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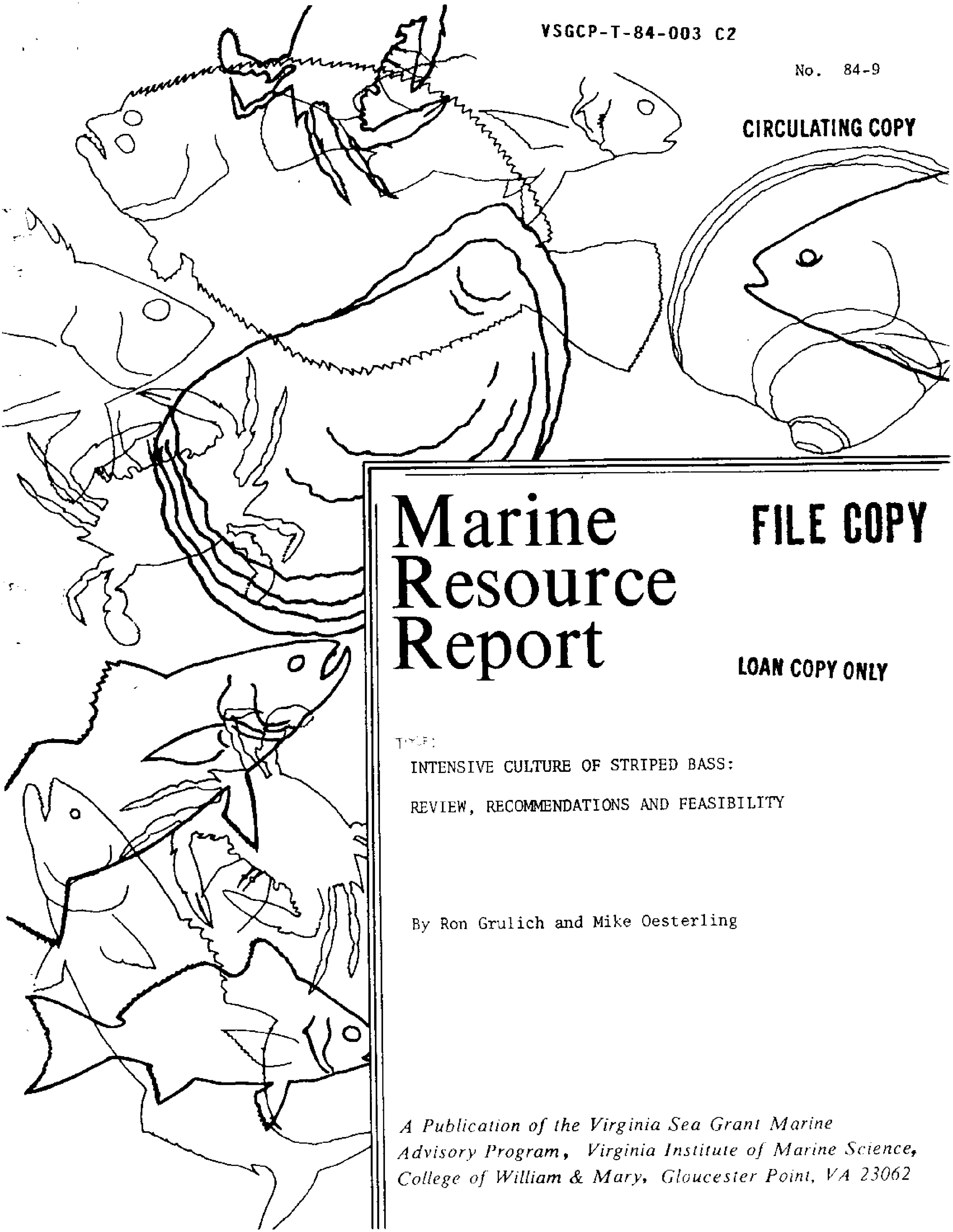
Marine Resources Report No. 84-9



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INTRODUCTION

The striped bass, Morone saxatilis (Walbaum), is an anadromous fish which orginially inhabited the Atlantic Coast of North America, and the Gulf of Mexico from Florida to Louisiana. Because of its potential for great size (over 50 pounds), fighting strength and excellent taste, it has long been prized as both a recreational and commercial species. Early in its exploitation concern was expressed over apparently dwindling stocks. This prompted attempts at population enhancement either by transplanting fish from one area to another or by means of culturing for stocking purposes.

The first successful striped bass enhancement occurred in 1879 when fingerlings were seined from New Jersey's Navesink River, transported by train across the continent and released into San Francisco Bay. A breeding population was subsequently established in San Francisco Bay. In 1906 the Bureau of Biological Services (precursor of the U.S. Fish and Wildlife Service) built a prototype striped bass hatchery in Weldon, N.C. Wild-caught brood fish were successfully spawned at the Weldon facility, but other attempts elsewhere failed. Following these failures interest in striped bass culture waned until 1954 when it was discovered that the Santee-Cooper Reservior, a freshwater impoundment in South Carolina, was supporting a reproducing population. This discovery prompted the South Carolina Wildlife Department to construct the Moncks Corner Striped Bass Hatchery. This facility was not immediately successful, primarily due to the continued dependency on wild-caught, ripe broodstock. Several years later a major breakthrough in striped bass culture occurred when personnel at the Moncks Corner Hatchery successfully induced ovulation. This freed the culturist from the need to harvest ripe broodstock. Close on the heels of the break-through, Moncks Corner personnel achieved a viable hybridization of striped bass females and white bass (*Morone chrysops*) males.

Since these developments knowledge of the conditions required for the culture of striped bass and its hybrids has increased tremendously. Much has been written in scientific literature regarding all aspects of striped bass culture. Bonn *et al* (1976), under auspices of the Striped Bass Committee of the Southern Division of the American Fisheries Society, compiled the authoritative text, *Guidelines for Striped Bass Culture*. Included in this text are discussions of hatching facilities; broodstock sources; capture and handling; spawning, incubation, and transportation of eggs and larvae; pond culture; intensive culture; hybrids; and parasites and diseases. During 1983, a conference on striped bass culture produced, *The Aquaculture of Striped Bass: A Proceedings* (J. P. McCraren, ed., 1984), which reviewed the current status and pertinent information on striped bass/hybrid culture.

Besides published information there are other sources of assistance to the potential striped bass aquaculturist. In most cases these sources are publicly supported and hence available at no cost. Each coastal state has a state/federally supported Sea Grant Marine Advisory Program with either the appropriate technical assistance or ties to sources of information. The Mid-Atlantic region is fortunate in having the Pamlico Estuarine Laboratory and Aquaculture Demonstration Facility located in Aurora, North

Carolina. This laboratory maintains a demonstration striped bass culture operation, as well as conducting research on striped bass culture technology. Mr. Randy Rouse of the laboratory has provided much of the practical culture information contained in this document. Other sources of information will be referenced at the end of the document.

Striped bass culture throughout the United States is in a period of resurgent activity. Commercial ventures are now being tried in California, Florida and New York. As of 1981 there were 17 state or federal hatcheries devoted to the production of striped bass fingerlings for wild stocking programs (McCraren, 1984). During that year over 40 million fingerlings were stocked in 456 reservoirs and 15-20 inland streams in 36 states (McCraren, 1984). These stocking programs have been so successful, and natural recruitment so poor, that it's estimated that more cultured stripers are now caught than wild fish!

Striped bass culture technology has advanced to the point where it can be practiced most anywhere. There are, however, many factors to consider when choosing a site for a culture facility. For this analysis, it is assumed that it will not be necessary to purchase land, but only find a suitable site on already owned property. If this were not the case, land costs and financing would figure prominently in site selection.

The factors that will be addressed here can be divided into three categories: environmental; political or legal issues; and availablity of support services. Rather than presenting a detailed examination of all the criteria, an outline will be presented. It will be the job of the potential culturist to follow-up on the individiual considerations.

I. Availability of support services easiest to handle.

A. Utility connections

1. electric service

a. cost to connect

b. operational costs

2. telephone service

a. cost to connect

b. operational costs

3. water, other than for culture system

a. availability

B. Labor source

1. availability of experienced or trainable personnel

2. wage structure compatible with local industry

C. Ancillary services

1. transportation links (consider ease of shipping product or receiving supplies)

2. availability of equipment repair services

3. solid waste management availability

4. septic system or severage

II. Political or social considerations may cause delays in construction or result in changes in site or operational plans.

A. Local zoning regulations

B. Permits

1. building permits

2. operational (business) license

3. water use/disposal permits (including pond construction)

4. county/state wetlands ordinances

5. Marine Resources Commission

C. Acceptability by neighbors, local residents or businesses

1. resistence could prolong permitting

2. security problems

D. Legal framework of "company" (i.e. corporation, partnership, etc.)

E. History

1. special concern of Virginia due to prominence in American history

2. consider proximity of historical or religious sites

III. Environmental factors ultimately decide the feasibility of culturing activities and will dictate the method used.

A. Sufficient quantities of good quality water

1. wells, surface water, municipal

2. because of importance will be addressed separately

B. Topography and condition of land

1. susceptibility of flooding caused by either heavy rains or river overflow

2. avoid slopes and hills in favor of more level sites (reduces cost of site preparation)

3. wooded versus cleared

4. past uses of land (identify presence of residual herbicides or pesticides in soil)

C. Expansion capabilities

1. plan for future growth

D. Natural predators in area

Concurrent with site selection and figuring into the site selection process, a decision must be made as to the type of culture operation. There are three basic types to consider: pond culture; cage culture (net or wire); and raceway systems. This analysis will discount pond culture as requiring too much land and will concentrate on cages and raceways. Since we were first approached with the idea of cage culture in a flowing river system, this will be addressed first.

A considerable amount of information exists on experimental (or research scale) cage culture of striped bass (Powell, 1973; Valenti, et al.

1976; Williams, et al. 1981; Woods, et al. 1983). While growth has been demonstrated and potential does exist, this technique may not be desirable for other reasons. For a complete overview of the advantages and disadvantages of cage culture in general, the reader is referred to Huguenin and Ansuini (1978).

In this situation, when considering potential cage culture sites within river systems (e.g. Pamunkey or Mattaponi River) certain problems can be highlighted.

1. A surface water system carries the potential for biofouling problems. Chesapeake Bay and its tributaries are notorious for summer fouling. In order to maintain proper water quality within the cages there would need to be increased care and cleaning thereby raising maintenance costs.

2. Since it is a river system attention must be given to drifting debris, either during normal conditions or periods of heavy flow following rainfall or seasonally. This requires that some form of protection be afforded the cage, both at the surface and throughout the water column. This will increase the initial cost and maintenance requirements.

3. Consideration must be given to varying tidal and river currents when deploying the cage in order to prevent distortion or movement.

4. In the natural environment, culture animals will continually be exposed to potential diseases or parasites.

5. The accessibility to the culture animals will be greatly decreased, making even routine inspection time consuming and difficult.

6. The risk of "catastrophic" failures of construction materials increases with length of time in the water.

7. Expansion capabilities would be severely limited within either river.

8. Feeding must be increased (and hence cost) due to reduced availability of food to the fish (currents continually flushing food out of the cage).

9. Depending upon the type of cage and mooring requirements, cage culture can become quite expensive initially.

10. There is a legal question about usage of "navigable" waters for aquaculture that has never been approached in Virginia. This could become a politicial nightmare.

From their experiences, it is the current belief of personnel at the Pamlico Laboratory that the disadvantages to cage culture of striped bass outweigh the advantages.

Raceways (primarily circular tanks) are currently being employed in commercial striped bass ventures in Florida and New York. Circular raceways appear to be the most feasible method for striped bass culture at this time for a number of reasons.

1. They allow for a greater choice in site selection since most raceway operations employ well water.

2. Striped bass in raceways are much more accessible than in cages. They are also easily observed permitting almost constant evaluation of condition.

3. Pest organisms (e.g. fouling organisms, competitors or predators) are excluded or can be controlled.

4. Food can be concentrated to insure accessibility to the fish. This can decrease food costs while increasing growth (i.e., favorable food conversion ratios).

5. Diseases can be controlled, prevented or treated more expeditiously.

6. Routine maintenance is much easier.

Based on these factors, it is recommended that raceway culture using circular tanks be the method chosen. Remaining discussions will be based on this assumption.

As mentioned previously, water quantity and quality are the foremost environmental considerations to site selection. Essentially there are two sources to consider: surface waters (rivers or ponds) or underground water (wells).

In this analysis there are two potential sources of surface water, the Pamunkey or Mattaponi River. We feel that there are many disadvantages to using these water sources.

1. It will require that the facility be located relatively close to the source. This obviously restricts choice of culture site. There are also legal aspects and potential problems in locating close to a river, e.g. permitting and flooding.

2. Already mentioned are the problems associated with using "natural" water systems. To reiterate, these include biofouling, clogging of intake by debris, diseases and parasites and siltation or mud problems.

3. The water temperature and salinity will fluctuate widely over the course of the year. Additionally, salt water may not be desirable at all, depending on the choice of "fish" (to be addressed).

The use of well-water has both advantages and disadvantages. These are enumerated below.

ADVANTAGES

1. Use of well-water allows great flexibility in site selection. It frees one from waterfront property; reduces potential legal constraints; and reduces the potential for catastrophic natural events (flooding).

2. Well-water generally is "sterile" in regards to biofouling organisms, parasites and disease organisms.

3. Ground water tends to maintain a fairly constant temperature over the year.

4. Other chemical considerations, such as salinity, pH and hardness, remain constant over the year.

DISADVANTAGES

1. There is an initial, one-time expense for the well. However, this can be depreciated or used in other ways for tax purposes, eventually recovering the cost of the well on taxes.

2. Well-water is usually devoid of oxygen. This can be corrected by choosing a method of water introduction to the culture tank that assists in oxygenating the water. It will also require that supplemental aeration be provided. This adds the expense of an air compressor (blower), which can also be recovered through taxes. (The blower would be necessary regardless of water source to insure saturation of dissolved oxygen and to prevent stratification.)

3. Care must be taken that the well-water is not contaminated by toxic chemicals of any kind. This most likely will not be a problem.

It is the recommendation that well-water be used for this culture venture. All potential disadvantages can be easily overcome or used to the culturist's advantage.

The succesful hybridization in 1965 of striped bass and white bass (Morone chrysops) and the high quality of the hybrids (i.e., favorable eating characteristics) now offers potential culturists with a choice of "fish." Earliest attempts at striped bass culture used only pure striped bass strains. More recently most research has focused on hybrids. There have been 19 different hybrids that have been identified. However, we will consider the original cross of striped bass females-white bass males when we use the term hybrid.

There are many reasons for this increased interest in the use of hybrids in culture situations; the more important of these follow.

1. Hybrids exhibit faster early growth than pure striped bass. Hybrids can reach 3" in length within 7 weeks.

2. Hybrid fingerlings are not as "excitable" as pure fingerlings making them easier to handle.

3. Hybrids tend to have a greater general "hardiness."

4. Hybrids adapt well to intensive culture and generally have a better survival rate in culture situations than do pure striped bass.

5. By using hybrids it may be possible to circumvent legal contraints on striped bass (size, seasons, limits, etc.).

It is recommended that hybrids (original cross) be used in this culture venture. All further discussions will be based on this assumption. The terms striped bass and hybrids will be used interchangeable for the rest of this report.

Raceways (circular tanks) can be constructed of a variety of materials. Low-cost raceways can be constructed as described by Woods et al. (1981). These tanks are currently in use at the Pamlico Laboratory. It is recommended to utilize these tanks for this venture; a description of these tanks follows.

Circular flow-through tanks holding approximately 10,000 gallons of water can be constructed from sections of galvanized steel grain bins measuring 24′ in diameter and 4′ in height. These sections range in price from $300 to $500; lower range is for "defective" sections. Inside this frame a packed sand or dirt bottom is graded to slope towards a center drain. It is important to "sterilize" this bottom to prevent nuisance weeds, such as nut grass, from puncturing the liner. The sections are made watertight by adding polyvinyl liners (6′ high on sides; 20 mil in thickness; $125-200), similar to swimming pool liners. Prior to placing the liner inside the galvanzied section a split-hose "cushion" should be added to the top edge of the metal frame. This will help prolong the life of the liner. It is estimated that the galvanized section will last 50 years and the polyvinyl liner 5 years (Woods et al. 1981). Water is introduced at 2 points opposite of each other and in such a manner as to create a circular flow. It is advisable to design for maximum aeration. One method is to incorporate a venturi aspirator at the water inflow. The depth of water in the tank is controlled by an exterior stand-pipe connected underground to the center drain. This configuration permits easy regulation of depth and does not present obstructions in the tank. A wire mesh screen covering the central drain prevents fish escape and permits more efficient cleaning of the tank. Gaskets and flanges around the drain prevent leaks.

The remainder of this section will cover a wide range of topics dealing with practical aspects of the culture operation. Information will be presented covering culture criteria and operational considerations. Topics will be presented separately for easy reference.

Fingerling Source

It is felt that attempting to spawn, hatch larvae and produce fingerlings is beyond the present scope of this project. Therefore, fingerlings must be obtained from commercial sources. In a recent publication by Jim Ayers of the National Marine Fisheries Service entitled National Aquaculture Directory (1984) over 35 firms are listed as handling striped bass. In order to obtain information regarding fingerling availability it was necessary to contact a producer. From information we've gathered one firm is the leader in production of hybrid fingerlings. That firm is Florida Fish Farms, Inc., (2137 SE 5th Street, Ocala, Florida 32671, 904/629-1175). (Mention of names does not imply endorsement.)

Information on fingerlings was provided by personnel at Florida Fish Farms (Jim Smith, personal communication, 25 September 1984).

Florida Fish Farms have hybrid fingerlings available from April through July, occasionally in August. Orders must be placed prior to the end of the year preceeding the time needed. Florida Fish Farms only produces enough fingerlings to cover their orders (i.e. no excess production). They also require 1/2 the price of the fingerlings at the time of ordering. In the past they have supplied 3" fingerlings, however, their current plans call for producing for sale fingerlings in the 1"-1 1/4" range. Average price per fish will be 20 cents, FOB Ocala. With orders over 100,000 price is negotiable. Transportation of fingerlings to Virginia is estimated to be approximately $1200 by truck or $800-$1,000 by air.

<u>Water Flow</u>

Striped bass are rheotactic and swim against a current (McCraren, 1984). For this reason flow should not be so great as to cause over-exertion or stress of the fish. In the same vein, however, flow should be sufficient enough to prevent excessive buildup on the tank bottom of debris, waste materials and uneaten food. Flow rate at the Pamlico Laboratory is approximately 16 gallons/minute/tank which effectively replaces total tank volume every 10.5 hours. Initially this flow rate should be used and then adjusted accordingly as the situation demands.

<u>Dissolved Oxygen</u>

Oxygen levels in the water are critical for proper growth and survival of striped bass. Low levels of dissolved oxygen reduces food consumption and decreases growth rate; fish also become more susceptible to parasites, diseases and shock. Dissolved oxygen levels should be as close to saturation as possible. It is recommended that dissolved oxygen be maintained above 5 parts per million, preferably in the range of 6-7 parts per million. During winter months care should be taken to avoid supersaturation which could lead to gas bubble disease and death. In order to insure proper oxygen levels it is recommended that supplemental aeration be provided to each tank. During warmer months this aeration can also help prevent thermal stratification within the tanks. A blower unit is included within the economic evaluations.

Water Hardness and pH

When using well-water total hardness of the water must be considered. It is desirable to have a value above 150 ppm; Pamlico Laboratory water is 250 ppm, mostly calcium carbonate. Low hardness (soft water) can cause problems from acidification of the water due to carbon dioxide from respiration and nitrogenous waste products. It is recommended that water pH be between 7.5 and 8.5, although pH as low as 6.7 have been reported as causing no deleterious effects (Lewis and Heidinger, 1981).

Nitrogenous Metabolites (Waste)

Normal bodily functions of the fish plus any uneaten food contribute nitrogenous compounds to the culture water. If permitted to accumulate toxic levels could result. Although in a flow-through system this should not occur, care must still be taken during warmer months to prevent unnecessary bottom buildup. This may mean increased cleaning and maintenance. The use of the central bottom drain combined with a circular water movement will help flush organic waste from the tank.

Temperature

Next to dissolved oxygen, water temperature will have the greatest effect on fish growth. Many studies have related temperature and growth rate. Rather than detail these a synopsis of information will be provided.

Growth rate of striped bass will vary over the course of a year. Cooler temperatures slow growth; warmer temperatures speed growth. Also to be considered with growth rate is the efficiency with which food is converted to fish flesh. Basically, striped bass show little or no growth below 10°C (50°F) (Setzler et al. 1980). Studies using elevated temperature water from power plant effluent showed an increased growth with increased temperature, but also showed a need for more food at elevated temperatures (McCraren, 1984). It has been discovered that the best growth/food conversion temperature is about 19°C (66.2°F). (See Table 1).

Table 1. Mean initial and final length and weight, food consumption, and food conversion efficiency of white x striped bass hybrids cultured for 30 days at various temperatures (developed from Woiwode and Adelman in McCraren, 1984).

culture T (°F)	average initial length(")	average final length(")	average initial weight(g)	average final weight(g)	average food consumed(g)	average conversion efficiency(%)
51.8	3.6	3.8	7.6	9.3	59	27
59.0	3.8	4.3	9.3	14.1	144	36
66.2	3.9	4.8	10.1	20.4	220	51
73.4	3.8	5.2	9.3	28.2	413	50
80.6	3.7	5.5	8.7	36.0	623	48
87.8	3.7	5.4	8.3	38.6	763	44
95.0	3.7	4.2	8.7	18.4	362	29

Because of this growth-temperature relation there will be differential growth over a year (See Figure 1). This will affect the feeding rate, which will be discussed next. However, by using well-water it is hoped that a more constant water temperature will be achieved permitting a longer growing season.

Food

The complete nutritional needs of hybrid striped bass are unknown. Hence, there is no striped bass "chow" available. Currently there is research underway to develop a specialized diet for striped bass. Until this is ready other feeds must be used. One feed being used by several facilities is Zeigler Brothers, sinking "Trout Grower, 36% protein" (Zeigler Brothers, Inc., P. O. Box 95, Gardners, PA 17324, 717/677-6181). Current price for this feed is approximately $8.00 per 50 pounds. Since this firm is reliable and relatively close (reduced transportation costs), in the economic analysis it will be assumed that this feed is being used.

Cultured fish are fed daily an amount based upon their body weight. This is expressed in terms of percent body weight rather than in absolute weights of food. Most sources recommend feeding between 3% and 5% of body weight daily during the summer months and "as much as they will eat" during the winter when feeding and growth slows. The following data were adapted from Williams et al. (1981) and serves to illustrate feeding strategies for one circular raceway, taking into account water temperature and different feeding rates.

Month	Total Fish WT (kg)	Feeding Strategy (% body wt. fed daily) (kg) 1%	2%	3%	4%	5%
July 1979	8.89	.09	.18	.27	.36	.45
Aug.	90.0*	.9	1.8	2.7	3.6	4.5
Sept.	190.0*	1.9	3.8	5.7	7.6	9.5
Oct.	325.41	3.25	6.51	9.76	13.0	16.27
Nov.	425.0*	4.25	8.5	12.75	17.0	21.25
Dec.	430.0*	4.3	8.6	12.9	17.2	21.5
Jan. 1980	445.0*	4.5	8.9	13.35	17.8	22.25
Feb.	443.0	4.43	8.86	13.29	17.72	22.15
Mar.	450.0*	4.5	9.0	13.5	18.0	22.5
Apr.	454.08	4.54	9.08	13.62	18.16	22.70
May	490.0*	4.9	9.8	14.7	19.6	24.5
June	452.89	5.43	10.86	16.29	21.72	27.14
July	644.53	6.45	12.89	19.34	25.78	32.23

*estimated

Month	# Days	Total Amount (kg) Fed During Month Assuming 1%	2%	3%	4%	5%
July 1979	26	2.34	4.68	7.02	9.36	11.7
Aug.	31	27.9	55.8	83.7	111.6	139.5
Sept.	30	57.0	114.0	171.0	228.0	285.0
Oct.	31	100.75	201.5	302.25	403.0	503.75
Nov.	30	127.5	255.0	382.5	510.0	637.5
Dec.	31	133.3	266.6	399.9	533.2	666.5
Jan. 1980	31	139.5	279.0	418.5	558.0	697.5
Feb.	28	124.04	248.8	372.12	496.16	620.2
Mar.	31	139.5	279.0	418.5	558.0	697.5
Apr.	30	136.2	272.4	408.6	544.8	681.0
May	31	151.9	303.8	455.7	607.6	759.5
June	30	162.9	325.8	488.7	651.6	814.5
July	20	129.0	258.0	387.0	516.0	645.0

Month	Assumed Feeding Strategy Based on Water T	Total Food (kg) Fed During Month
July 1979	5%	11.7
Aug.	5%	139.5
Sept.	5%	285.0
Oct.	4%	403.0
Nov.	3%	382.5
Dec.	1%	133.3
Jan. 1980	1%	139.5
Feb.	1%	124.04
Mar.	1%	139.05
Apr.	4%	544.8
May	5%	759.5
June	5%	814.5
July	5%	645.0
	Total	4521.39

In Williams et al. (1981) they estimated that their food conversion (dry weight of food/wet weight of fish) was approximately 2.1. If this value is used, the above amount of food (4521.39 kg) could have produced approximately 2153 kg (4737 pounds) of fish. Other researchers have reported much better conversion rates for hybrids which would yield a greater weight of fish for the same amount of food. Kerby et al. (1983) estimated conversions ranging from 1.47 to 1.73; using the above values, these would yield 3075.8 kg (6766.7 lbs.) and 2613.5 kg (5749.7 lbs.), respectively. Woods et al. (1983) estimated a conversion of 1.58; 2861.6 kg (6295.6 lbs.).

Stocking Density, Standing Crop and Survival

There have been as many different initial stocking densities as there have been striped bass culture studies. Lewis and Heidinger (1981) stated, "To date the optimum density (kg fish/m^3) has yet to be determined for striped bass." They further state, "To maximize the efficiency of the rearing tanks, the fish should be crowded into them (with corresponding increase of flush rates) up to the point where water velocity is not excessive or growth of the fish is not inhibited by the high density." Stocking densities for research purposes have ranged from .1g of fish/gallon of water (Williams et al. 1981) to 33.8g of fish/gallon of water (Woods et al. 1983), with equal success. Likewise the initial size of fish (g/fish) has varied: Powell (1973) used 9.6g fish; Wawronowicz and Lewis (1979) used 10g fish; Williams et al. (1981) used 1.0, 2.1, and 3.0g fish; Kerby et al. (1983) used 20g fish; Woods et al., used 44.6g fish. The information developed above for feeding strategies was taken from Williams et al. (1981) stocking of 3.0g fish.

From the research of Kerby et al. (1983) and Woods et al. (1983) there appears to be an inverse relation between initial stocking density and the mean weight of individual fish at harvest. Kerby et al. (1983) stocked in what they called low (10000 20g fish/hectare) and high (15000 20g fish/hectare) densities. At harvest, 13 months later, 72% of the fish in the high density pond were considered to be market size (over 300 grams), while 94% in the low density ponds exceeded 300 grams. They state:

> "There was an inverse relation between mean weight of individuals and final harvest density. At harvest, average weight of fish in the low density ponds (465g) was greater than that of fish in the remaining high density pond (350g). However, the standing crop was much greater

in the high density ponds (4,886 kg/ha compared to a mean of 2,1312 kg/ha)." (Kerby et al. 1983).

Woods et al. (1983) report similar findings under different culture conditions (Kerby et al. used ponds, Woods et al. used net cages). At harvest, the mean weight of fish stocked at 100 45g fish/m^3 was greater (352g) than that of fish stocked at 150 45g fish/m^3 (335g) and fish stocked at 200 45g fish/m^3 (311g). Standing crop, however, exhibited a linear relation (positive); low stocking density yielded 32.6 kg/m^3, medium stocking density yielded 47.6 kg/m^3, and high stocking density yielded 57.7 kg/m^3.

Survival to harvest has not been a problem in experimental conditions, with exceptionally good rates being achieved. Powell (1973) in his flow-through raceway experiment reported 94% survival after 93 days; his cages were even better at 98.5% to 99.5%. Wawronowicz and Lewis (1979) after 441 days in ponds had 91.8% survival. Using large net cages (13.6 m^3), Williams et al. (1981) had 88% survival after 380 days. Woods et al. (1981) had 88% survival after 380 days. It is not unreasonable to assume that survival to harvest values of 80 to 90 percent cannot be regularly obtained.

We are still left with the question of stocking strategy for circular raceways. After analysizing reported stocking densities and discussions with personnel at the Pamlico Laboratory, the following stocking strategy is recommended. Initial stocking density should approximate 1.0g of fish/gallon of water. Essentially this becomes 1 fish/gallon when using 1 1/4" fingerlings. We suggest starting with 3 raceways with 10,000 fish per raceway. After 3-4 weeks of growing time grade the fish and distribute them among 6 tanks (approximately 5000 fish per tank). Following 3-4 weeks a final grading will take place, with fish being distributed among 12 tanks (about 2500 fish per tank). This will be the final number of fish per tank until harvest. If we assume only 2000 fish per tank survive (80%), we can construct a table of possible standing crop depending upon average fish weight.

Average Fish Weight (G)	Standing Stock in Kg (Pounds)	
300 g	600 kg	(1320 lbs.)
310	620	(1364)
320	640	(1408)
330	660	(1452)
340	680	(1496)
350	700	(1540)
360	720	(1584)
370	740	(1628)
380	760	(1672)
390	780	(1716)
400	800	(1760)

Diseases, Predators and Vandalism

Diseases and/or parasites are the least of the problems in striped bass culture. According to A. J. Mitchell (in McCraren, 1984):

"Infectious diseases pose few problems in the culture of striped bass, even though 70 parasitic and disease agents of the species are known. Many of these pathogens are present continually in culture situations, particularly ponds. For a disease outbreak to occur, stressful conditions on the fish and optimum environmental conditions for the disease organism are required. The key to preventing disease lies in maintaining a suitable environment for the fish, supplying a good diet, imposing no undue stress, and using prophylactic treatments when stress cannot be avoided."

Predation, primarily by birds such as kingfishers and ospreys, will need to be prevented. Raceways can be covered with netting to help exclude predators. Additionally traps (for mammal predators) or "scare-crows" may be used to help reduce predation. The best way to limit predation losses is to be prepared to deal with any possible predator.

Vandalism and theft may also be a distinct problem. Security measures may be necessary depending upon location, facility accessibility and other factors.

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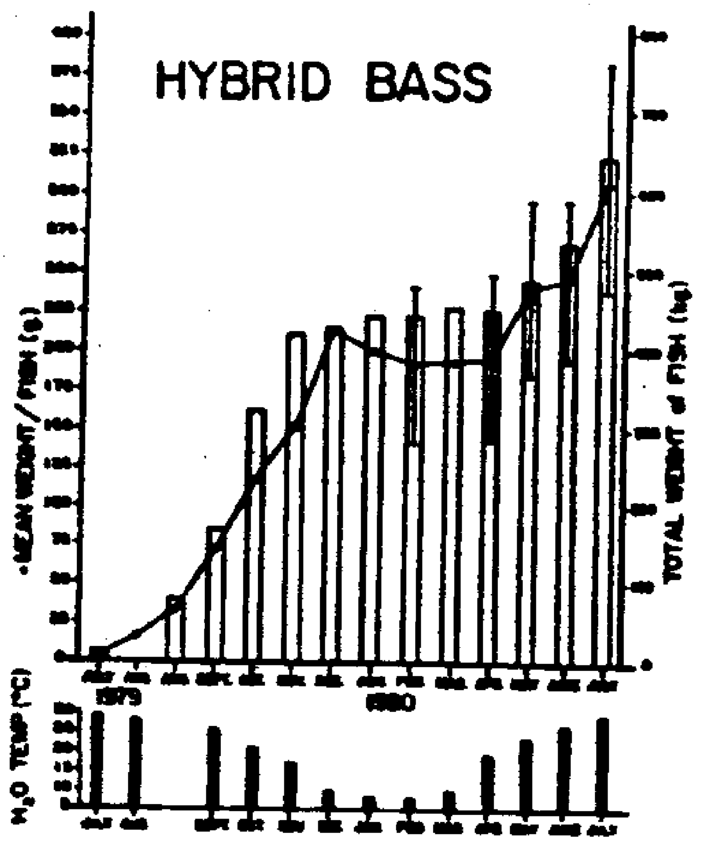
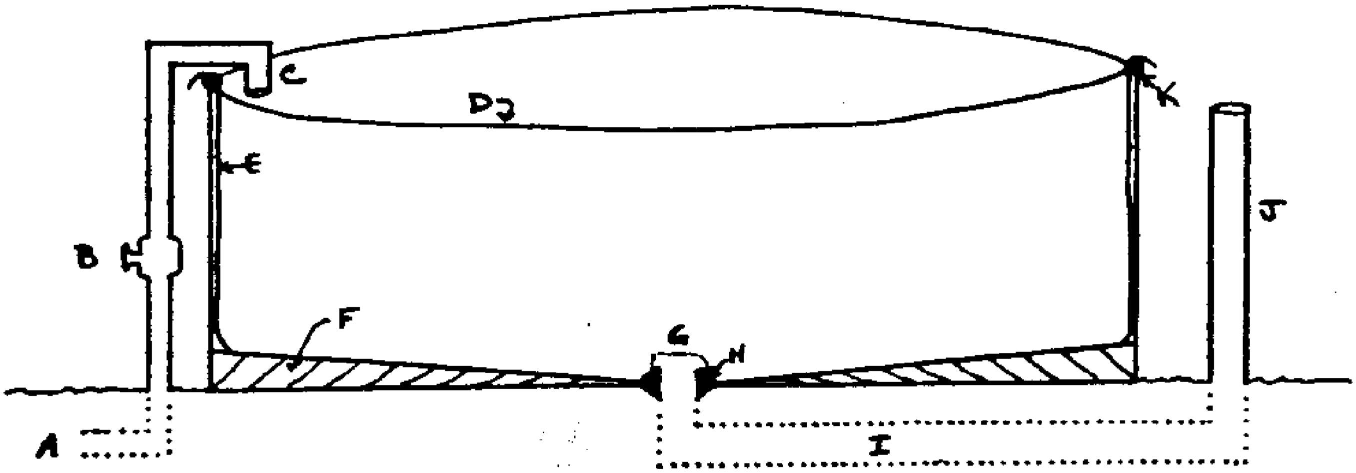


Increases in weight (mean ± s.d.) and standing crop (bar graphs) of striped bass x white bass hybrids reared in salt-water net-pens in South Carolina in relation to time and temperature, July 1979–July 1980.

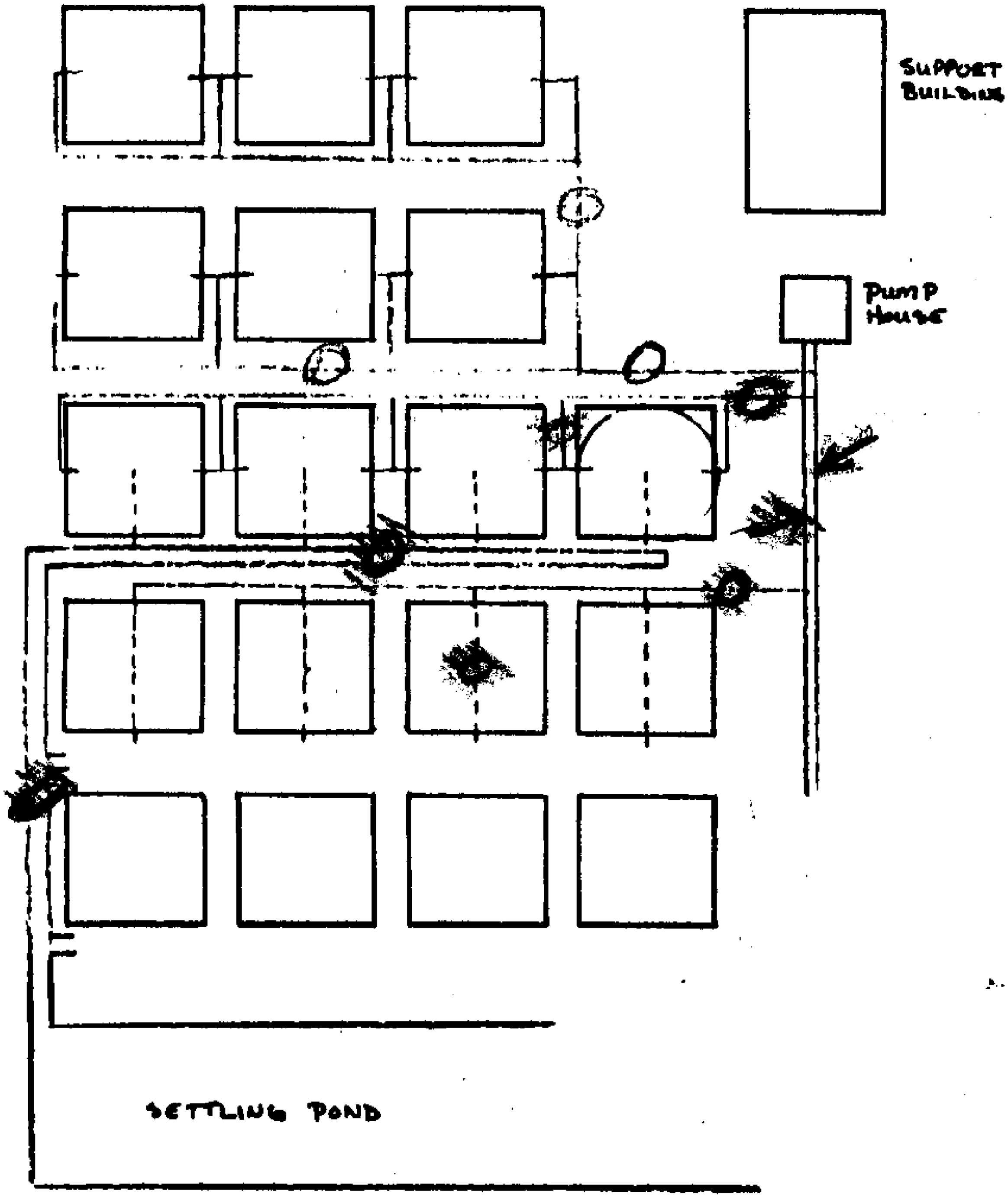
Figure 1. Taken from Williams et al. 1981.

DRAWING 1.



A = WATER INFLOW FROM PUMP
B = CONTROL VALVE
C = WATER INPUT
D = METAL FRAME
E = LINER
F = PACKED SAND FLOOR
G = WIRE SCREEN
H = FLANGED COUPLER
I = UNDERGROUND DRAIN
J = STAND PIPE
K = HOSE "CUSHION" AROUND METAL

DRAWN AFTER WOODS et al. 1981. NOT TO SCALE



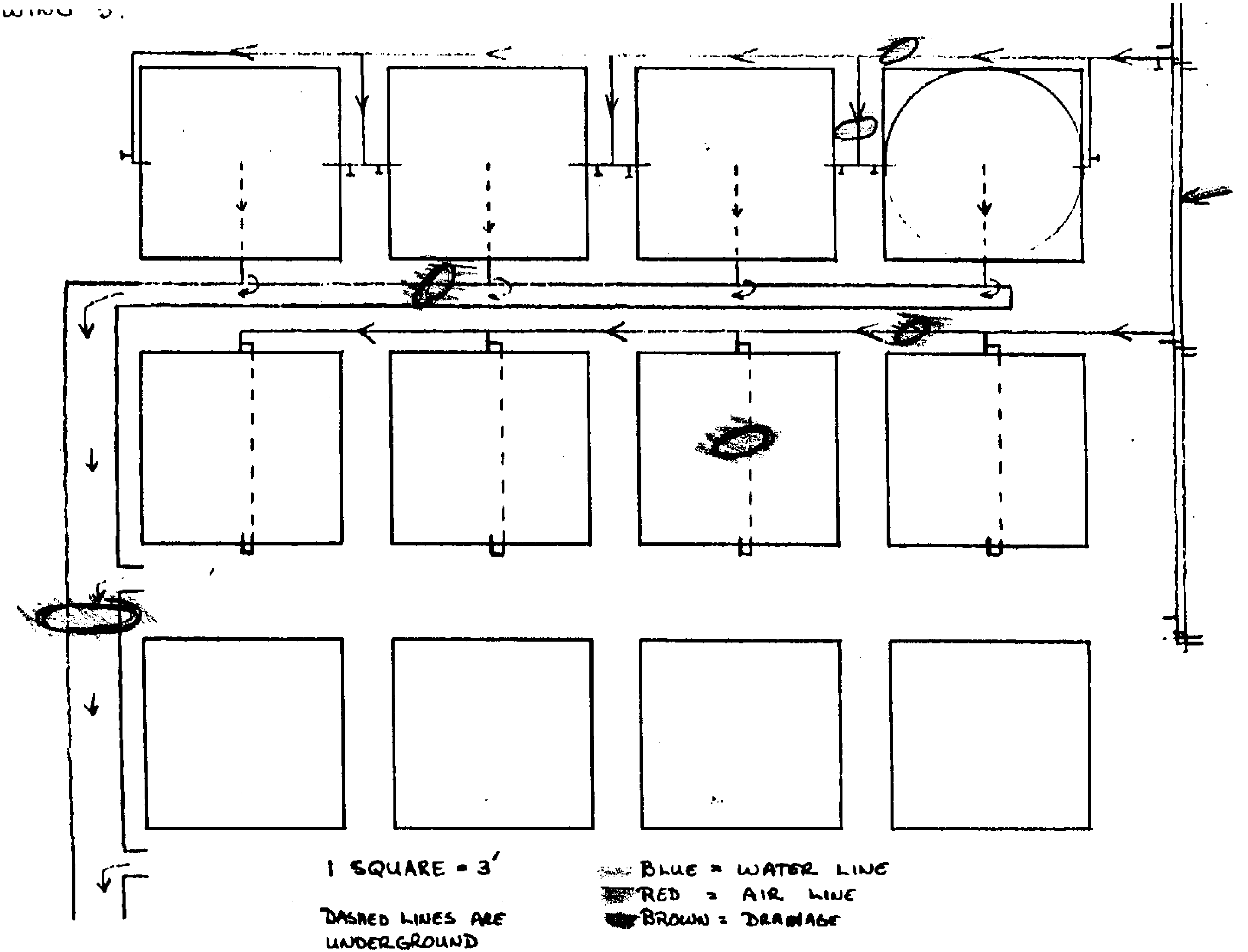
1 SQUARE = 6'

BLUE = FIRST PHASE WATER
YELLOW = EXPANSION WATER/AIR
RED = FIRST PHASE AIR
BROWN = DRAINAGE

DRAWING REPRESENTS 1/2 OF TANK ARRAY.

TOTAL AREA NEED
2 - 3 ACRES (DEPENDING UPON FUTURE PLANS AND SIZE OF SETTLING POND)

DRAWING 3.



1 SQUARE = 3'
DASHED LINES ARE UNDERGROUND
BLUE = WATER LINE
RED = AIR LINE
BROWN = DRAINAGE

Key Factors Affecting Project Profitability

Much research has been conducted on the commercial culture of striped bass. This research has resulted in the establishment of several aquaculture facilities in various regions throughout the United States. Even though these projects appear to be economically viable, any attempt to start up a new project with individuals who are inexperienced in aquacultural techniques is an inherently risky business. The key biological factors have been outlined earlier in this report. This section will outline the elements affecting this project's viability as a business venture.

The project will be dependent on outside sources for the fingerlings necessary to stock the raceways. Initially, it may be possible to obtain free or low cost fingerlings from government hatcheries because the project will be constructed and operated on an indian reservation. Nevertheless, the ultimate goal of this project will be to develop a self-sustaining, economically viable operation. Since a substantial number of fingerlings will be necessary to sustain the operation, it is best to consider the problems of securing long-term supplies of fingerlings.

The project is designed to employ low skilled labor so it will not be possible to hatch and grow fingerlings on site. Therefore, the operation will be dependent on outside sources for juvenile striped bass. Several sources of striped bass fingerlings were contacted and the suppliers interviewed indicated that juvenile fish could be secured if the project can provide expected stocking dates sufficiently far enough in advance to plan spawning activities. Expected prices for striped bass hybrids are expected to average between 20 and 50 cents apiece including transportation. By giving adequate notice and using volume discounts the project can expect to pay a price on the lower end of this price range. If the time schedules for stocking are not established well in advance of the stocking date, it may be very expensive, if not impossible to secure enough fingerlings to properly stock the raceway systems. Proper planning is critical since most commercial sources of fingerlings require a downpayment before they will commit to deliver product by a specified date. If the purchaser is unable to take delivery, the downpayment will be forfeited to the supplier.

Another key factor affecting the project's profitability is the survival of fingerlings from the initial stocking date until they reach marketable size. Preliminary research indicates that striped bass hybrids are extremely hardy creatures, and with adequate feeding and care, a very high success rate can be expected. Recent studies have shown that a survival rate of 90% is a reasonable target range for this type of operation. Since this project will begin with an unskilled labor force, the economic analysis will provide projected returns based upon a range of 70 to 90 percent survival. Potential investors should expect to reach the upper end of this range by the end of the first production cycle.

Under normal circumstances striped bass hybrids can be expected to achieve very high survival rates. Unfortunately, even in the best run systems the possibility exists that a catastrophic accident will occur which can have a significant impact on the captive striped bass population. It is possible that a pump failure could subject the fish to adverse water quality conditions or a sudden outbreak of disease could infect the system. Fortunately, it is possible to secure insurance covering the crop much as a farmer would insure his crops. The cost of this insurance has been included in the annual operating costs of the project.

One of the key factors in total system performance is the stocking density in the individual raceways. There is a definite relationship between the stocking density, the food conversion ratio and growth rates. The final population density in each raceway is expected to be approximately 3000 fish (1.2 g./gallon). It is expected that the fish will be harvested at 340 grams, approximately 3/4 of 1 pound. It is anticipated that the hybrids will take 14-16 months to reach marketable size. In addition, a 2 to 1 food converstion ratio is expected based upon recent studies with similar stocking densities.

Once the system is established it may be possible to increase stocking densities without increasing the growout period or decreasing the hybrid's food conversion efficiency. If the fish can be stocked at higher levels it will have a significant impact on total return on assets. It would be presumptuous to anticipate the impacts associated with increasing stocking density, but one of the first experiments which should be carried out at the facility should be to determine the most profitable stocking options.

The success of a striped bass growout facility will be determined to a large extent by management's ability to anticipate problems, plan for future needs, and to meet these needs with timely actions. As was indicated earlier a significant lead time is necessary to secure supplies of fingerlings. Once the contract is finalized, facility construction must be completed on time in order to avoid penalties that would result from postponing delivery of the initial stock. The proper start-up period is critical to achieving the best growth rate from the hybrids. If the operation does not take fingerlings in the spring, it may result in a significant increase in the length of time necessary to reach marketable size. This would increase the cost to produce the fish and reduce overall return on investment. Management's ability to plan for the procurement of adequate food supplies and to schedule preventive maintenance will also be critical to maximizing project profitability.

There are several operational costs which may have a significant impact on the project's success. Food is expected to be the largest operational cost associated with the project. It is expected that commercial trout feeds will be used. The current price of this feed is $8.00 per 50 pound bag. It may be possible to obtain volume discounts once the facility is fully operational.

Labor will be a significant cost in the business venture. One full-time manager, one full-time laborer, and one part-time laborer will be employed in the project. These costs will not vary significantly if the project is expanded to accommodate 36 tanks or if stocking densities are increased. Therefore, the ultimate goal of the project should be to increase the throughput of the facility to take advantage of the available labor force.

Energy costs will be signficant since the facility will use fresh water pumped from a well. Water will be pumped constantly to maintain all important water quality parameters. Initial flow rates are expected to be approximately 200 gallons per minute. This rate may have to be increased if stocking densities are raised. Initial electricial usage is estimated to be 100 kwh per day. Since local electricial rates are .08 per kwh the expected daily cost for electricity is $8.00.

Since the striped bass operation will be established in an undeveloped section of an indian reservation, certain costs will be incurred that might be reduced if the culture operation were established in conjunction with other commercial activities. For instance, the project includes funding for a combination office/warehouse facility, electricial hook-up, site preparation, well drilling, as well as the fixed costs of purchasing and constructing the raceways. The level of fixed costs involved in establishing this facility make it imperative that it be laid out in such a manner to permit the construction of additional raceways to increase the productive capacity of the project. In addition, it is extremely important to schedule the stocking of the raceways to permit maximum growth in the shortest period of time as well as making the maximum use of the raceways (i.e. minimizing the time that raceways are empty between crops). Since a high level of fixed costs are necessary to construct the facility and the incremental costs of building additional raceways are relatively small, it is our opinion that the ultimate plan should be to construct more raceways in the future to try to spread the fixed costs of investment over more pounds of fish by increasing throughput levels. If total system capacity and crop turnover can be increased the fixed cost burden becomes less important to overall project profitability.

Marketing of the striped bass products will have a major influence on the project's success. Striped bass is in great demand both as a commercial and sport fishery. This demand has caused the natural stocks to suffer dramatic declines. The demand has not subsided and prices for striped bass are consistently high. Several states are contemplating restrictions on commercial and recreational harvests which would make cultured striped bass more valuable.

In addition to the great natural demand for this species, cultured striped bass have several advantages in the marketplace. First, the final product size and form can be controlled. This may permit the project to realize a higher price per pound if markets for specific sizes and forms (i.e. headed and gutted, fillets, whole, etc.) can be identified. For instance, many restaurants desire fish between 3/4 and 1 pound. They cannot control portion sizes in the current commercial fishery. The quality of the product can also be controlled by fish culturists. This may permit the facility to achieve higher profits by capitalizing on a high quality image in the market. A well managed culture facility can regulate its production to match favorable market conditions to achieve the maximum return on investment. The seasons when striped bass are traditionally delivered to the marketplace vary by regions of the country as the striped bass migrate up the East Coast. If the product is presented to the various markets when traditional supplies are weakest, it should be possible to realize the maximum price per pound.

Finally, striped bass is sold directly to the consumer and to various institutional buyers. Hotels and restaurants generally prefer scaled, headed and gutted fish. The consumer, on the other hand, often prefers striped bass fillets. It may be possible for the project to provide specific products for particular market segments to maximize profits. Initially the project may have to sell whole fish to minimize labor requirements, but as it matures it may be possible to provide value-added or customized processing to meet individual customer preferences.

Fixed Costs of Investment

1. Land			$ -0-
2. Site Preparation			4,000
3. Electricial Hookup			4,000
4. Well Drilling			1,350
5. Purchase and Install Pump, Blower and Motor			6,000
6. Purchase and Install Emergency Generator			6,000
7. Build Settling Pond			2,000
8. Construct 24 Raceways			
	a. silos	12,000	
	b. plastic liners	4,800	
	c. PVC pipe	5,650	
	d. labor	1,800	
	Total Cost		24,250
9. Equipment, Wet Lab and Office			4,000
10. Building, including electricial, plumbing, insulation and concrete pad			17,500
Total Borrowed			$69,100
A. Purchase Fingerlings (72,000)			18,000
Total Investment			$87,100
B. Working Capital*			

*Working Capital will be necessary for the first 18 months. This money can be borrowed or it can be supplied as part of the initial investment. This need will build throughout the first 18 months until the first sale of product takes place. In this analysis it is assumed that the investors will supply the working capital, therefore, the interest category does not reflect the cost of borrowing working capital. Borrowing working capital would add approximately $6,000 to interest costs.

Total Assets

1.	Pump, Blower and Motor	$ 6,000
2.	Generator	6,000
3.	Raceways	24,250
4.	Equipment	4,000
5.	Building	17,500
Total Assets		$57,750

Depreciation Schedule

	Total Cost	Yrs. of Dep.	Annual Dep.
Raceways (1/2 site)	26,250	10	2,625
Building (1/2 elec. and 1/2 site)	21,500	15	1,433
Pump, Blowers and Motor (1/2 elec)	6,000	3	2,000
Generator	6,000	4	1,500
Equipment (Office and Lab)	4,000	3	1,333
Total Annual Depreciation			8,891
Two Years			17,782

Key Assumptions

1. Each raceway will be stocked with 3,000 fingerlings. It is estimated that fingerlings will reach market size in 14 months. Fingerlings will be purchased for a cost of 25 cents per organism (including transportation).

2. Food cost is estimated using a 2 to 1 conversion ratio. Food cost is projected using a price of $8.00 for each 50 pounds of feed.

3. Electricity is estimated using a daily consumption of 100 kwh at 8 cents per kwh.

4. Depreciation is estimated using the straight line method according to the following schedule:

   a. building - 15 years

   b. raceways - 10 years

   c. truck - 4 years

   d. atc - 4 years

   e. generator - 4 years

   f. motor, pump and blower - 4 years

5. Principal and interest payments are estimated using by borrowing $69,100 for 20 years at 15%.

6. Transportation costs are estimated to be $2,500 per year.

7. Insurance costs are estimated using the following assumptions:

   a. aquaculture insurance - 1,000 per year

   b. personal property - 200 per year

   c. liability - 150 per year

8. Maintenance and repair costs are estimated at 2,500 per year.

9. Taxes are estimated using 74 cents per $100 of valuation.

10. Office supplies and phone costs are estimated at $100 per month.

11. Labor is estimated at the following rates:

   a. manager - 14,000 per year

   b. laborer - 7,000 per year

   c. laborer (part-time) 4,000 per year

Table 1

Pro-Forma Income Statement

(24 months for 24 raceways)

($2.50 per lb.)

	% Survival		
	70	80	90
Gross Revenues	94,500	108,000	121,500
Operating Costs			
Labor (8000)	50,000	50,000	50,000
Food	9,500	9,500	9,500
Electricity	6,000	6,000	6,000
Maintenance and Repair	5,000	5,000	5,000
Transportation	5,000	5,000	5,000
Fingerlings	18,000	18,000	18,000
Office Supplies and Phone	2,400	2,400	2,400
Total Operating Expenses	95,900	95,900	95,900
Operating Income	(1,400)	12,100	25,600
Fixed Costs			
Principal and Interest	21,838	21,838	21,838
Insurance	2,700	2,700	2,700
Depreciation	17,782	17,782	17,782
Taxes	1,022	1,022	1,022

Total Fixed Expenses	43,342	43,342	43,342
Net Income	(44,472)	(31,242)	(17,742)
Depreciation	17,782	17,782	17,782
Cash Flow	(26,960)	(13,460)	40

Pay Back Period	--	--	2200 yrs.
Annual Return on Investment	--	--	.0005%
Annual Return on Assets	--	--	.0006%

Table 2

Pro-Forma Income Statement

(24 months for 24 raceways)

($3.50 per lb.)

	% Survival		
	70	80	90
Gross Revenues	132,300	151,200	170,100
Operating Costs			
Labor	50,000	50,000	50,000
Food	9,500	9,500	9,500
Electricity	6,000	6,000	6,000
Maintenance and Repair	5,000	5,000	5,000
Transportation	5,000	5,000	5,000
Fingerlings	18,000	18,000	18,000
Office Supplies and Phone	2,400	2,400	2,400
Total Operating Expenses	95,900	95,900	95,900
Operating Income	36,400	55,300	74,200
Fixed Costs			
Principal and Interest	21,838	21,838	21,838
Insurance	2,700	2,700	2,700
Depreciation	17,782	17,782	17,782
Taxes	1,022	1,022	1,022

Total Fixed Expenses	43,342	43,342	43,342
Net Income	(6,942)	11,958	33,101
Depreciation	17,782	17,782	17,782
Cash Flow	10,840	29,740	30,858
Pay Back	8.4 yrs.	2.93 yrs.	2.63 yrs.
Annual Return on Investment	--	6.86%	19.00%
Annual Return on Assets	--	10.35%	28.66%

Table 3

Incremental Revenue Analysis

(Add 12 Raceways)

1. Additional Fixed Investment

   A. 12,125 - Parts and Labor - 12 Raceways

   B. 3,000 - Purchase and Install Blower and Motor

   15,125 - Total Added Investment

2. Additional Operating Costs (2 Years)

A.	Food	4,750
B.	Fingerlings (36,000)	9,000
C.	Labor	8,000
D.	Electricity	1,500
E.	Principal and Interest	4,780
F.	Depreciation	4,425
G.	Insurance	1,000
Total Incremental Costs		33,455

3. Projected Income Statement ($3.50 per pound and 3000 fingerlings per raceway)

	% Survival		
	70	80	90
Incremental Revenue	66,150	75,600	85,050
(Less) Incremental Costs	33,455	33,455	33,455
Incremental Profit	32,695	42,145	51,595
Depreciation	4,425	4,425	4,425
Incremental Cash Flow	37,120	46,570	56,020

Results of the Financial Analysis

Pro-forma income statements were prepared for a striped bass aquaculture facility equipped with 24 circular raceways. The projections are based upon information described in the literature, conversations with individuals experienced in striped bass culture, and the experience of the authors of this report. All assumptions are believed to be conservative and the projected revenues should be attainable with employees of relatively low skill provided that they have the proper technical back-up to solve any unforeseen difficulties.

A primary factor in the success of the proposed facility will be the market price received for the end products. The analysis focuses on two prices to provide an indication of the market risk faced by a new striped bass culture facility. The low price ($2.50/lb.) should be considered as the worst case price for 3/4 pound fish. The $2.50 price was the low price received for striped bass in the Fulton Fish Market during the summer of 1984. This price was paid for large fish which must undergo additional value added processing (scaling, filleting, etc.) before they are suitable for consumption in the restaurant trade. Market prices are also somewhat lower during the summer since striped bass are in great abundance in Massachusetts, during this season.

The high price of $3.50 per pound is probably a very realistic price for 3/4 pound fish. This was the average price for similar size fish during the summer of 1984 in the Fulton Market. Conversations with other Sea Grant employees indicate that some striped bass culturists are receiving $5.50 per pound (D. Webster, Univ. of Maryland, Personal

Communication). It is unrealistic to expect a high price for cultured striped bass unless a direct market link with restaurants or supermarkets can be developed.

The higher the price of the end product the greater the impact of survivability on the profits of the operation. For instance, at $3.50 per pound each 10 percent increase in survival results in $18,900 of additional revenue. At $2.50 per pound, on the other hand, each 10 percent increase means an addition $13,500 of revenue. Each additional dollar per pound has a significant impact on project profitability. At seventy percent survival, an extra dollar per pound provides $37,800 of revenue. If 90 percent of the hybrids survive, the project generates an additional $48,600 of revenue for each dollar increase in market price. One can readily see the impact of the higher market prices on the potential success of the operation. A major objective of the project would be to secure long term constracts for the end products at $3.50 or more per pound. This would reduce the potential risk of adverse prices resulting from sudden increases in market supplies of striped bass.

The rate of survival is also a key element in the feasibility of a striped bass culture facility. All information indicates that a 90 percent survival rate is well within the reach of a commercial facility. The first attempts to culture fish in a new facility would probably meet with some problems; therefore, an 80 percent survival rate would probably be a good target for the initial stocking. At $3.50 per pound, this would result in a net profit of $11,958 over two years. The payback period at 80 percent survival is a respective 2.93 years; therefore, the investment would be at risk for a little less than 3 years. The expected annual return on investment and return on assets, if the 80 percent survival rate is attained, is estimated to be 6.86% and 10.35% respectively. Should the survival rate increase to 90% the return on asset figure would increase to 19.0%, while return on assets would rise to 28.66%. These increased returns are very attractive to potential investors and should be attainable according to the information compiled in the analysis.

The project will require a significant investment in fixed assets. A key factor in the long term profitability of the facility will be the ability to get the maximum turnover of fish through the raceways in the shortest period of time. The initial pro-forma estimates are based upon the assumption that 72,000 fish will be stocked during the first two years of the project. It may be possible to gain an extra 36,000 fish every few years if the project is managed to maximize the use of available raceway space. If the facility is well managed it should be possible to gain extra portions of growing seasons over 2 or 3 years by minimizing the down time between the harvest of mature fish and the stocking of new fingerlings. The extra crop will not result any signficiant increase in operating costs, (fingerlings, food) yet the increased revemue would have a significant impact on project profitability.

Since the project has a high percentage of fixed costs, it requires 24 raceways to make it an economically viable investment. In addition, with a relatively small additional investment (approximately $15,125) 12 more raceways can be constructed. These additional raceways would greatly increase the project's chances for success because the incremental costs to purchase and grow an additional 12 raceways of hybrids are relatively small in relation to the fixed costs required to construct and operate the facility. Table 3 indicates that for this small investment it would be possible to obtain at a minimum, an additional $32,695 every two years. If a 90 percent survival rate is achieved, this profit would increase to $56,020 over two years. Since the returns are so great it is very important that the 12 additional raceways be constructed. If the funds are not immediately available, the profits from the initial stocking of fish can be used to construct the next phase of the project. The project, as designed, can readily accommodate the 12 additional tanks and should be implemented as quickly as funds become available.

Cash flow will have a great deal of impact on the eventual success of the investment. The first positive revenue will not be generated until 17 months into the project. Until this time, all costs must be financed through working capital. This working capital can be provided by investors or by obtaining a revolving credit arrangement with a local bank. Approximately $50,000 will be necessary to sustain the project until the first product is sold. After the second crop is sold at 21 months, the project will generate sufficient cash flow to provide working capital during the next stocking period. It is absolutely essential that this project be adequately capitalized or it will have little or no chance for success.

The financial analysis indicates that the project, as outlined, has a good potential for success. If the 90 percent survival rate is achieved consistently the expected returns on investment and assets are very attractive. If 12 additional raceways are constructed the project's risk will be greatly reduced and its potential profit will be greatly increased. For this reason, potential investors should consider this investment in two stages. The first stage includes the initial construction of the building and 24 raceways. The second stage involves the construction of an additional 12 to 24 raceways. These raceways can be constructed as additional investment capital becomes available through profits from the project or from other investors. The most important factor in the success of this project will be the construction of sufficient raceways to support a high level of fixed costs. If the project is carried out at the proper scale, there is a high probability of success.

Cash Flow Budget - Year One

	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Revenue	0	0	0	0	0	0	0	0	0	0	0	0	0
Payments													
Labor	1166	2238	2238	2238	2238	2238	2238	2238	1702	1702	1702	1702	1702
Food	0	0	5	10	120	250	357	394	471	160	160	160	160
Electricity	0	100	250	250	250	250	250	250	250	250	250	250	250
Maintenance and Repair	0	0	200	200	200	200	200	200	200	200	200	200	200
Transportation	200	200	200	200	200	200	200	200	200	200	200	200	200
Fingerlings	0	0	9000*	0	0	9000*	0	0	0	0	0	0	0
Office Supplies and Phone	0	0	200	200	200	200	200	200	200	200	200	200	200
Principal and Interest	0	0	909	909	909	909	909	909	909	909	909	909	909
Insurance	0	0	112	112	112	112	112	112	112	112	112	112	112
Taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Gain (Loss) During Month	(1366)	(2538)	(4114)	(4119)	(4229)	(4359)	(4466)	(4503)	(4044)	(3733)	(3733)	(3733)	(3733)
Cash on Hand Beginning of Month	10000	8643	6096	1982	(2137)	(6366)	(10725)	(15191)	(19694)	(23738)	(27471)	(31204)	(34937)
Cumulative Cash	8634	6096	1982	(2137)	(6366)	(10725)	(15191)	(19694)	(23738)	(27471)	(31204)	(34937)	(38670)
Less: Desired Level of Cash	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)
Total Loans Outstanding to Maintain $10,000 Cash Balance	1366	3904	8018	12137	16366	20725	25191	29694	33738	37471	41204	44937	48670
Surplus Cash	-	-	-	-	-	-	-	-	-	-	-	-	-

Assume $3.50 per lb. final price for product.
Assume survival rate of 80 percent.
*Initial cost of fingerlings is assumed to be provided by investors.

Cash Flow Budget - Year Two

	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Revenue	0	0	0	0	75600	0	0	0	75600	0	0	0
Payments												
Labor	1702	2238	2238	2238	2238	2238	2238	2238	1702	1702	1702	1702
Food	770	1061	1175	1290	600	705	810	125	40	40	40	40
Electricity	250	250	250	250	250	250	250	250	250	250	250	250
Maintenance and Repair	200	200	200	200	200	200	200	200	200	200	200	200
Transportation	200	200	200	200	200	200	200	200	200	200	200	200
Fingerlings	0	0	0	0	0	9000	0	0	0	0	0	0
Office Supplies and Phone	200	200	200	200	200	200	200	200	200	200	200	200
Principal and Interest	909	909	909	909	909	909	909	909	909	909	909	909
Insurance	112	112	112	112	112	112	112	112	112	112	112	112
Taxes	511	0	0	0	0	0	0	0	0	0	0	0
Capital Const.	0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Gain (Loss During Month)	(4854)	(5170)	(5284)	70201	(4709)	(13814)	(4919)	73979	(3613)	(3613)	(3613)	(3613)
Cash on Hand Beginning of Month	(38670)	(43524)	(48694)	(53978)	16223	11514	(2300)	(7219)	66760	63147	59534	55921
Cum. Cash	(43524)	(48694)	(53978)	16223	11514	(2300)	(7219)	66760	63147	59534	55921	52308
Less: Desired Level of Cash	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)	(10000)
Total Loans Outstanding to Maintain $10,000 Cash Bal.	53524	58694	63978	-	-	12300	17219	-	-	-	-	-
Surplus Cash	-	-	-	6223	1514	-	-	56760	53147	49534	45921	42308