percent of total variable cost, respectively. Survival rate of fish also affects the breakeven price: a 1 percent increase in Phase II and Phase III survival rate decreased breakeven price by 1.73 percent.

Direct Stocking Pond Culture System

Direct stocking of hybrid striped bass is a more streamlined approach to pond culture in which 3 gram (151 fish per pound) fingerlings are stocked in ponds at the rate of 3,750 to 4,000 per water-acre and fed there until they reach 1.5 to 2 pounds (Fig. 2) (D'Abramo and Frinsko 2008).

D'Abramo et al. (2002) commented that direct stocking method: 1) is easier to implement than the Phase II-Phase III culture system because Phase II fish do not need harvesting in the interim, size grading, and restocking in Phase II ponds, and 2) could lead to lower mortality over the Phase II-Phase III method because fish are handled less often. However, Dunning and Daniels (2001) stated that multi-phase production results in higher overall productivity (expected yield of 5,168 pounds per water-acre Vs. 4,000 pounds per water-acre under direct stocking) due to benefits of size grading Phase II fish approximately midway in the growth cycle (i.e., decreasing differentiated size-based mortality). Both pond culture methods could stock the same size of fingerlings, and take the same amount of time to produce food sized fish.

Using D'Abramo et al. (2002) data for direct stocking, we compiled expected variable costs for the direct stocking method for a 50 water-acre farm, with ten 5 water-acre ponds, in Table 4. The calculations in this table assume that survival rate of the direct stocking system was 52.8 percent and feed conversion ratio was 2.8:1.

Comparisons in Tables 3 and 4 show that the Phase II-Phase III system produced 2.2 percent more fish than the direct stocking method. These results were based on actual pond culture demonstrations and are consistent with Dunning and Daniel's (2001) statements about the higher productivity of Phase II-Phase III system. By calculating the breakeven price, the direct stocking technol-

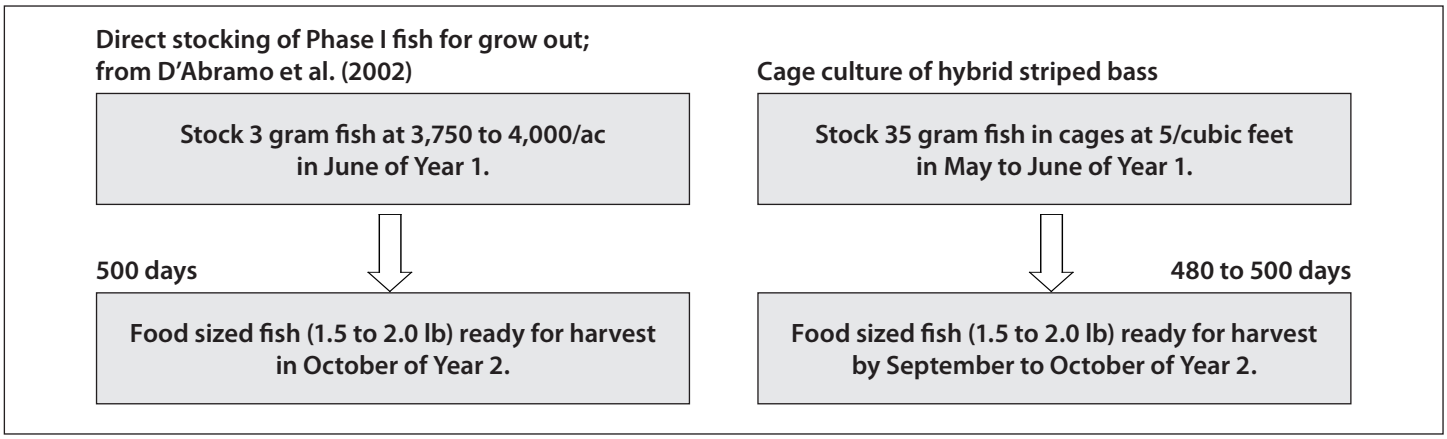

Figure 2. Illustration of direct stocking culture method and cage culture method.

ogy resulted in an economic cost of $4.83 per pound of fish, which was insufficient to show an economic profit in wholesale markets, based on the wholesale prices of hybrid striped bass in 2010 (i.e., $4.14 per pound, using 2013 U. S. dollars).

Table 4 shows that feed cost was the single most important contributor to total variable cost, accounting for 68 percent costs in direct stocking. Hence, a change in feed cost or feeding efficiency could significantly impact profitability. This can be illustrated by inspecting the breakeven price for farms located close to a feed mill; such operations will pay the price of bulk feed, without significant transportation costs ($930 per ton). The corresponding breakeven price would be $4.02 per pound, i.e., low transportation cost of feed can lead to profits in wholesale markets.

The survival rate under direct stocking technology (53 percent) was lower than the overall survival from the Phase II-Phase III technology (60 percent). For the direct stocking technology, a 60 percent survival rate and feed price that includes transportation cost ($1,200 per ton), lowered the breakeven price to $4.29 per pound. Thus, increasing survival rate was insufficient in making the direct stocking method profitable in wholesale marketing of bass.

Costs of Cage Aquaculture of Hybrid Striped Bass

Hybrid striped bass can be grown in floating cages in ponds. Cage culture is usually chosen for ponds that are not specifically constructed for aquaculture such as deep watershed ponds. The confinement of fish in cages makes feeding and harvesting of fish easy. This method is particularly useful for supplying restaurants, direct and ethnic markets that want regular supply of small quantities of fish. However, cage culture is usually more stressful on fish than open pond culture because the fish are unable to swim to regions of better water quality in a pond. In extreme cases this can result in high mortality, which underscores the risk associated with cage culture. Harrell (1988) is an excellent guide for cage culture and management of hybrid striped bass.

Cage mesh size is typically 0.5 inches to house 3 to 10 gram fingerling hybrid striped bass and cage sizes might vary from 64 to 288 cubic feet. Riepe et al. (1992) reported using cylindrical cages that were 3.5 feet in diameter and 4 feet tall. Cage culture experiments with hybrid striped bass in Kentucky used 8 feet × 4 feet × 4 feet cages. The stocking size of fish was 19 grams (24 fish per pound); and the stocking density was 0.78 fish per cubic feet, i.e., 100 fish per cage (Webster et al. 2001). Fish were stocked in May and harvested five months later, after 153 days. The average harvest weight was 0.71 pounds, with a survival rate of 62 percent and a feed conversion rate of 2.4:1. In a similar experiment, 36 gram fingerlings (13 fish per pound) were stocked in same-sized cages at the same density, as reported above. After 391 days of culture the average fish weight was 1.12 pounds, average survival rate was 90 percent, and the average feed conversion ratio was 2.59:1.

In this fact sheet, it is assumed that cage culture will be primarily used in small-scale applications, which

Table 4. Variable costs associated with the direct stocking method of hybrid striped bass production using a 50 water-acre farm, with 10, 5 water-acre ponds[a].

Item	Unit	Amount	Price	Value
Phase I fish	Fingerlings	200,000	$0.25	50,000
Feed	Tons	419	$1,200.00	$502,668
Electricity	KWH	123,239	$0.06	$7,394
Electricity meter fee	Months	17	$10.00	$170
Chemicals	Acres	50	$79.23	$3,962
Fuel	Gallons	421	$3.50	$1,474
Labor	Man hours	6,678	$7.25	$48,416
Harvest labor	Pounds	158,400	$0.24	$38,016
Management	Months	17	$1,000.00	$17,000
Telephone	Months	17	$30.00	$510
Legal permit				$50
Maintenance				$2,225
Insurance				$500
Interest forgone				$92,844
Total variable cost				$765,229

[a] Total amount of food sized fish produced = 158,400 pounds.

follows the industry norm. A "standard" cage will be a box-like structure 8 feet × 4 feet × 4 feet with a PVC pipe frame and plastic net mesh sides. A cage will have a frame and mesh top that can be easily opened for accessing fish, and secured to keep predators out. Each cage will also have floats such as Styrofoam blocks attached to the sides. Cost of a cage ($121.05) includes material cost of $106.55 (64 feet of one inch PVC pipe for the frame, 24 feet of PVC pipe for the lid, 8 three-way PVC fittings, 4 L-shaped PVC fittings, a 50 foot roll of 4 foot wide plastic netting material) and $14.50 worth of labor costs for two man hours.

The number of cages that can be stocked with hybrid striped bass in a pond can be calculated by first obtaining the maximum adult fish biomass in the pond. This is a matter of dividing the maximum feed application per water-acre per day with the daily feeding rate during the growing season of 3 percent of fish biomass. Using the target harvest weight (usually 1.5 to 2 pounds), the number of adult fish could be estimated by dividing the biomass by the average harvest weight. The number of fingerlings needed is the result of dividing the number of adult fish with the estimated survival rate. Finally, the expected number of cages is the result of dividing the number of fingerlings with the stocking rate per cage.

Table 5 lists the fixed costs associated with a small-scale cage culture system for hybrid striped bass, using a 2 water-acre pond. Cage culture requires investment in cages and docks, but not in seines, seine reels, live cars, etc., which are needed in open pond aquaculture. Fixed costs are approximately $3,000 per water-acre per season, which is 53 percent of the corresponding fixed costs for a small-scale open pond operation.

Cage culture data and fingerling price data show that stocking size in cages is approximately 35 grams (13 fish per pound), the corresponding fingerling price is approximately $1 per head, the stocking density is 5 to 7 per cubic foot, the average feed conversion ratio is 2.5:1, and the overall survival rate is 90 percent. The production cycle is approximately 480 days (from June to September of the following year). A schematic of this production method is illustrated in Fig. 2. These production assumptions were used to calculate the corresponding variable costs for the small-scale cage culture operation (Table 6). Feed prices are likely to reflect bagged feed, because most cage operations are at a small scale. Unlike open pond aquaculture, cage culture requires constant aeration; additionally, harvest labor is less under cage culture and is based on an estimated labor of 4 man hours per cage. Cage culture ponds are less productive in per water-acre yield than open pond systems.

Based on the costs reported in Tables 5 and 6, cage culture production results in an economic breakeven price of $5.78 per pound for a small-scale farm, which is significantly higher than wholesale price. For farms located near a feed mill, the relevant feed price would be ($960 to $1,100 per ton). In this scenario, the breakeven price falls to $5.22 to $5.46 per pound. If the pond size was larger, the breakeven price drops to $4.56 per pound

Table 5. Fixed costs of a hybrid striped bass farm, with a single 2 water-acre pond, using a cage culture system. Depreciation was calculated using the straight line method. Interest foregone charged was at the rate of 8 percent per annum[a].

Item (units)	Amount	Original value	Depreciation	Interest
Land (Acres)	2.08	$3,120	$0	$683
Ponds (Acres)	2	$6,000	$395	$473
Aerators	1	$2,500	$657	$132
Cages	8	$484	$127	$26
Dock	1	$2,000	$263	$105
Water pump	1	$540	$142	$28
Dissolved oxygen meter	1	$1,400	$184	$74
Water quality kit	1	$185	$81	$10
Feed storage	1	$5,000	$438	$263
Generator	1	$5,000	$658	$263
Mower and brush cutter	1	$4,000	$526	$210
Use of a pickup truck	10%	$2,000	$149	$263
Miscellaneous	1	$500	$132	$26
Property tax		$10		
Total		$32,739	$3,752	$2,556

[a] Production season is approximately 480 days. Total fixed cost per growing season = Depreciation +Interest + Property Tax = $6,318.

Table 6. Variable costs associated with the cage culture of hybrid striped bass production using four 128 cubic feet cages in a single 2 water-acre pond[a].

Item	Unit	Amount	Price	Value
Fingerlings (average weight 35 g)	Fingerlings	5,120	$1.00	$5,120
Feed	Tons	9.22	$1,200.00	$11,059
Electricity	KWH	6,735	$0.06	$404
Electricity meter fee	Months	16	$10.00	$160
Chemicals	Acres	2	$79.23	$159
Fuel	Gallons	266	$3.50	$932
Labor	Man hours	839	$7.25	$6,080
Harvest labor	Man hours	32	$7.25	$232
Telephone	Months	16	$10.00	$160
Legal permit				$50
Maintenance				$359
Insurance				$250
Interest forgone				$3,282
Total variable cost				$28,247

[a] Total amount of food sized fish produced = 6,144 pounds.

(or $4.09 to $4.33 per pound without feed transportation costs). In a survey of independent restaurants in Kentucky and Ohio, Bryant et al. (2013) discovered the willingness to pay for whole hybrid striped bass to vary from $4 to $6 per pound. Thus, small-scale cage culture operations could find supplying whole fish to urban, independent restaurants to be profitable.

Table 6 shows that feed, labor, and stocking costs contribute mostly to the total variable costs. Profitability is very sensitive to these three parameters. Farmers in areas without local feed mills are at a substantial disadvantage. A 1 percent increase in feed price results in a 0.34 percent increase in breakeven price. Stocking costs also increase as fingerlings are transported farther from the hatchery. Thus, a 1 percent increase in stocking costs causes a 0.17 percent increase in breakeven price. Labor is charged at the minimum wage rate. If the wage rate was to increase by 1 percent, it would cause a 0.17 percent increase in breakeven price.

Discussion and Conclusions

This fact sheet reports the cost of growing hybrid striped bass in ponds using three alternative production systems. Turano (2013) reported the wholesale price of hybrid striped bass to be $3.75 per pound at the farm gate in 2010, which corresponds to $4.14 per pound in 2013 U. S. dollars. Using this price, the Phase II-Phase III production system in a 50 water-acre hybrid striped bass farm was profitable. The direct stocking production system was less profitable that the Phase II-Phase III system. Cage culture is predominantly done at a small scale using ponds that are unsuitable for implementing any other form of pond culture. Cage culture fish were too expensive for wholesale sales; however, willingness to pay data show that cage culture would be profitable if farmers sold whole fish to restaurants and other retail and direct markets.

Suggested Readings

D'Abramo, L.R., C.L. Ohs, T.R. Hanson, and J.B. Taylor. 2002. Production and Economic Analysis of Two-Phase and Three-Phase Culture of Sunshine Bass in Earthen Ponds. North American Journal of Aquaculture, 64: 103-112.

D'Abramo, L.R. and M.O. Frinsko. 2008. Hybrid Striped Bass: Pond Production of Food Fish. Southern Regional Aquaculture Center Fact Sheet, Publication Number 303 (Revision).

Dunning, R. 2001. Aquaculture in North Carolina. Hybrid Striped Bass. Inputs, Outputs, and Economics. North Carolina Department of Agriculture and Consumer Services. Raleigh, NC 27611.

Harrell, R.M. 1988. The Culture of Striped Bass and its Hybrids in Cages. Maryland Sea Grant Extension. Publication Number UM-SG-MAP-88-02.

Hodson, R.G. and M. Hayes. 1989a. Hybrid Striped Bass Pond Production of Fingerlings. Southern Regional Aquaculture Center Publication Number 302.

Hodson, R.G. and M. Hayes. 1989b. Hybrid Striped Bass Pond Production of Foodfish. Southern Regional Aquaculture Center Publication Number 303.

Riepe, J.R., L. Swann, and P.B. Brown. 1992. Analyzing the Profitability of Hybrid Striped Bass cage Culture. Fact Sheet AS-487. Aquaculture Extension, Illinois-Indiana Sea Grant Program, Purdue University, Lafayette, Indiana.

United States Department of Agriculture Economic Research Service (USDA ERS). 2013. Catfish and Trout: Inventory, sales, and prices – All years. http://www.ers.usda.gov/data-products/aquaculture-data.aspx#.Ua3WZNhAF0M. Accessed on June 4th 2013.

Webster, C.D., K.R. Thompson, A.M. Morgan, E.J., Grisby, and S. Dasgupta. 2001. Feeding Frequency Affects growth, Not Fillet Composition of Juvenile Sunshine Bass *Morone chrysops* x M. *saxatilis* Grown in Cages. Journal of the World Aquaculture Society, 32(1): 79-88.

SRAC fact sheets are reviewed annually by the Publications, Videos and Computer Software Steering Committee. Fact sheets are revised as new knowledge becomes available. Fact sheets that have not been revised are considered to reflect the current state of knowledge.

USDA United States Department of Agriculture National Institute of Food and Agriculture

The work reported in this publication was supported in part by the Southern Regional Aquaculture Center through Grant No. 2010-38500-21142 from the United States Department of Agriculture, National Institute of Food and Agriculture.